NATIONAL MISSILE DEFENCE IN THE US

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The US National Missile Defence (NMD) programme aims to protect the US against a limited number of ballistic missiles, fired from a 'state of concern'. NMD plans have attracted criticism that it is technically difficult to implement and risks destabilising international security by undermining nuclear arms control. In particular, NMD deployment would breach the 1972 Anti-Ballistic Missile Treaty between the US and Russia (**Box 1**). Current plans for NMD envisage the use of upgraded facilities on UK soil, which would require UK permission.

This note sets out the design and technical challenges of the proposed NMD system, and discusses the issues, focussing on the UK's role.

BALLISTIC MISSILES

Ballistic missiles have a short period of powered flight when they are launched towards their destination. They then continue on an unpowered, ballistic, course in space, arcing back down to reach their target on earth.

Ballistic missile defence involves destroying a missile before it reaches its target, and divides between 'theatre' (TMD) and 'national' missile defence (NMD). The former aims to protect a limited area, such as a troop concentration or military base, from attack by shorter-range or 'theatre' ballistic missiles. The latter aims to protect an entire national territory from attack by longer-range intercontinental and submarine-launched ballistic missiles. In practice, however, there is a continuum between the two. This note examines current US plans for NMD.[1]

THE CURRENT POSITION

Box 2 sets out the history of US NMD programmes. Current US NMD plans are based on an interceptor missile system which aims to protect all fifty US states from limited attack by a 'state of concern' (such as North Korea, Iran or Iraq, formerly referred to as 'rogue' states), or accidental or unauthorised launch of a few missiles by Russia or China.

In September 2000, President Clinton decided not to authorise deployment of the system, but to continue development and testing. He stated that more confidence was needed in the technology - two out of three flight tests had failed and concerns remained about the experimental system's ability to deal with countermeasures (such as decoys). The delay would also allow for further discussions with Russia over

BOX 1 THE ANTI-BALLISTIC MISSILE TREATY

In 1972, the Soviet Union and US signed the Anti-Ballistic Missile (ABM) Treaty. The treaty (and its subsequent protocol) limited the ABM systems each side could deploy to 100 launchers around a single site. It specifically forbade a national missile defence system.

The ABM Treaty aimed to maintain the balance of nuclear deterrence by decreasing the risks of an arms race in ABM systems, and thus ensuring that each side remained vulnerable to nuclear retaliation by the other. It is seen as a cornerstone on which nuclear arms reduction has been based.

BOX 2 HISTORY OF US NATIONAL MISSILE DEFENCE

The US has spent over $120 billion (in current dollars)[2] on missile defence since the 1950s. However, the only US strategic missile defence system to be deployed was the Safeguard system, in the mid-1970s. This defended the US ICBM silo field in Grand Forks, North Dakota, but was in operation for only a few months before being shut down. In parallel, the Soviet Union developed an anti-ballistic missile (ABM) system around Moscow (called Galosh).

President Reagan began the 'Strategic Defense Initiative' (SDI, commonly known as 'Star Wars') in 1983. This aimed to set a 'shield' in place over the US, to protect from a large-scale missile attack by the Soviet Union. SDI examined a number of technologies for intercepting ballistic missiles, including directed energy weapons (such as lasers) in space. However, serious technical difficulties[3], along with its large cost ($250 billion) and the collapse of the Soviet Union, led to the refocussing of efforts in the early 1990s into TMD and limited NMD. Limited NMD aimed to protect against the accidental or unauthorised launch of a restricted number of ex-Soviet missiles, or attack by a state with a small number of missiles.

In 1996, the Clinton administration decided it would develop NMD for three years, and then possibly deploy three years later. The risks of this compressed timing were highlighted in a report of February 1998 (the Welch report[4]), which called NMD a "*rush to failure*".

In July 1998, a bipartisan expert commission, mandated by Congress and chaired by former Secretary of Defense Donald Rumsfeld,[5] concluded that 'rogue states' could develop long-range ballistic missiles within five years of deciding to do so. Almost immediately, in August 1998, North Korea tested its Taepo Dong-1 missile - a three-stage ballistic missile, which North Korea stated was a satellite launch vehicle. Although this attempt failed, it demonstrated that North Korean missile development was further advanced than had previously been estimated, and led to increased (predominantly Republican) calls for rapid deployment of NMD.

The Missile Defense Act of July 1999 made it US policy to deploy NMD "*as soon as technologically possible*". President Clinton signed the bill into law after Congress passed amendments referring to wider arms control objectives and the need for annual approval of NMD budgets. He established four criteria for the deployment decision: the nature of the threat, technical feasibility, cost and overall impact on national security (including arms control). In order to deploy the system by 2005 (a revised target date), a Presidential decision to begin constructing an X-band radar in Alaska was needed by autumn 2000. However, in September 2000, President Clinton deferred the decision (see main text).

[1] POST Note 72 (1996), *Ballistic Missile Defence*, considered theatre missile defence in more detail.

[2] Communication with Joseph Cirincione, Carnegie Endowment. US billion (1 billion =1,000 million)

[3] *Ballistic Missile Defense Technologies*,1988, Office of Technology Assessment

[4] *Report of the Panel On Reducing Risk In Ballistic Missile Defense Flight Test Programs*,1998. Chaired by former Air Force Chief of Staff General Welch.

[5] *Report of the Commission to Assess the Ballistic Missile Threat to the United States*, 1998. Chaired by Donald Rumsfeld

amending the Anti-Ballistic Missile Treaty (Box 1) and consultation to gain the support of allies. The deployment decision has been left to the incoming President and the system is now unlikely to be deployed before 2006 or 2007 at the earliest.

THE PROPOSED SYSTEM

NMD aims to shoot down ballistic missiles as they travel through space by hitting them with ground-launched missiles. The system is designed to protect the US, but not Europe. When a missile is launched, US defence satellites would detect its 'boost phase' - while its engines are burning. The satellites would then alert early warning radars, which would track the missile during its ~30 minute flight. Higher resolution 'X-band' radar would then be used to discriminate between warheads (contained in re-entry vehicles), decoys and other penetration aids designed to confuse the sensors, the rocket tank and other debris.

Once the warheads had been identified, one or more interceptor missiles would be launched. These consist of a rocket booster and a 'kill-vehicle' designed to hit the incoming warhead and thereby disable it. After the attempted interception, continued radar and satellite monitoring would be used to judge whether the target had been destroyed and, if possible and necessary, further interceptor missiles may be launched (time permitting).

Phases of development

The first phase of NMD (Extended Capability 1, EC1) aims to defend the US from attack by a few warheads (tens) with limited capability countermeasures. It would cost $30bn and is optimised to meet a potential threat from North Korea. A 'threshold' deployment of 20 interceptors would be followed two years later by a further 80 interceptors, all based in Alaska. EC1 would include satellites, one X-band radar, also in Alaska, and five upgraded early warning radars, including one at RAF Fylingdales in the UK.

Capabilities 2 and 3 (C2/3) would involve building more X-band radars (possibly including one in the UK), deploying further interceptors (half of which would be based at a second site under C3) and using an upgraded satellite system to track missiles after their boost phase. C3 aims to defend against larger threats, including a small accidental or unauthorised Russian or Chinese launch and relatively sophisticated countermeasures. Deployment of C2 and 3 would be after 2010, but blurring of the boundaries between these phases is possible.

BOX 3 FLIGHT TESTS

The US Department of Defense Ballistic Missile Defense Organization (BMDO), which manages the NMD programme, has run five 'integrated flight tests' (IFT) to test the entire NMD system. Because not all planned NMD components are fully developed (for example, the missile booster), tests used prototypes and surrogates where necessary. Each IFT costs around $80 million. A target ICBM is launched from Vandenberg air base in California, and the kill-vehicle from a US base in the Pacific, ~4,000km from Vandenberg.

The first two IFTs did not involve attempts at interception - the kill-vehicle flew by the target to test its guidance and sensors - and both were deemed a success by the BMDO. However, there has been criticism of this interpretation of the data, with suggestions that the analysis was skewed to result in the desired outcome.[6]

IFT-3, in October 1999, resulted in the kill-vehicle intercepting the target. The target for IFT-3 included the warhead and a large balloon decoy. In fact, the decoy helped the kill-vehicle find the warhead, with the US Department of Defense's Director of Operational Test and Evaluation concluding, *"The large balloon aided in acquisition of the target. It is uncertain whether the [kill-vehicle] could have achieved an intercept in the absence of the balloon."*

Neither IFT-4 nor IFT-5 was successful. In the fourth test, the cooling system for the sensors on the kill-vehicle failed. It thus could not see the target, and failed to intercept. During the fifth flight test, the kill-vehicle failed to separate from the rocket booster, and the single balloon decoy failed to inflate. IFT-6 was due in late 2000, but has been put back to early 2001.

Some critics argue that the 21 flight tests planned for NMD do not include realistic future threats such as multiple-warhead missiles with credible decoys, so will not be sufficient to assess the long term effectiveness of the system.

Challenges

NMD poses major technical challenges. With only one interceptor missile site (in Alaska) to defend the entire US, interceptors must be launched early to reach the incoming missile while it is still in space. Hence, attacking missiles must be detected, tracked and countermeasures identified within minutes. It also limits possibilities for launching a second round of interceptors should the first round fail.

Another key challenge is distinguishing warheads from decoys. This is controlled by ground-based radars and by visible and infrared sensors on the kill-vehicle. Commentators[7] suggest these sensors could be defeated using relatively simple countermeasures. Examples include releasing large numbers of metal-coated decoy balloons to reflect radar waves, disguising the warhead outer surface as a decoy balloon, or cooling the warhead so it is less easily detected. Countermeasures are being studied and solutions pursued. However, flight tests (**Box 3**) demonstrate the difficulty of disabling a missile with a direct hit, even under controlled conditions.

[6] Letter from Ted Postol, MIT Security Studies Programme, to John Podesta, White House Chief of Staff, 11 May 2000.

[7] *Countermeasures: a technical evaluation of the operational effectiveness of the planned US National Missile Defense System*, April 2000, Union of Concerned Scientists and MIT Security Studies Programme

ISSUES

Threat assessments

NMD is intended to counter the threat from weapons of mass destruction - nuclear, chemical or biological - carried by ballistic missiles. However, some experts query whether NMD would be effective against chemical or biological weapons packaged in small submunitions, with tens or hundreds released from each missile (although protection during re-entry would be required for the submunitions, so their design is not straightforward). Commentators also point out that 'states of concern' could deliver weapons into the US by ship-launched missiles, civilian ship, aeroplane, truck or suitcase - all of which would bypass NMD.

Many states have or are developing ballistic missiles (**Box 4**). NMD plans refer to possible missile threats from four 'states of concern' - North Korea, Iran, Iraq and Libya. US intelligence estimates North Korea is a likely threat, and Iran a probable threat, within 15 years. While acknowledging the existence of a threat from proliferation of weapons of mass destruction, some critics suggest alternative measures (such as deterrence, diplomacy and economic pressure) would be effective in preventing their use. For example, there have been recent diplomatic developments with North Korea. Analysts also point out that, unlike previous threat assessments, the Rumsfeld Commission (Box 2) did not consider intent to use such weapons as well as capability.

Strategic Stability and the ABM Treaty

As its current plans for NMD do not comply with the ABM Treaty (Box 1), the US is seeking agreement with Russia to modify its terms. Modification of the treaty is not unprecedented - for example, in 1997 agreements were signed to clarify the demarcation between strategic and theatre ABM systems, and to make Russia, Ukraine, Kazakhstan and Belarus parties to the treaty. However, allowing NMD would be a modification of far greater significance.

So far, Russia is opposed to NMD and to modifying the treaty, pointing out that a future substantially expanded NMD could undermine the effectiveness of its strategic deterrent. Russia has also stated that US withdrawal from the ABM Treaty would have consequences for other arms control agreements. US deployment of NMD without Russian agreement to modifications would require six months notice of US withdrawal from the ABM Treaty. Presidents Clinton and Putin agreed a Joint Statement in June 2000 on the Principles of Strategic Stability, acknowledging efforts to strengthen the ABM Treaty.

BOX 4 STATES WITH BALLISTIC MISSILES (>1,000KM)

States with ballistic missiles operational or in development, with a range of over 1,000km.

China	Iran	North Korea	Saudi Arabia
France	Iraq (possibly)	Pakistan	USA
India	Israel	Russia	UK

Source: Carnegie Non-proliferation Project
http://www.ceip.org/files/projects/npp/resources/missiles.htm

China also opposes NMD, which would undermine its relatively small nuclear deterrent (~20 single-warhead intercontinental missiles). It is upgrading these, but their number and capability may be further increased in response to NMD deployment.

Members of the international community, including NATO allies such as France and Germany, have been critical of US NMD plans, citing concerns over the potential impact on strategic stability. In November 1999, the UN overwhelmingly passed a resolution sponsored by Russia, China and Belarus (with French amendments) calling for strict compliance with the ABM Treaty.

FUTURE DECISIONS

Although the outcome of the US Presidential election is still unknown, both Bush and Gore support NMD. Bush has proposed a wider NMD programme that would also seek to defend US Allies. But both intend to conduct strategic reviews upon entering office, so are unlikely to make a rapid decision. Building an X-band radar in Alaska in summer 2002 would not need a deployment decision until autumn 2001.

Meanwhile, proponents of NMD advocate a range of other programmes, such as adapting sea-based theatre systems, or boost phase interception (**Box 5**). There are also other options - for example, the US Air Force is developing an airborne laser - but these are technically very challenging and likely to be expensive. Deployment of boost phase missile defence would take longer than current proposals for NMD, and has its own inherent limitations. One proposal is to supplement current plans by other systems, but this has cost implications.

ROLE OF THE UK

Current US plans for the first phase of NMD envisage the use of two US bases in Yorkshire. The Early Warning Radar at RAF Fylingdales could be upgraded to improve missile detection and tracking; and RAF Menwith Hill used as a relay ground station for data from satellites detecting missile launches. But permission for the use of these sites for NMD purposes has not yet been requested by the US, or granted by the UK Government.

BOX 5 BOOST PHASE NMD

Boost phase missile defence would attempt to intercept the target missile while one of its rocket engines is still burning. This would overcome a major technical problem with current NMD plans - the difficulty of discriminating between warheads and decoys - as during boost phase, these have not yet separated from the booster. The missile is also much easier to detect by its hot plume. Because the missile is attacked at launch, boost phase defence offers the chance of extending protection to allies as well as the US itself.

Boost phase interception raises technical and political problems. Target missiles must be intercepted soon after launch, and future missile design could reduce the intercept opportunity further, so interceptors must be located close to the launch site. These could be on sea, air or land: the co-operation of neighbouring countries would be needed for certain deployment options. The target missile must be travelling towards the interceptor - it is not possible to 'catch up' with the target. Further, the speed of events means the decision to launch the interceptor may have to be made by computer.

Fylingdales

RAF Fylingdales has been part of the US Ballistic Missile Early Warning System since 1963. In 1992, the original 'golf ball' structures were replaced with a 360° coverage, phased-array radar.

Plans for the first phase of NMD envisage five early warning radars - three in the US (Massachusetts, California and Alaska), one at Thule in Greenland, and Fylingdales. Fylingdales already provides the UK and US with early warning of incoming ballistic missiles, and tracks space debris. For NMD, it would need to be upgraded to enable incoming warheads to be detected and tracked earlier. The upgrade is expected to be internal - changing radar software and related IT hardware.

Even the upgraded radars would have limited resolution to identify and track warheads and decoys and would thus be effective only against relatively uncomplicated missiles. To meet a more sophisticated threat, NMD plans to augment the upgraded radars with higher frequency, and hence higher resolution, very narrow beam, X-band radar. The first phase of NMD (EC1) would see an X-band radar built in Alaska, to deal with the potential threat from North Korea. However, the second phase proposes three further X-band radars, possibly including one in the UK. This would require construction of a new facility, with consequent local issues such as whether planning permission is required and possible objections.

Menwith Hill

In its initial configuration, NMD would rely on US Defense Support Program (DSP) satellites to detect missile launches. These will be replaced by the Space-Based Infra Red System-high (SBIRS-high), which will provide more accurate location and tracking of missiles in their boost phase. Such systems are seen as necessary for early warning of missile launches, whether or not NMD is deployed - for example, DSP satellites were used to detect the launch of Scud missiles in the Gulf War. The UK gave permission in 1997 for Menwith Hill to be used as the European ground station for SBIRS-high, and this is now under construction. However, if the US wished to use data relayed via Menwith Hill for NMD, specific UK consent would be required.

The UK's position

The UK Government has not yet received a formal request from the US for the use of UK sites as part of the proposed NMD system. It does not expect to do so unless and until the US decides to proceed with deployment.

Although no decision will be made until such a request is received, the Government has made clear that it continues to value the strategic stability provided by the ABM Treaty and wishes to see it preserved. Article IX of the treaty forbids deployment of ABM components (such as radar) by the US or Russia outside their national borders, although the Government has argued that upgrading Fylingdales is unlikely to be the step that breaches the treaty. UK consideration of a US request for such an upgrade would be expected to take place either in the context of an amended treaty between the US and Russia, or US withdrawal from the ABM Treaty.

Fylingdales is critical to the ability of the proposed NMD system to counter missiles launched from the Middle East. Some commentators have argued that this role could increase the threat to the UK; others that changes in the threat would be driven by ballistic missile proliferation, not by US NMD proposals themselves.

In its July 2000 report on Weapons of Mass Destruction, the Foreign Affairs Select Committee recognised that the UK Government's response to NMD is *"complex and sensitive"*, and commended the Prime Minister's approach. However, they concluded, *"We are not convinced that the US plans to deploy NMD represent an appropriate response to the proliferation problems faced by the international community."* The Committee also urged, *"the Government to impress upon the US Administration that it cannot necessarily assume unqualified UK co-operation with US plans to deploy NMD in the event of unilateral US abrogation of the ABM Treaty."*