MINISTRY OF DEFENCE

# MISSILE DEFENCE

## a public discussion paper

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# Contents

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## Introduction

1. On 22 November 2002, the nineteen Heads of State and Government of the NATO nations meeting in Prague agreed on the need to pay increased attention to the issue of missile defence. In the words of the summit communiqué:

> 'We are determined to deter, disrupt, defend and protect against any attacks on us, in accordance with the Washington Treaty and the Charter of the United Nations… We have therefore decided to… examine options for addressing the increasing missile threat to Alliance territory, forces and population centres in an effective and efficient way through an appropriate mix of political and defence efforts, along with deterrence. Today we initiated a new NATO Missile Defence feasibility study to examine options for protecting Alliance territory, forces and population centres against the full range of missile threats, which we will continue to assess. Our efforts in this regard will be consistent with the indivisibility of Allied security.'

2. As this statement serves to emphasise, missile defence is a subject of growing global importance. The potential threat of most concern both to national populations and to deployed forces is not from the strategic arsenals of Russia and China but from the increasing proliferation of ballistic missiles, not least owing to the potential for their combination with chemical, biological and nuclear weapons of mass destruction. The United States is now committed to a major technological effort to counter this threat. Britain too has a responsibility to take stock of the issues involved, and to consider our options for addressing this potential threat, including whether we should play a role in the US programme.

3. Many of these issues do not allow for short-term judgements. There are few absolute certainties involved. The technology challenges are formidable, and the timescales in which they can be overcome are still uncertain. The pace of missile proliferation, and the intentions of those states who might present a threat, are hard to gauge. The threat to UK territory is not immediate, but the developing potential cannot be ignored, particularly given the time required to develop missile defences. All these matters need to be considered in the context of other security and defence priorities, and balanced with a range of means of protecting international and national interests.

4. There are of course many other, possibly even more visible, threats to national security in today's world. States and terrorist groups can attack their enemies in many different and novel ways. Nevertheless, we must aim to address all these threats, not just the most prominent. An increasing number of states have acquired, or are in the process of acquiring, advanced longer-range ballistic missile technology. Some states are seeking to develop or procure missiles with ranges greatly in excess of those which would be relevant in the context of regional threats.

5. It is not only the future possibility of a ballistic missile attack on the UK which threatens our national interests. We have a broader mutual defence commitment within the NATO Alliance. We must seek to protect our deployed forces from such attack, often as part of an Alliance or coalition effort. Global and regional stability are also important to the UK's economic and political interests.

6. The Government agrees with the United States and our other NATO allies that the proliferation of ballistic missiles must be taken seriously. We already have a range of responses for dealing with this, from diplomacy, deterrence and arms control to non-proliferation and counter-proliferation. But we need to consider if and when we might need to decide to add further protection by joining in an expanding system of missile defences, which in due course could cover the UK and Europe. We therefore need to continue to analyse carefully the potential threat we face, the costs and benefits of a missile defence system, and how the development of missile defences might impact on our wider security concerns and those of our Allies - which includes our existing deterrence posture, as well as any bearing it may have on regional and global security.

7. This discussion paper examines the growing threat posed by the proliferation of weapons of mass destruction and their means of delivery. It then considers possible responses to this potential threat, and whether missile defence is an appropriate addition to the range of responses available. To inform this consideration, it sets out technical details of how American and other programmes might provide a means of defending against ballistic missile attack, and reviews some of the policy issues which the UK will need to address in coming to decisions on missile defence. It seeks above all to provide a foundation for a deeper debate of the issues concerned.

# Part One

# The missile threat

8. Threat is a factor of both capability and intention. We do not have any evidence that any state with ballistic missiles currently has the intention specifically to target them at the UK, or UK interests. Of course, intentions can change quickly, and we could not wait until a direct threat became clear before determining how to defend against it. We are therefore very concerned by the proliferation of weapons of mass destruction and ballistic missiles as a means of their delivery, and continue to monitor developments closely.

9. We assess that at present there is no immediate significant threat to the UK from ballistic missiles. Nevertheless, it is a serious cause for concern that some states have developed, or are seeking to develop or acquire ballistic missile capabilities of increasing range. The UK government has in recent years identified a number of countries of concern. We believe them to have active and often relatively sophisticated ballistic missile programmes, and some to be developing weapons of mass destruction. It is this combination of ballistic missiles and weapons of mass destruction, coupled with the intent and a demonstrated willingness to use these capabilities, that makes **Iraq** the most immediate state threat to global security. Elsewhere the most credible potential missile threat comes from **North Korea**, **Iran**, and **Libya**. The threat from these four countries is not identical, nor are they necessarily the only

nations that might emerge as threats. Of the four, North Korea has the most advanced longer-range missile programme: a ballistic missile they are currently developing would if successful have the capability to reach the UK. Iraq and some other states would also be capable of targeting UK interests overseas, or British forces deployed in their area.

## Ballistic missiles

10. Long-range ballistic missiles are technologically complex weapons systems. They have a short period of powered flight when they are launched towards their destination and then continue on an unpowered, ballistic trajectory, arching back down to reach their target on earth. The three phases of flight for a ballistic missile are boost, mid-course and terminal. Longer-range missiles are designed to travel through space during mid-course, thereby spending a smaller part of their flight in the atmosphere. At these ranges, only the re-entry vehicle (the tip of the missile carrying the warhead) continues to the target. The technologies to develop a re-entry vehicle are complex, both to control the vehicle's behaviour and to cope with the heating effect when it re-enters the atmosphere. Most ballistic missiles are inaccurate (they are normally unguided once boost is complete): an accuracy of about 1km at a range of about 1250km would be typical of an unguided vehicle. Thus the ability to deliver a ballistic missile on target is also a major technological challenge. Ballistic missiles can carry biological, chemical, nuclear or high explosive warheads, the nature of which is unlikely to be known by the defender prior to the missile landing (or being intercepted).

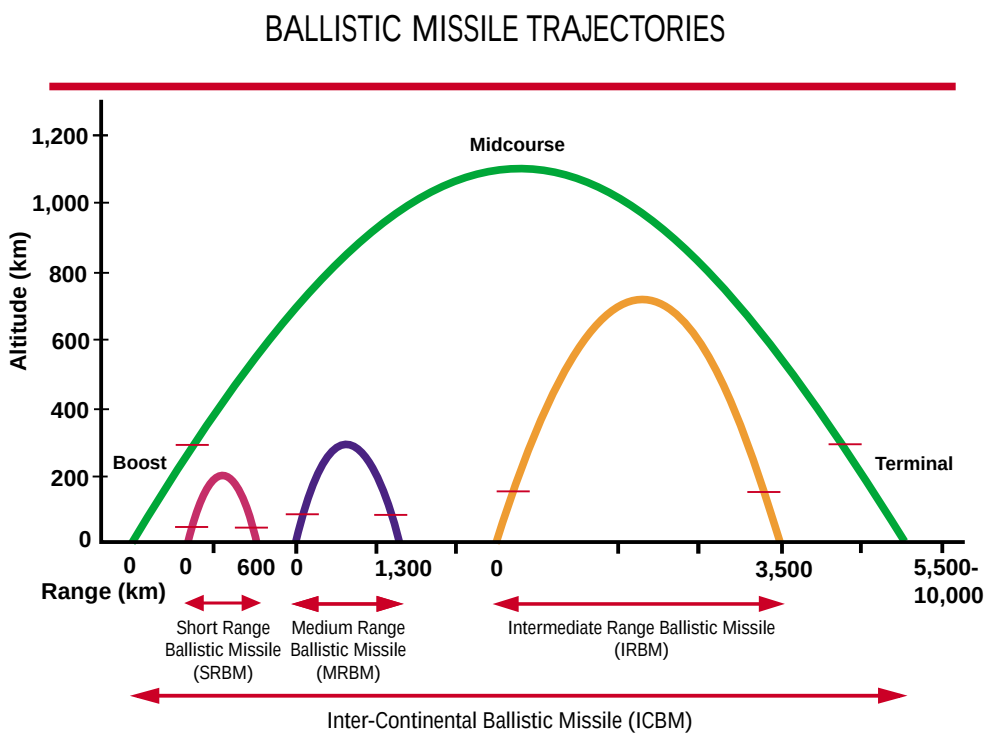


*Figure 1. Ballistic missile trajectories*

## History of the ballistic missile threat to UK

11. The first ballistic missile threat to the UK emerged in September 1944 with the German V2 attacks on London. The V2 carried a 1000kg high-explosive warhead, and was the forerunner to the ubiquitous SCUD short-range ballistic missile. Thousands of V2s were launched, targeted primarily at London and Antwerp. Indeed, along with Belgium, the UK has had more ballistic missiles fired at its territory than any other country in the world. By the end of the war, German plans were in place to develop an intercontinental capability to hit New York.

12. During the 1950s, the Soviet Union developed longer range ballistic missiles capable of hitting the UK equipped with nuclear warheads. China developed such a capability in the 1970s, but has always had a much smaller arsenal of such weapons.

## How ballistic missile programmes evolve

13. Although some countries do buy whole missile systems, most wish to develop self-sufficiency through indigenous programmes. As the indigenous programmes develop, then the emphasis is for increasing qualitative improvements in guidance and propellants. Typically countries begin with a liquid-propellant programme. The technology for these missiles is more readily available (from North Korea normally) and it is easier to develop longer-range liquid-propellant missiles than their solid-propellant equivalents. Most countries then evolve towards solid-propellant programmes, often running the two in parallel. Solid propellant is more reliable and more flexible to use, especially from mobile platforms. This avoids the time-consuming need to fuel the missile prior to firing, and decreases vulnerability to counter-force operations.

14. With the development of even simple missile defence systems, countries are likely to start to look towards the need for advances such as decoys. In addition, an improved accuracy would give the potential for more precise attacks against high-value military targets. However, these long-term projects are costly and technically complex, and we judge that most countries will retain their emphasis on the development of basic missile systems.

15. Countries possessing ballistic missiles are in most cases working to increase the range, reliability and accuracy of their missiles. The proliferation of ballistic missile technologies and knowledge has enabled countries to accelerate missile development times and to develop more capable and longer-range missiles. The more countries which possess the technology and know-how to build ballistic missiles, the greater the risk of any single country purchasing a system "off the shelf".

## Missile technology proliferation

16. Proliferation of missile technology can be driven by commercial and economic considerations and also by a desire to exert regional or even global influence. Sharing technology can also result in shared lessons, and general benefits for the domestic missile programme. Technology transfer can take the form of complete missiles and associated support equipment; the provision of production technology; or the provision of assistance to indigenous programmes through the transfer of knowledge, technical advice, the loan of scientists, engineers and technicians, or training.

17. The development of commercial space systems poses a particular challenge for those seeking

to limit the transfer of technology between civil and military programmes. The technologies required for an intercontinental ballistic missile (ICBM) are very similar to those for a satellite launch vehicle. The main differences are in the development of a re-entry vehicle, a guidance system, and a warhead rather than a satellite. A state with a satellite launch capability has thus already acquired many of the key technologies required for an ICBM. In a similar manner, many of the technologies required for weapons of mass destruction can be hidden as parts of legitimate civilian programmes. This greatly complicates the ability to assess accurately the timeframe during which a country might acquire the capability to threaten the UK with ballistic missiles delivering warheads armed with weapons of mass destruction.

## The ballistic missile threat today

18. As stated earlier, the combination of capability and intent makes Iraq the immediate state threat to global security. Russia and China retain a range of ballistic missiles which would be capable of delivering weapons from their territory to targets within the UK. Many countries already possess short-range ballistic missiles with the capability to target UK forces deployed overseas. There has also been a slow but steady increase in the number of states possessing medium-range ballistic missiles, increasing the number of potential threats to UK interests such as the Sovereign Base Areas in Cyprus. We recognise that some of our NATO Allies are closer to regions of ballistic missile proliferation, and also that the US has security commitments in areas of the world that we do not.

19. Ballistic missiles owned and operated by states of concern tend to lack accuracy, and in general have more political than military utility. They have in practice been primarily used as weapons of strategic terror against urban targets, such as Iraq's attacks on Israel. However, the use of warheads armed with weapons of mass destruction gives these missiles strategic utility: the potential to cause large-scale civilian casualties, to deter, and in certain circumstances to achieve significant military effect.

## The ballistic missile threat in the future

20. We assess that there is no immediate significant ballistic missile threat to the UK. But we believe that Iraq, North Korea, Iran and Libya are working to obtain longer-range ballistic missiles with the potential ability to target the UK or our deployed forces. When a capability might emerge depends not just on technical factors (in terms of range, accuracy, and ability to design a robust re-entry vehicle) but on a continued political commitment to developing ballistic missiles and the capacity to procure expertise or complete systems from proliferators. It also depends on the effectiveness of international efforts to curb missile proliferation.

21. Achievement of capability is of course not the same thing as intention to use (or to threaten to use) such capability. However, the continuing proliferation of ballistic missile technology and expertise between countries of concern makes it more rather than less likely that the UK will in due course be within range of missiles in the hands of those who may have the intent to impose their will by threat of ballistic missile attack.

| Approximate distances to the United Kingdom | |
|---|---|
| North Korea | 8600km |
| Iran | 3750km |
| Iraq | 3700km |
| Libya | 2350km |

## Iraq

22. Iraq fired over 500 SCUD type missiles at Iran during the Iran-Iraq War at both civilian and military targets, and fired 93 SCUD-type missiles during the Gulf conflict, at Israel and the Coalition forces stationed in the Gulf region. Further missiles and components were declared to the UN Special Commission (UNSCOM) or discovered during challenge inspections. We believe that Iraq covertly retains up to 20 SCUD-type missiles called the Al Hussein, with a range of around 650km, after the Gulf conflict. UN Security Council Resolution 687 permits Iraq to develop missiles up to a range of 150km, and since the Gulf conflict Iraq has been openly developing Ababil 100 and Al Samoud short-range missiles. In the absence until recently of UN inspectors, Iraq has worked on extending their ranges to at least 200km. Iraq has long had ambitions to develop longer-range missile systems with ranges of over 1000km; work on such systems continues, but is able to make only relatively slow progress while UN restrictions remain in place. It would probably not be able to produce such a missile before 2007. While such a missile could be used to target British interests in Cyprus, it could not be used against mainland UK. This prognosis could, however, be rapidly invalidated were Iraq to acquire missiles or technology from North Korea.

23. Iraq has admitted to having had offensive chemical and biological weapon capabilities, which included warheads for the Al Hussein missile filled with nerve agent, anthrax, botulinum toxin and aflatoxin. It has used chemical weapons against the Iranians and the Kurds. Iraq sought to conceal these programmes from UN inspectors and did not acknowledge its biological weapons programme until 1995. It failed to convince UN inspectors of the accuracy of its declarations about these programmes. It failed to account to UN inspectors for significant amounts of material produced under these programmes. And between 1998 and 2002 it refused to allow UN inspectors into Iraq to continue to investigate these programmes. Iraq has a useable chemical and biological weapon capability, which has included recent production of chemical and biological agents. Iraq can deliver these agents using an extensive range of delivery means including ballistic missiles. Current military planning specifically envisages the use of chemical and biological weapons.

24. Iraq has also long sought a nuclear weapons capability, and continues to do so. We believe it has retained much of its former expertise, but currently lacks certain key components and materials. We believe that if sanctions were lifted, it would take at least five years for Iraq to produce an indigenous nuclear weapon. However, if Iraq obtained fissile material and other essential components from foreign sources Iraq could produce a nuclear weapon in between one and two years.

## North Korea

25. North Korea has some hundreds of SCUD missiles in service, with ranges of up to 500km. It can produce these itself and they are available for export. It also has in service No Dong

missiles, with a range of up to 1300km.

26. In August 1998, North Korea launched a three-stage Taepo Dong-1 as a satellite launch vehicle. This demonstrated that North Korea could produce a missile with a range of about 2000km. It also demonstrated expertise in multi-stage missile technology. The Taepo Dong-2 (another multi-stage missile) is under development, variants of which could have ranges in excess of 5000km and 10,000km. North Korea has since 1999 observed a moratorium on the flight-testing of long range missiles. However, ground-testing and other development activities have continued and a flight test of a Taepo Dong-2 could be carried out within weeks if the moratorium ended. If a Taepo Dong-2 variant with a range of at least 8,600km is developed successfully, North Korea would then have the capability to reach the UK.

*Figure 2. North Korean launch of its Taepo Dong-1 ballistic missile*

27. A particular cause for concern is North Korea's willingness to sell its missiles and technology widely. North Korea is the world's biggest supplier of ballistic missiles and related technology to countries of concern. Its unique, state-driven missile export industry is primarily motivated by the need to acquire hard currency. Missiles are North Korea's most significant export and, by channelling profits back into the programme, an almost self-sustaining missile industry has been developed, supporting the requirements of both the domestic programme and the export market. Foreign sales may also allow North Korea to obtain flight test data from foreign customers during North Korea's own moratorium on flight-testing. North Korea has provided No Dong missile technology to Iran and Pakistan, enabling them to acquire their own versions. SCUD technology is also available for export, and has been sold to Iran, Syria, Egypt, Libya, UAE and Yemen. Over the last 15 years North Korea has exported at least 400 missiles.

28. North Korea acceded to the Nuclear Non-Proliferation Treaty (NPT) in 1985. An associated

safeguards agreement with the International Atomic Energy Authority (IAEA) entered into force in 1992. But in 1993 North Korea refused to accept an IAEA inspection to clarify suspicions that it had not declared past production of enough plutonium for at least one nuclear weapon. It gave notice of its withdrawal (subsequently suspended) from the NPT. A 1994 agreement with the US to freeze plutonium production made some progress. But North Korea still has sufficient plutonium in spent fuel rods under IAEA supervision for additional nuclear weapons.

29. Then, in October this year, North Korean admissions to the United States confirmed suspicions that it had been pursuing a covert nuclear weapons programme based on the production of Highly Enriched Uranium, which can be used in nuclear weapons as an alternative to plutonium. This has again raised questions about North Korean intentions and nuclear aspirations, as have statements by North Korean representatives abroad. The IAEA now believe that North Korea is in violation of her international commitments, including the 1992 safeguards agreement. North Korea also has the infrastructure to support the development of chemical and biological weapons.

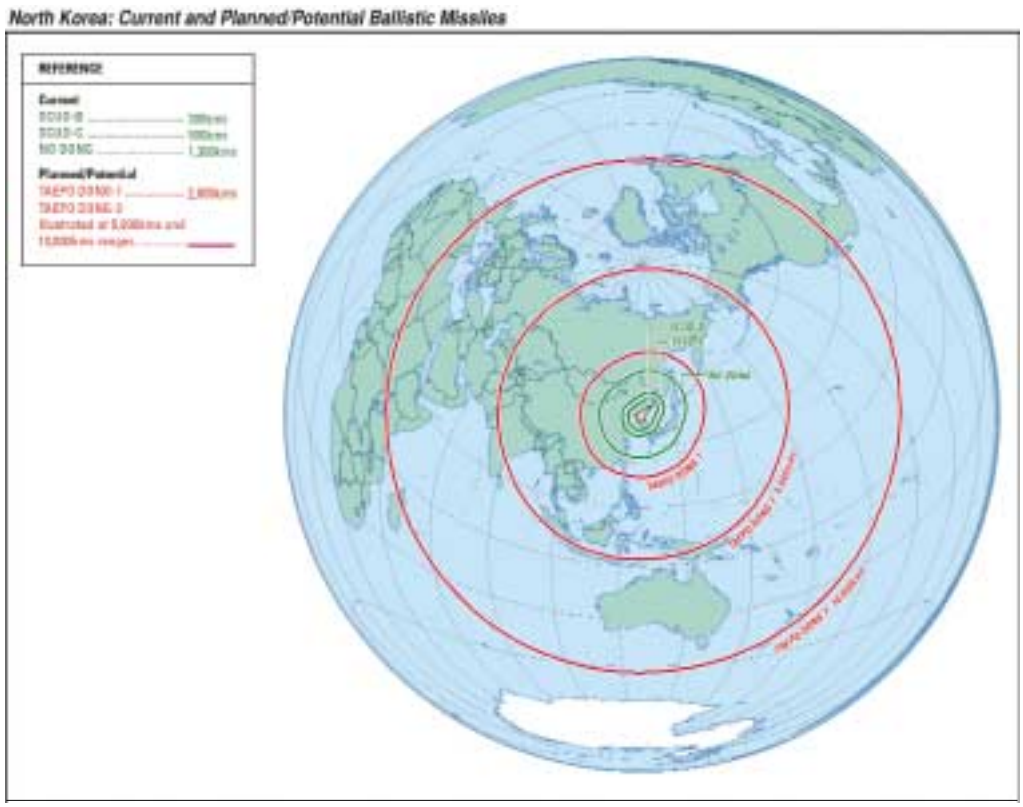


*Figure 3. Range of North Korean ballistic missiles (existing and planned)*

## Iran

30. Iran currently has in service several hundred short-range SCUD and SCUD-type missiles with ranges up to 500km. In addition, based on North Korean No Dong technology, Iran is developing the Shahab-3 missile, with a range of up to 1300km. Following successful tests in 2002, it should be able now to field a limited number, and is working to produce a substantial force. Iran has made no secret of its aspirations to develop a satellite launch vehicle capability. This technology is very similar to that required for longer-range and intercontinental ballistic

missiles (as described in paragraph 17). We believe Iran could test such systems by the end of the decade. If it acquired a complete long-range ballistic missile system, it could achieve such a capability more quickly.

31. Iran is seeking to master the full nuclear fuel cycle so that it can develop a totally indigenous civil nuclear power programme. Any such legitimate programme could be exploited for use in a covert nuclear weapon programme. We have longstanding concerns that Iran may be seeking to acquire nuclear weapons. Iran signed the Chemical Weapons Convention in 1993, and has acknowledged a past chemical weapons programme. It has also signed the Biological and Toxin Weapons Convention, but is capable of producing biological weapons.

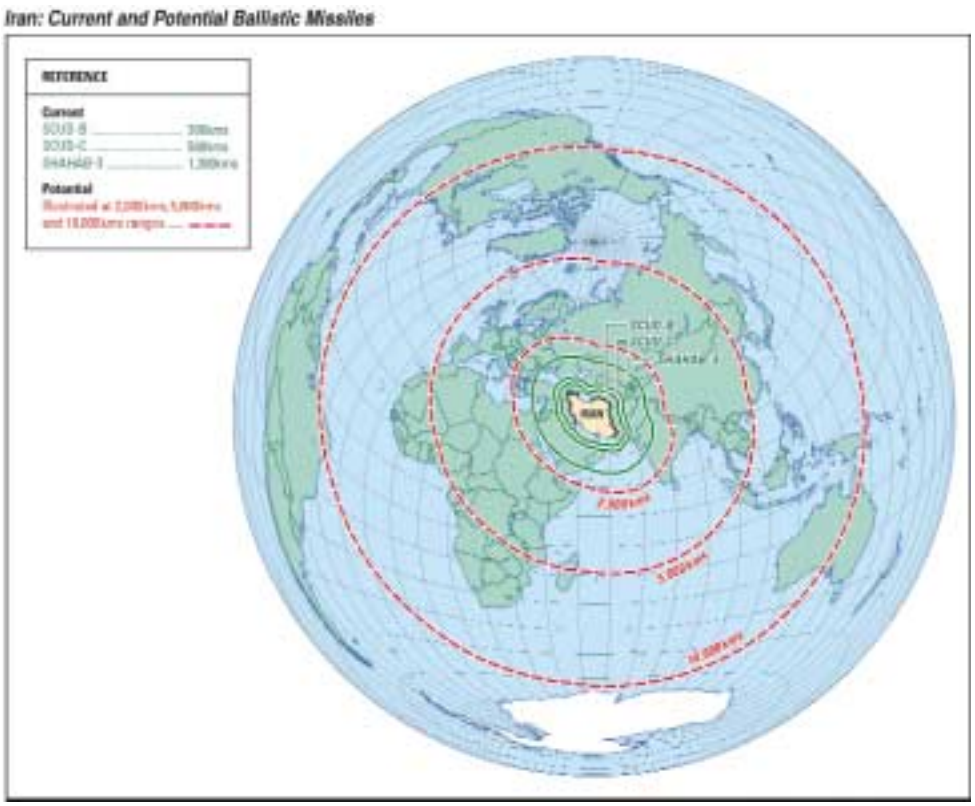


*Figure 4. Range of Iranian ballistic missiles (existing and potential)*

## Libya

32. Libya has an ageing force of SCUDs. It is now seeking to produce extended-range SCUD missiles, with extensive North Korean assistance that includes the provision of components and equipment. Libya also has an interest in procuring a longer-range capability. We are concerned by persistent reports that Libya retains aspirations for weapons of mass destruction. Libya has subscribed to the International Code of Conduct against Ballistic Missile Proliferation.

## Non-state actors

33. As the Prime Minister has stated, there is a clear link between the terrorist threat and weapons of mass destruction. However, using long-range ballistic missiles as a means of delivering

terrorist weapons is unlikely. Developing ballistic missiles from scratch would be beyond the means of a terrorist organisation. Acquisition of a capability off-the-shelf is conceivable, but unlikely in the absence of state sponsorship or complicity. Likewise, a non-state entity is very unlikely to be in a position to operate a ballistic missile force without extensive state-sponsored or state-condoned assistance with land, training, maintenance and spares support. Operating liquid-propellant systems is particularly demanding, because of the need to acquire, store and handle the propellants; but even solid-propellant ballistic missile systems require extensive in-service support. As such, ballistic missiles are a more attractive capability for state actors than for non-state actors. The latter are more likely to seek covert means of delivering weapons of mass destruction, a potential threat we also take very seriously.

# Part Two

# Responding to the threat

34. We are living in an increasingly complex security environment. The Government's recently published "new chapter" to its Strategic Defence Review demonstrates that a degree of flexibility and sophistication is required in the way we address new and unconventional threats. There will be no single answer to meeting these potential threats; we need rather to develop a range of mutually reinforcing approaches.

35. In this light, missile defence is just one of a range of responses for tackling the potential threat from weapons of mass destruction and ballistic missiles as their means of delivery. We need to consider how missile defence could work as part of a comprehensive strategy that includes non-proliferation and counter-proliferation measures, intelligence co-operation, law enforcement, conflict prevention, diplomacy and deterrence, as well as defensive measures. NATO members also reaffirmed in Prague, alongside their commitment to missile defence studies, the essential contribution which disarmament, arms control and non-proliferation make to preventing the spread and use of weapons of mass destruction and their means of delivery.

36. **Diplomacy** will remain the first means of countering a threat. We are already pursuing many diplomatic means to address the drivers of missile proliferation, not least by seeking to alleviate regional insecurities and tensions. The Government is also strongly committed to multilateral **non-proliferation and arms control agreements,** such at the Nuclear Non-Proliferation Treaty, the Chemical Weapons Convention and the Biological and Toxin Weapons Convention. Such agreements help to create an international consensus against the proliferation of weapons of mass destruction, which in turn makes it easier to bear down on proliferators. When underpinned by inspection arrangements (as in the case of the first two above), they can also raise the economic cost of proliferation. Export controls are also an important tool.

37. Together with the US, the EU and others, we are also committed to obstructing the spread of missile technology, through the Missile Technology Control Regime (MTCR). However, tackling missile proliferation goes much wider than technology control – a point widely recognised by MTCR members. With our EU partners the UK has also taken a lead in promoting the establishment of a politically-binding International Code of Conduct against Ballistic Missile Proliferation, which was launched at a meeting in the Hague on 25 November. This is the first

step towards a set of international norms in the field of ballistic missiles. Its purpose is to increase transparency and confidence – including with a pre-launch notification agreement – that ballistic missiles are not being developed under the cover of legitimate space launch programmes. Clearly, as well as export controls and codes of conduct, other measures will be needed. But it is a visible expression of the international community's determination to address the unrestrained spread of these destabilising weapons – nearly a hundred countries have subscribed to the Code. Against that backdrop, it is notable that several missile-holding countries of concern have not subscribed to this political declaration against the proliferation of ballistic missiles capable of delivering weapons of mass destruction.

38. The issue on missile defence is therefore essentially whether it could provide an effective addition to the responses available to the UK and its allies and partners. The US have answered this question for themselves in the affirmative, and have committed themselves to invest massively in developing and deploying effective systems of direct defence. The Government supports this technological and industrial effort; the US effort is in effect creating options for the enhancement of our security where none previously existed, and as such is to be welcomed. Indeed, we have contributed in a small way to this work for many years, as has UK industry. The industrial issues are discussed at paragraph 86 below.

39. Soon, however, we will need to decide whether we want to move beyond support for the development programme to actual involvement in deployed systems. This raises important issues of policy. But these cannot sensibly be addressed without a better understanding of the technologies involved, and what may, and may not, be realistically feasible by way of missile defence systems, in what timescales.

## Missile defence technology

40. Active ballistic missile defence involves destroying a missile before it reaches its target. This may involve defending a limited area, such as a troop concentration or military base from attack by a short-range missile (theatre missile defence), or protecting an entire national territory from attack by a longer-range ballistic missile (territorial missile defence).

41. From the early days of the Cold War, the US and the Soviet Union both expended considerable effort in the search for technological solutions to counter the threat from ballistic missiles. While the Anti-Ballistic Missile Treaty was designed to limit the development of strategic missile defence, it allowed certain limited development of this type. At present Russia is the only state in the world to have a deployed missile defence system designed to defend against long-range ballistic missiles, covering the area of Moscow.

42. Many states are involved in the development of short- to medium-range missile defences. In addition to work by the US and Russia, Israel, Japan, Italy, France and Germany among others are all involved in work on various systems and components. Such system development is already widely accepted. The UK has for some years had an active national programme contributing to its forward defence planning, following and evaluating advances in missile defence technology. NATO is close to completing a feasibility study on theatre missile defence options for the protection of deployed forces. And the EU has identified the risk of attack on the forces it might deploy. More detail on these programmes is at paragraph 53.

## Concept of a ballistic missile defence system

43. The US sees an active ballistic missile defence system having three key elements:

- sensors – radars and satellites;
- interceptors – ground- or sea-based missiles or airborne laser;
- battle management, command, control and communication ($BMC^3$).

44. The concept is for a wide range of networked sensors (deployed on land, at sea, in the air and in space), together with command and control to direct the interceptors at the incoming ballistic missile. An intercontinental ballistic missile aimed at the UK might take 20-30 minutes in flight. Satellites could detect missiles during their boost phase and alert early warning radars. These radars could then track the missile during its flight, whilst a higher resolution 'X-band' radar could discriminate between warheads, decoys (if present), the rocket tank and other debris. Once incoming warheads had been identified by the early warning radars, one or more interceptor missiles could be launched. These missiles consist of 'launch' and 'kill' vehicles, the latter designed to hit the incoming warhead and thereby destroy it. After the engagement, continued radar monitoring would be used for kill assessment.

*Figure 5. Prototype Ground Based X-Band Radar at Kwajalein Atoll, Pacific Ocean*

45. For the defence of deployed troops, some of the basic systems elements are the same, but the issues are rather different. **Theatre ballistic missiles** have much shorter flight times (typically five to ten minutes from launch to impact) and spend most of their flight time within the earth's atmosphere. Consequently, the motion of the missile and its warheads is more difficult to predict, and therefore more difficult to intercept. Additionally, defensive systems need to be deployed forward with the deployed forces, so mobility is a key requirement. Hence some of the technologies required for detecting, tracking and intercepting the threat are likely to be different. Also early warning of a threat to deployed forces can significantly enhance their ability to take protective measures.

46. **Boost phase missile defence** would attempt to intercept the target missile while its rocket engines were still burning. This would overcome the problem of discriminating between warheads and decoys, because during boost phase these elements have not yet separated from the booster. Two options are being explored for boost phase intercept: one using interceptors and the other using lasers. As the target ballistic missiles must be intercepted soon after launch, interceptors or the laser must be located close to the launch site; the co-operation of neighbouring countries would be needed for certain deployment options. The US is developing a laser-beam fired from a Boeing-747 airframe. Whilst the technology is acknowledged to have limitations, testing will start in 2004 and operational aircraft are due to enter service in 2007. The US is also considering faster interceptor missiles to attack the ballistic missile during or shortly after boost phase.

*Figure 6. Airborne Laser Concept*

47. The aim is to disable a ballistic missile at the earliest possible time in its flight. Given the short flight times for an incoming missile, however, identifying, tracking, initiating a response and then actually intercepting during boost phase is extremely challenging. So intercepting in **mid-course or terminal phases** (preferably the former) is initially more likely. For these stages, interceptor missiles have been and continue to be developed. A number of interceptors are currently being tested, of which the Sea-based Mid-course system and the long-range Ground-Based Interceptor (GBI) are examples. Both use hit-to-kill technology as the mechanism for destroying the incoming target.

48. The STANDARD Missile-3 (SM-3) is an interceptor that is part of the US Sea-based Mid-course system that will provide allied and US forces with protection from theatre ballistic missiles. It is designed to be launched from the current and future fleet of Aegis cruisers and destroyers, to intercept an incoming theatre ballistic missile outside the earth's atmosphere. Its maximum speed is about 3 km/s. The system is in the early stages of development and has recently demonstrated three successful intercepts of an incoming target, including an intercept as the missile was still ascending.

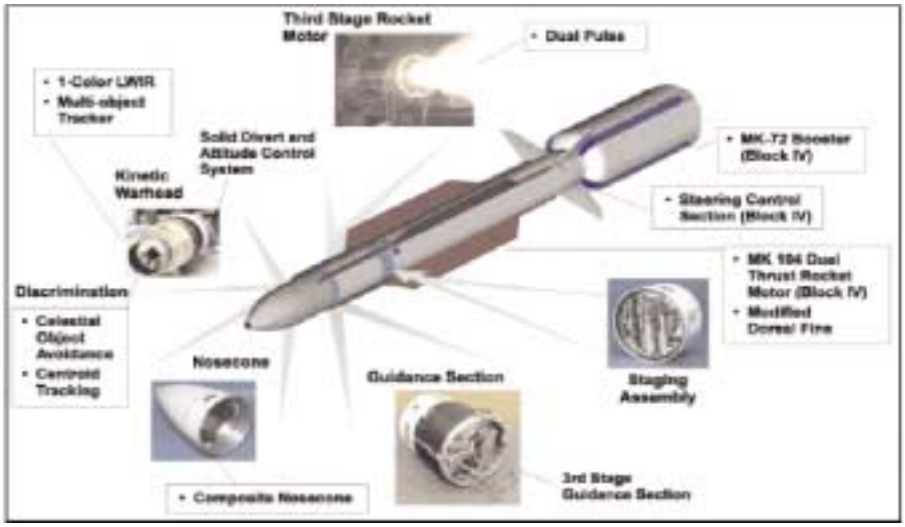


*Figure 7. STANDARD Missile-3 Interceptor Layout*

49. The Ground Based Interceptor (GBI) is a large, land-based missile. It is designed to engage Intercontinental Ballistic Missiles (ICBMs) and defend large areas with only a few launchers. The Exo-atmospheric Kill Vehicle (EKV) is the intercept component of the GBI and has its own seeker, propulsion, communications, guidance and computers to support targeting decisions and manoeuvres. GBI is the interceptor element of the US Ground-based Mid-course system. A prototype GBI launched from Kwajalein Atoll has successfully intercepted, on a number of occasions, a modified Minuteman ICBM launched more than 7,500km away.

## Current technological position

50. Advances in technology are bringing closer the possibility of a credible and useful defence against limited numbers of missiles. The US testing programme continues to demonstrate the increasing success of their interceptor missiles, and radar and computer technology is creating the ability to handle ever more sophisticated threats. But the United States is still some way from completing the elaborate system concept described.

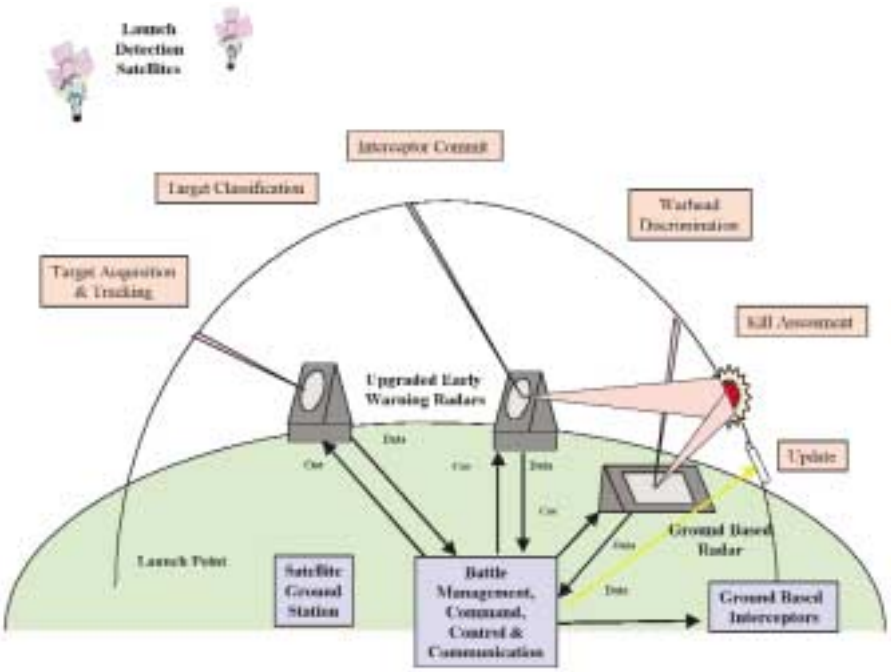


*Figure 8. US Concept of Operations for Active Ballistic Missile Defence*

51. What is certain is that we can expect the US to deploy ever more sophisticated solutions over time, as both the potential threat and the Ballistic Missile Defence System evolves. Their plan is to have an initial missile defence capability, which could provide an emergency operational capability, centred on the Pacific in the 2004 timeframe. Their intention is to upgrade their missile defence capability every two years using the latest technology available to counter the threat. Addition of other sensor and interceptor sites will also be a key issue. The US are planning their initial capability around their Pacific Test Bed, comprising a small number of interceptors located at Fort Greely (Alaska), supported by sensors on an Aegis ship, a prototype X-band radar on Kwajalein Atoll in the Pacific, and early warning radars on the west coast of the US.

52. Supported by recent successful missile intercept tests at the Pacific Test range, the US has refocused its programme towards demonstrating and testing a ballistic missile defence capability. Whilst the ability to hit the incoming missile with an interceptor has been proved, there are still some key technical questions which require further study. These include issues concerning debris, whether from destroyed ballistic missiles or indeed from interceptors (although if the intercept is conducted outside the Earth's atmosphere, much of the problem may be resolved by burn-up on re-entry).

## UK and NATO research programmes

53. Ballistic missile defence is a vast enterprise, involving cutting edge technologies. The UK has been closely involved since the mid-1980s with US research[1], including that on sensors, imaging and discrimination (between warheads and decoys), materials, and battle

[1] Through the 1985 Memorandum of Understanding relating to Co-operative Research for the Strategic Defense Initiative.

management, command, control and communications. The 1998 Strategic Defence Review recognised ballistic missile defence as of growing importance and initiated a three-year study (the Technology Readiness and Risk Assessment Programme) to investigate the protection of UK forces. This was achieved jointly by an innovative arrangement between UK government and industry.

54. Within NATO, feasibility studies aimed at addressing the proposed requirement for active, layered defence of deployed forces have looked at areas such as warheads, systems and architectures, battle management command and control, integration and industrial strategy. Two multinational industrial consortia are delivering the programme; the UK is represented on both teams through MBDA and Qinetiq. The study will report in early 2003. Following the recent Prague summit, a new NATO feasibility study will be initiated to address the increasing missile threat to Alliance territory, forces and population centres. Further work within NATO has involved a study with Russia, looking at interoperability of their respective systems for defending deployed troops from ballistic missiles. And as part of the Helsinki Headline Goal process, an EU panel is examining the options for protection of forces under the European Capability Action Plan: this is due to report next spring.

55. As the potential threat from ballistic missiles grows, and technologies develop, the UK and other European allies need to consider whether they should add a further capability to the current range of responses by acquiring missile defences. The Ministry of Defence must therefore ensure that it is in a position to make such a decision in a well-informed way should the need arise. A programme of science and technology activity is planned to continue, with close links to US experts who are developing the evolving US system, and to NATO. This includes work to continue assessing our requirements and options in relation to defence of deployed forces. A small programme is also planned which will seek to identify an emergency initial operational capability within a short time frame, should it be so required.

## Options for missile defence of US and Europe

56. As described at paragraph 51, the Pacific Test Bed facility could form an initial missile defence system in the 2004 timeframe that would offer an emergency capability against a possible North Korean threat to the US, if the US so decide. However, this initial system would only have a limited capability against a possible Middle Eastern threat. The interceptors available will initially be only those based in Alaska.

57. In order to provide a better capability against a possible Middle Eastern threat, the US might need a second interceptor site to complement the site at Fort Greely. However, although the coverage of the system would be much improved, the robustness of its performance would still be affected by confining radar capability to US territory. This is not far forward enough to give sufficient warning time to support fully the capability of the interceptor. Defence of the US eastern seaboard would thus be further improved by an Upgraded Early Warning Radar (UEWR) in north-western Europe, and so the US are considering asking for the radar at RAF Fylingdales to be upgraded to UEWR standard. The additional warning time provided by RAF Fylingdales for a Middle Eastern threat is very substantial.

*Figure 9. Early Warning Radar at Beale, California*

58. The technical challenge of intercepting an in-coming Intercontinental Ballistic Missile is severe. The US commonly liken it to hitting a bullet with a bullet. Given the imperative of destroying each and every incoming threat, a degree of redundancy – overlap – is a fundamental requirement in all missile defence architectures. Additional interceptor sites, perhaps in the North-East United States and in North-West Europe, would greatly enhance the defence of the US, and the latter could also provide protection for part of Europe.

59. Finally, in the same way as the defence of the US would be significantly enhanced by a forward radar at Fylingdales, so the protection of Europe would be greatly enhanced by a forward radar to give maximum warning time of the threat. The ideal location for such a radar would clearly be as far towards the source of the threat as possible. To address a Middle Eastern threat, this might imply placing the radar somewhere in south-eastern Europe.

60. Such a system architecture would provide good defence of the US and most of Europe. The only area left undefended would be the area closest to the launch point of the incoming missile, since threats to this area would be much shorter range and might therefore fly under the missile defence umbrella (which is optimised to defend against longer-range ballistic missiles). This could be corrected by the deployment of theatre ballistic missile defence systems to forward areas of Europe.

## RAF Fylingdales

61. RAF Fylingdales has operated since 1963 as one of the radars which provides early warning of ballistic missile launches against the UK, Western Europe and the US. The other Early Warning Radars are based at Clear (Alaska), Thule (Greenland), Beale (US) and Cape Cod (US), and the data that they produce are shared to form the Integrated Tactical Warning and Attack Assessment for both the UK and US. RAF Fylingdales is under UK operational command. Advanced radars are a key element in providing effective early warning of incoming ballistic missiles. There is currently however no ability to defend directly against incoming missiles.

62. The facilities at RAF Fylingdales have been upgraded over the years. In order to keep up with developments in ballistic missiles (in particular the introduction of submarine-launched missiles)

and in the nature of the warheads, the radar facility at RAF Fylingdales has been modernised a number of times. A significant upgrade during the late 1980s replaced the three "golf ball" radars with a pyramid-shaped solid state phased array radar. Improvements in computer technology have led to other upgrades of the missile warning and space object tracking functions of the station. A Service Life Extension Programme is also currently underway, which replaces older technology equipment with newer, more reliable, equipment to maintain the current early warning and space object tracking capabilities.

63. As described at paragraph 57, Early Warning Radars would need to be upgraded in order to provide a missile defence capability, so that incoming threat objects could be tracked more accurately. Resulting data could be fed back to the UK's Missile Warning Cell and to the US Ground-based Mid-Course Defence control centre. Such an upgrade would entail installation of new hardware and software, but we would not expect it to involve any significant change to the outward appearance of the radar. We would not expect any material environmental impact to be involved, but we would clearly need to discuss this further with the US and local planning authorities. Without the hardware and software upgrades, the radar at RAF Fylingdales would be unable to provide the data needed for missile defence purposes.

*Figure 10. RAF Fylingdales today*

## Policy considerations

64. The concept of active missile defence has changed fundamentally since its Cold War origins. The 1980s' vision of a comprehensive space-based shield for the United States against massed ballistic missile attack – nicknamed "Star Wars" – would indeed have profoundly changed the global strategic landscape. But such a system, even if it were desirable, is now acknowledged to be out of technological reach in any meaningful timescale. Instead, the United States has refocused its efforts on the much more limited (but realistic) aim of defending against potential assailants who hold only small numbers of missiles. The programme has also been relabelled 'Missile Defence', significantly dropping the earlier epithet 'National'. The US is now looking to

work closely with friends and allies to develop defences which enhance global security in the face of the potential threat which all of NATO recognises. In May 2001, President Bush commissioned an examination of 'effective missile defences that could protect the US, our deployed forces, our friends and our allies.' As he again emphasised last June,

> 'These threats also endanger our allies and friends around the world… it is essential that we work together to defend against them. The United States will deepen our dialogue and co-operation with other nations on missile defences.'

It is in this context that we must consider the policy issues surrounding missile defence.

## Deterrence

65. Deterrence seeks to prevent aggression by presenting potential adversaries with the prospect of losses which outweigh any gains they could hope to achieve. During the Cold War, the international security context was dominated by two politically opposed superpowers, each with the power to destroy the other. Both sides expended great intellectual effort in understanding the effect that such a power would have on the other. Mutually assured destruction based on large-scale nuclear forces provided sufficient deterrence to ensure relative stability. The independent UK (and French) nuclear forces added to the overall deterrent environment by complicating the calculations an aggressor would need to make about the risks to him of proceeding. These collective forces will continue to act as a deterrent against large nuclear capabilities.

66. However, it is arguable that this concept alone may no longer be the full answer for the greatly more complex and unstable mixture of threats we face today. A bipolar world has been replaced by a much more varied international landscape, with a multiplicity of independent actors with different ambitions, values and perceptions. Some of these might wish to threaten the US, UK and their allies with damage which, while falling short of national annihilation, would nonetheless be catastrophic. Even more than in the past, deterrence can no longer be solely about our nuclear weapons, but rests instead on the whole range of military and non-military capabilities.

67. One charge levelled at previous incarnations of missile defence proposed by the United States was that it undermined the deterrent relationship between the US and Russia. However, as described above, the current territorial missile defence proposals are much more limited, seeking to develop the capacity to deal with only the small numbers of incoming missiles which represent the currently foreseeable threat. No missile defence system being planned or developed will have the capability to act as a shield against a first strike of thousands of warheads, which was the nature of the threat faced during the Cold War.

68. We must, however, take very seriously the danger that deterrence will be less effective against new owners of these awesome capabilities who may not subscribe to international norms of behaviour and may be willing to take greater risks than were the leaders of the Soviet Union. Some clearly view weapons of mass destruction in a very different light, and indeed have in at least one case already demonstrated a willingness to use these weapons indiscriminately. Without the means for such a state to pose a credible conventional threat, such weapons could become not a last resort but potential weapons of choice. They may also be seen as a short

cut to regional pre-eminence and, potentially, as a way of deterring intervention by the international community.

69. In this changing international strategic context, we therefore need to consider carefully whether a defensive system against a limited ballistic missile attack might in some circumstances in fact serve to reinforce the deterrent effect of our conventional and nuclear forces. Any regime contemplating the use of ballistic missiles against the UK (whether in a desperate attempt to cling to power, or to prevent allied intervention in a regional conflict) would then face not only the near certainty of an overwhelming response, but also the probability that the attack would fail altogether. Furthermore, the existence of effective missile defences should help to dissuade any states who might be weighing up whether to embark on the costly and technically difficult path of developing or procuring ballistic missiles and weapons of mass destruction in the first place.

70. The UK needs to maintain the ability (together with her Allies) to intervene in regional crises where national interests or international stability are threatened, or the will of the international community is being flouted. We need therefore to be prepared for a scenario in which a state carries out an act of regional aggression, and then seeks to deter intervention by threatening population centres with ballistic missiles and weapons of mass destruction. We believe that a potential aggressor would be more likely to be deterred if he knew that he could not threaten the homelands of key states in the international community in this manner.

*Figure 11. Prototype Ground Based Interceptor at Kwajalein Atoll, Pacific Ocean*

## International issues

71. Missile defence will work as part of an overall strategy to counter the emerging missile threat only if it does not itself contribute to a change in the scale of the growth of that threat, by causing a rapid increase in missile proliferation or the strategic arsenals of other states. The maintenance of **strategic stability** is an important consideration.

72. The suggestion that missile defence would spark an arms race therefore needs to be taken seriously. It is possible that states in the process of developing long-range missile capabilities would seek to intensify these efforts in an attempt to overcome any defences. On the other hand, as already noted, it is perhaps more likely that missile defence would succeed in dissuading countries from taking this ever more difficult and expensive path. Many feared that US withdrawal from the Anti-Ballistic Missile Treaty (ABMT) in June 2002 (after the six months' notice allowed for under the Treaty) would cause global instability, damage international relationships and create an arms race. But this has not happened.

73. Although the UK welcomed the stability brought by the ABMT to the Cold War stand-off, it is important to recognise that it is the stability which is important, not the mechanism by which it is achieved. During the Cold War, the ABMT controls on the development of missile defences were part of a process of confidence-building at a time of real tension. This enabled gradual moves towards the reduction of US and Soviet strategic nuclear arsenals. Thirty years later, circumstances have changed dramatically and a new strategic relationship is developing between Russia and the United States, based on the principles of mutual security, trust, openness, co-operation and predictability. The Moscow Treaty signed in May this year commits both Russia and the US to large reductions in their operationally deployed nuclear forces.

74. The US and Russia are now involved in an active process of dialogue on missile defence. They are committed to a number of steps to strengthen confidence and increase transparency, including exchange of information, reciprocal visits, observation of tests and a joint data exchange centre. They have further agreed to study possible areas for missile defence co-operation, such as expanding their existing joint exercises and exploring potential joint research programmes. And NATO member states are also working together with Russia in the NATO Russia Council in areas such as theatre missile defence.

75. While China has expressed concerns about US missile defence plans, she has been pursuing her modernisation programme for her nuclear forces for some years irrespective of these proposals. Beijing recently reiterated its commitment to preventing the spread of weapons of mass destruction and their means of delivery. China has also established new export controls to apply international non-proliferation standards, and has called for a security concept based on mutual trust and co-operation. The United States continues to seek to engage constructively with China on the issue at official and political level.

76. As the US has made clear on numerous occasions, missile defence is not intended to defend against responsible states with established strategic forces. Its aim is to tackle limited threats from states of concern with emergent missile capabilities, which seek to acquire and threaten to use ballistic missiles and weapons of mass destruction in contravention of widely accepted international norms. The proliferation threat is not new; missile defence is a response to, not the cause of, the problem.

## UK security issues

77. Thus far this section has considered the broad policy issues surrounding active missile defence. The UK needs to consider more specifically her own possible involvement and investment in a developing and expanding system of defences. The US Administration has on a number of occasions emphasised its keenness to involve its Allies in a co-operative development programme expanded to cover US and European territory and beyond. And, depending on US decisions on her missile defence architecture, the Government may also need to decide whether to allow UK facilities to be used as part of the US-led programme.

78. The Government will agree to a US request for the use of UK facilities for missile defence only if we believe that doing so enhances the security of the UK and the NATO alliance. In this, the key point must be that the UK and other countries need to address the ballistic missile threat from certain states of concern. The principal driver of this potential threat to the UK is not the deployment of missile defences, or the use of UK facilities as part of a US system, but the ability of states of concern to succeed in flouting the international non-proliferation framework by developing or acquiring weapons of mass destruction and their means of delivery.

79. The United States is one of the closest allies of the UK, and we fully understand US concerns to avoid vulnerability to the threat of ballistic missile attack. Reducing that vulnerability would give the US a wider range of options for responding to emerging threats to her and NATO's regional security commitments. However, we are aware of concerns expressed that an upgrade of the Fylingdales radar to allow it to contribute to a missile defence system could place the UK at greater risk of attack. These concerns focus particularly on the possibility that the US may request an early upgrade, to be brought into operation in advance of any possibility of extending effective anti-missile protection over UK territory.

*Figure 12. Battle Management, Command, Control and Communications ($BMC^3$) at Cheyenne Mountain, Colorado*

80. During the Cold War, military strategists speculated that Soviet nuclear planners might contemplate clearing the way for a devastating nuclear strike by first launching an attack to "blind" the West by destroying the Early Warning Radar system. To that extent, the existence of the Fylingdales radar constituted a specific example of the general strategic risk with which

we lived for many years. Russia maintains a substantial nuclear arsenal, to which our own strategic deterrent continues to provide an important counter-poise. But the risk of post-Cold War Russia contemplating a "bolt from the blue" nuclear strike now seems entirely remote. Nor is missile defence as now contemplated any sort of a threat to Russia's strategic capabilities.

81. Might not, however, a new proliferator consider adopting a similar tactic? We have considered this possibility but view it as highly improbable. A strike to "blind" the West could be contemplated only by a power with an extensive and highly sophisticated ballistic missile capability. It would presuppose a sizeable arsenal, to be able to assign missiles to a preparatory or path-clearing role. It would presuppose a sophisticated system of command and control. And it would presuppose the ability to strike point targets at many hundreds of kilometres' range with high degrees of precision and reliability. As discussed earlier, we do not see the achievement of these conditions by any proliferator as a realistic prospect for many years to come. For the foreseeable future, long-range ballistic missiles in the hands of proliferators are likely to remain essentially weapons of terror, holding at risk not specific military installations but population centres.

82. RAF Fylingdales is therefore not a plausible target. As described earlier, it could nonetheless be a key building block for any future system of active missile defence protection for the UK and Europe. With interceptors placed somewhere in Europe, such a system could protect the UK and North-West Europe. With the addition of a forward radar, the system would protect most of Europe.

83. If a role for Fylingdales itself would not heighten risks, might the threat to the UK rise from the broader fact of our involvement in a US-led missile defence system? The world already knows that we see our national security interests as closely identified with those of the US, and of other allies and partners. The NATO Alliance at the Prague Summit acknowledged squarely the new threats it faces from terrorism and proliferation of weapons of mass destruction and their delivery means, and it committed itself to respond appropriately, wherever the threat may arise. The risk to the UK from ballistic missiles – and hence the desirability of coverage by a missile defence system – will be driven by the inimical intentions of other states and improvements in ballistic missile technology and accuracy, and not by the existence of the US missile defence programme. The conclusion is essentially the same as the one we earlier drew in the New Chapter to the Strategic Defence Review. Keeping a low profile and hoping for the best is not an option. Safety lies through recognising threats as they arise, and taking proactive steps to address them.

## Value for money

84. As with all investment decisions, the UK will need to assess the **cost and operational effectiveness** of a missile defence capability. There is no doubt that missile defence is an expensive capability. It is too early to estimate the cost of acquiring missile defence protection for UK territory at the present time – system architectures and technologies are still under development and the ways in which the UK might participate in any future programme remain to be determined. It is also important to be clear that the expenditure would not be designed to replace deterrence, but to buttress deterrence in a new but vital area. However, the work underway both nationally and within NATO will help to inform future judgements on such an investment.

85. Similarly, the cost of theatre missile defence for deployed forces is not yet available with any degree of accuracy. Ongoing work will enable us to assess costs and operational effectiveness in due course. This will need to appraise active theatre missile defence against other means of protecting deployed forces: significant protection can be achieved with passive defensive steps, such as the appropriate tactics, training and procedures and providing detection and defence against chemical and biological, and radiological weapons. We will also consider the most efficient approach to theatre missile defence for coalition forces. This may involve a degree of role specialisation.

86. Assessment of the approach which offers best value for the UK also involves wider national factors, such as **industrial issues**, as set out in our recent policy paper on *Defence Industrial Policy*. Missile defence is a massive technological undertaking, involving research and development of high value, cutting-edge systems. The UK's defence industry is well placed to participate in and benefit from the enterprise, an enterprise which also has real opportunities for the creation of highly-skilled employment in this country.

87. The United States has a 'national team' of industrial partners contributing to the development of missile defence technology. BAE Systems's North American arm has already secured a place in this team; the company signed a Memorandum of Understanding with Boeing (one of the prime contractors) last summer. As described earlier, UK industry has been involved in the international research being undertaken in missile defence since 1985. The US are now looking to bring in the expertise of a wider 'international team' as their programme expands. British companies large and small, as well as universities and research centres, have an excellent opportunity to contribute to the international effort.

88. In order to harness the UK's efforts, we are considering the creation of a **Missile Defence Technology Centre**, jointly funded by Government and industry, which would be a virtual 'centre of excellence' to provide a focus for technical work in support of missile defence. We are also discussing with the US updating our bilateral **government-to-government arrangements** to facilitate our exchanges and to improve the establishment of technical partnerships between our industries and the transfer of technology. By ensuring that the UK continues to keep as close as possible to the developing programme, we will be able to assist the US with their research, development and test and evaluation, position ourselves to take national decisions on the basis of the fullest possible information, and promote the fullest possible opportunities for UK industry to participate.

# Conclusion

89. There are an increasing number of potential threats to the security of the UK and her Allies in the world today. To choose only to tackle some of these and hope others never materialise would be a dangerous approach. The precise extent of the threat to the territory and forces of NATO member states from ballistic missiles carrying weapons of mass destruction is certainly difficult to quantify in time and scale. However, potential threats are growing and cannot be ignored. If we are to meet these prospective threats as far as we can, we need to plan ahead and prepare properly. There are complex issues to be considered before the UK and others can determine the best overall strategy for addressing this threat, and the role that missile defence could play as an element of this strategy: issues of technology, timescale, international relations and cost, all of which are closely linked. But now is the time to consider these issues. It is hoped that this discussion paper will help that debate.

## Contact address

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