The **Future** of the **United Kingdom's Nuclear Deterrent**

Presented to Parliament by
The Secretary of State for Defence
and
The Secretary of State for Foreign and Commonwealth Affairs
By Command of Her Majesty

December 2006

Cm 6994

£13.50

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Foreword to the White Paper by the Prime Minister

The primary responsibility of any government is to ensure the safety and security of its citizens. For 50 years our independent nuclear deterrent has provided the ultimate assurance of our national security. For most of that time, during the Cold War, its purpose was clear, though never without controversy.

Today's world is different. Many of the old certainties and divisions of the Cold War are gone. We cannot predict the way the world will look in 30 or 50 years time. For now, some of the old realities remain. Major countries, which pose no threat to the UK today, retain large arsenals some of which are being modernised or increased. None of the present recognised nuclear weapons States intends to renounce nuclear weapons, in the absence of an agreement to disarm multilaterally, and we cannot be sure that a major nuclear threat to our vital interests will not emerge over the longer term.

We also have to face new threats, particularly of regional powers developing nuclear weapons for the first time which present a threat to us. Despite our best efforts, the number of states with nuclear weapons continues to grow, and may grow further. We are already trying to counter the threat posed by a nuclear North Korea and by the nuclear ambitions of Iran. And we need to factor in the requirement to deter countries which might in the future seek to sponsor nuclear terrorism from their soil. We must assume that the global struggle in which we are engaged today between moderation and extremism will continue for a generation or more.

Those who question this decision need to explain why disarmament by the UK would help our security. They would need to prove that such a gesture would change the minds of hardliners and extremists in countries which are developing these nuclear capabilities. They would need to show that terrorists would be less likely to conspire against us with hostile governments because we had given up our nuclear weapons. They would need to argue that the UK would be safer by giving up the deterrent and that our capacity to act would not be constrained by nuclear blackmail by others.

The Government believes that now, as in the Cold War, such an argument is misguided. We believe that an independent British nuclear deterrent is an essential part of our insurance against the uncertainties and risks of the future. We have therefore decided to maintain our deterrent system beyond the life of the Vanguards with a new generation of ballistic missile-carrying submarines. We will also extend the life of the Trident D5 missile.

I believe it is crucial that, for the foreseeable future, British Prime Ministers have the necessary assurance that no aggressor can escalate a crisis beyond UK control. An independent deterrent ensures our vital interests will be safeguarded. But as before, it will be the minimum necessary. We already have the smallest stockpile of nuclear warheads among the recognised nuclear weapons States, and are the only one to have reduced to a single deterrent system. In this White Paper we are announcing a further 20 per cent cut in our operationally available warheads. This leaves the deterrent fully functioning, with fewer than 160 warheads, but it means Britain continues to set an example for others to follow in our commitment to work towards a peaceful, fairer and safer world without nuclear weapons. Our decision to maintain the deterrent is fully compatible with all our international legal obligations.

Our nuclear deterrent is of course only one part of our overall military capability. We are, as before, committed to ensuring that the investment required to maintain it will not come at the expense of the conventional capabilities our armed forces need.

Some argue that we should put off this decision. But one is necessary because the present submarines will start to leave service in the early 2020s, and we have to decide now whether we want to replace them. Delaying a decision would risk a future break in our deterrent protection.

These are not decisions a government takes lightly. The financial costs are substantial. We would not want to have available the terrifying power of these weapons unless we believed that to be necessary to deter a future aggressor.

The Government's decision followed a careful review of all the issues and options, which are set out in full in the White Paper. We now look forward to a substantial period of public and parliamentary debate in which the issues can be aired freely. But I am confident that that debate will only confirm that maintaining our nuclear deterrent is in the best interests of the country's future security.

Tony Blair

Executive Summary

The UK is committed to helping to secure international peace and security. Since 1956, the nuclear deterrent has underpinned our ability to do so even in the most challenging circumstances. Over the last 50 years, it has been used only to deter acts of aggression against our vital interests, never to coerce others.

Why do we need to take decisions now?

At the 2005 General Election our manifesto made a commitment to retain the UK's independent nuclear deterrent. Even with an extension to their lives, the Vanguard class submarines are likely to start leaving service from the early 2020s. We estimate that it will take around 17 years to design, manufacture and commission a replacement submarine. So we need to take decisions now on whether to retain this capability in the longer term.

Why should we retain our nuclear deterrent?

The Government's primary responsibility is for the security of current and future UK citizens. The UK's security position has changed from the Cold War, and this change was reflected in the sharp reductions in the scale and readiness of our nuclear forces that were set out in the 1998 Strategic Defence Review.

The threat has now changed – but the global context does not justify complete UK nuclear disarmament:

- significant nuclear arsenals remain, some of which are being modernised and expanded;
- the number of states possessing nuclear weapons has continued to grow, as demonstrated most recently by North Korea's attempted nuclear test in October this year.

Ballistic missile technology has also continued to proliferate and most industrialised countries have the capability to develop chemical and biological weapons.

It is not possible accurately to predict the global security environment over the next 20 to 50 years. On our current analysis, we cannot rule out the risk either that a major direct nuclear threat to the UK's vital interests will re-emerge or that new states will emerge that possess a more limited nuclear capability, but one that could pose a grave threat to our vital interests. Equally there is a risk that some countries might in future seek to sponsor nuclear terrorism from their soil. We must not allow such states to threaten our national security, or to deter us and the international community from taking the action required to maintain regional and global security.

We can only deter such threats in future through the continued possession of nuclear weapons. Conventional capabilities cannot have the same deterrent effect. We therefore see an enduring role for the UK's nuclear forces as an essential part of our capability for deterring blackmail and acts of aggression against our vital interests by nuclear-armed opponents.

We have thus decided to take the steps necessary to sustain a credible deterrent capability in the 2020s and beyond.

How should we maintain our nuclear deterrent?

Our review of the available options has demonstrated that retaining a submarine-based system provides the most effective deterrent; and that no credible alternative is cheaper. Submarines are far more difficult to detect and track and so are less vulnerable to attack than the other options. Ballistic missiles are more effective than cruise missiles because they have much greater range and payload, and are far harder to intercept.

We have therefore decided to maintain our nuclear deterrent by building a new class of submarines. Currently we require a fleet of four submarines to maintain one continuously on patrol and retaining this posture is essential to assure the invulnerability of the deterrent. We will investigate fully whether there is scope to make sufficiently radical changes to the design of the new submarines, and their operating, manning, training and support arrangements, to enable us to maintain these continuous deterrent patrols with a fleet of only three submarines. A final decision on whether we require three or four submarines will be taken when we know more about their detailed design.

We have also decided to participate in the US life extension programme for the Trident D5 missile, which will enable us to retain that missile in-service until the early 2040s. Our existing nuclear warhead design will last into the 2020s. We do not yet have sufficient information to know whether it can, with some refurbishment, be extended beyond that point or whether we will need to develop a replacement warhead: a decision is likely to be necessary in the next Parliament.

What will this cost?

The costs of this programme will be refined as we engage in detailed discussion with industry. Our current estimate is that the procurement costs of the new submarines and associated equipment and infrastructure will be in the region of £15-20 billion (at 2006/07 prices) for a four-boat fleet. The costs will fall principally in the period between 2012 and 2027. The investment required to maintain our deterrent will not come at the expense of the conventional capabilities our armed forces need. Decisions on the level of investments in nuclear and conventional capability will be taken in the Comprehensive Spending Review, the results of which will be announced next year. In-service costs for the deterrent over the period between 2020 and 2050 will remain broadly similar to the current position.

What are our international obligations?

Renewing our minimum nuclear deterrent capability is fully consistent with all our international obligations. It is also consistent with our continuing commitment to work towards a safer world in which there is no requirement for nuclear weapons. We have taken a leading role in a wide range of multilateral initiatives in support of the

objectives of the Nuclear Non-Proliferation Treaty (NPT). We have also taken significant steps to reduce our nuclear capabilities. We have the smallest stockpile of nuclear warheads amongst the nuclear weapon States recognised under the NPT and are the only one to have reduced to a single deterrent system.

We have now decided that we can reduce our stockpile of operationally available warheads to fewer than 160. This will represent a 20% reduction on the figure set out in the 1998 Strategic Defence Review, and is almost a 50% reduction compared to the plans of the previous Government.

Summary

We are commited to retaining the minimum nuclear deterrent capability necessary to provide effective deterrence, whilst setting an example where possible by reducing our nuclear capabilities, and working multilaterally for nuclear disarmament and to counter nuclear proliferation. We believe this is the right balance between our commitment to a world in which there is no place for nuclear weapons and our responsibilities to protect the current and future citizens of the UK.

Section 1: Maintaining our Nuclear Deterrent

1-1. The United Kingdom is committed to helping to secure international peace and security. Since 1956, the UK's nuclear deterrent has underpinned our ability so to do, even in the most challenging circumstances. Throughout, the UK has proved itself a responsible steward of nuclear weapons, reducing our capability as circumstances have allowed. Consistently we have employed our nuclear forces strictly as a means to deter acts of aggression against our vital interests and have never sought to use them to coerce others.

1-2. Our manifesto at the 2005 General Election made a commitment to retain the UK's existing nuclear deterrent. We have already said this means retaining this capability at least until the current system reaches the end of its life. We have now reached the point at which procurement decisions are necessary on sustaining this capability in the longer term. The timetable for decision-making is driven by our assessment of the life of elements of the existing Trident deterrent system and the time it might take to replace them.

HMS VANGUARD

The Vanguard Class Submarines

1-3. The first of four Royal Navy Vanguard-class ballistic missile submarines (or SSBNs), which carry the Trident D5 missile, was launched in 1992 and the class had an original design life of 25 years. We have undertaken detailed work to assess the scope for extending the life of those submarines. Our ability to achieve this is limited because some major components on the submarines – including the steam generators, other elements of the nuclear propulsion system and some non-nuclear support systems – were only designed for a 25-year life. The submarines have been, and will continue to be, subjected to a rigorous through-life maintenance regime and we believe that, by revalidating those

components, it should be possible to extend the life of the submarines by around five years. Accordingly, the first submarine would be going out of service around 2022 and the second around 2024. Continuous deterrent patrols could no longer be assured from around this latter point if no replacement were in place by then.

1-4. Any further extension of the life of the submarines would mean that the key components described previously would need to be replaced or refurbished, and this would require a major refit of the submarines. This would not extend the lives of the submarines much further and would not therefore be cost effective. There have been some suggestions that we should replicate US plans to extend the lives of their Ohio-class SSBNs from 30 to over 40 years. A substantial life extension of this kind would need to have been built into the original design of the Vanguard-class, and into the subsequent manufacture, refit and maintenance of the boats. Unlike with the Ohio-class, this was not the case. There are also some radical differences between the two classes – such as the propulsion systems – which mean that their potential lives are different.

1-5. Past experience with UK submarine programmes suggests that even a 5-year life extension will involve some risk. The lives of the previous Resolution-class SSBNs ranged between 25 and 28 years, but there was a significant loss of availability and increase in support costs towards the end of their lives. The longest life extension for any UK nuclear powered submarine was to 33 years for one of the Swiftsure-class conventional role submarines but again availability was significantly reduced during its later years. Therefore, while it should be possible to extend the life of the Vanguard-class into the 2020s, we believe that it would be highly imprudent now to plan on the basis that it will be possible to extend them further.

1-6. We have considered carefully how long it might take to design, manufacture and deploy replacement submarines. It took some 14 years from the decision to purchase Trident in 1980 to the system first being deployed operationally in 1994. However, in the preceding decade a good deal of initial concept and design work had already taken place. Much has changed since 1980. Safety and regulatory standards have been raised over the last 25 years. The capacity and experience within the UK submarine industry is less now than it was in 1980. There are also risks that, in the event of a significant gap between the end of design work on the Astute-class conventional role nuclear submarines and the start of detailed design work on new SSBNs, some of the difficulties experienced on the Astute programme would be repeated because of the loss of key design skills.

1-7. Detailed assessment of the duration of a programme to build new SSBNs will need to await contractual negotiations with industry. A reasonable estimate is that it might take around 17 years from the initiation of detailed concept work to achieve the first operational patrol. This estimate reflects the judgement of industry and is consistent with US and French experiences. Given this estimate, the fact that non-submarine options are likely to take at least as long to develop and that our current SSBNs will reach the end of their (extended) lives during the 2020s, detailed concept work on renewal of our deterrent system needs to start in 2007 if we are to avoid a gap in deterrence at the end of the life of the Vanguard-class submarines.

HMS VANGUARD test fires a Trident D5 missile in October 2005

The Trident D5 Missile

1-8. The US Government plans to extend the life of the Trident D5 missile to around 2042 to match the life of their Ohio-class submarines. That will involve the manufacture of a number of new missiles and the modernisation of the existing missiles. Work will focus entirely on replacing components of the system to minimise the risk of obsolescence, especially of the electronics in the flight control systems. There will be no enhancement of the capability of the missile in terms of its payload, range or accuracy.

1-9. Unless we participate in that life extension programme, it will not be possible to retain our existing Trident D5 missiles in service much beyond 2020, except at much greater cost and technical risk. Decisions on whether or not we should participate are required by 2007.

The Warhead

1-10. Our existing Trident warhead design is expected to last into the 2020s and no decisions on any refurbishment or replacement are required currently. The longer term position is described in Section 7.

Conclusions

1-11. We have concluded that, if we are to maintain unbroken deterrent capability at the end of the life of the Vanguard-class submarines, we need to take decisions now on whether to replace those submarines and whether to participate in the Trident D5 life extension programme.

Section 2: The Policy Context

2-1. Section 1 set out why decisions on the future of the UK's nuclear deterrent are needed now. Given the implications of those decisions, we considered that it was appropriate also to reassess our policy in this area.

2-2. Our over-arching policy on nuclear weapons remains as set out in the December 2003 Defence White Paper (Command 6041-1 Paragraph 3.11):

> *We are committed to working towards a safer world in which there is no requirement for nuclear weapons and continue to play a full role in international efforts to strengthen arms control and prevent the proliferation of chemical, biological and nuclear weapons. However, the continuing risk from the proliferation of nuclear weapons, and the certainty that a number of other countries will retain substantial nuclear arsenals, mean that our minimum nuclear deterrent capability, currently represented by Trident, is likely to remain a necessary element of our security.*

Disarmament

2-3. We have taken a series of measures (see Box 2-1) to reduce the scale and readiness of our nuclear forces to ensure they are the minimum necessary to achieve our deterrent objectives. We have now decided to make a further reduction in the number of operationally available warheads. This will be reduced from the present position of fewer than 200 to fewer than 160. Also, we will make a corresponding 20% reduction in the size of our overall warhead stockpile, which includes a small margin to sustain the operationally available warheads.

2-4. These further reductions will mean that, since coming to power in 1997, we will have reduced the upper limit on the number of operationally available UK nuclear warheads by nearly half. Since the end of the Cold War, the UK will have reduced the overall explosive power of its nuclear arsenal by around 75%. The UK's nuclear deterrent now accounts for less than 1% of the global inventory of nuclear weapons, and our stockpile is the smallest of those owned by the five nuclear weapon States recognised under the Nuclear Non-Proliferation Treaty (NPT).

2-5. In the 1998 Strategic Defence Review we announced that we had by then purchased 58 Trident D5 missiles. Subsequently, we decided not to take up an option to purchase an additional seven missiles. As a result of a number of test firings, our current holding has reduced to 50. We believe that no further procurement of Trident D5 missiles will be necessary through its planned in-service life.

Box 2-1: UK Progress on Nuclear Disarmament

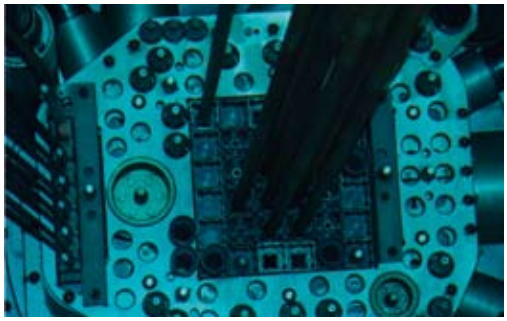
- We stand by our unequivocal undertaking to accomplish the total elimination of nuclear weapons.
- We are the only nuclear weapon State recognised under the NPT which has reduced its deterrent capability to a single nuclear weapon system. We have dismantled our maritime tactical nuclear capability and the RAF's WE177 free-fall bombs.
- We will reduce the upper limit on the number of operationally available warheads to less than 160, a reduction since 1997 of nearly one half, compared to the previously declared maximum.
- We have reduced significantly the operational status of our nuclear weapons system. Normally, only one Trident submarine is on deterrent patrol at any one time, with up to 48 warheads on board. That submarine is normally at several days 'notice to fire'. Its missiles are not targeted at any country.
- We have not conducted a nuclear test explosion since 1991 and we ratified the Comprehensive Nuclear Test Ban Treaty in 1998.
- We have increased our transparency with regard to our fissile material holdings. We have produced historical records of our defence holdings of both plutonium and highly enriched uranium.
- We have ceased production of fissile material for nuclear weapons and other nuclear explosive devices. We support the proposal for a Fissile Material Cut-Off Treaty and call for the immediate start of negotiations in the Conference on Disarmament in Geneva.
- We continue to make progress on the "13 practical steps" towards nuclear disarmament agreed by consensus at the 2000 NPT Review Conference.

2-6. Through the NPT and a wide range of fora, including the Conference on Disarmament and the UN Disarmament Commission, we continue to work multilaterally to help and encourage others to reduce their nuclear stockpiles. In 1998 we ratified the Comprehensive Test Ban Treaty. We call on other states to do likewise. Repeatedly, we have called for negotiations to begin immediately and without preconditions on a Fissile Material Cut-off Treaty. Such a treaty would put a global cap on the amount of fissile material available to be turned into nuclear weapons. We have supported the significant reductions in the numbers of nuclear weapons achieved by the bilateral arms control initiatives between the United States and Russia, and are encouraging both sides to make further reductions.

Counter-Proliferation

2-7. We have made further efforts to counter proliferation of nuclear, chemical, biological and radiological weapons (see Annex A). We have put in place a comprehensive multilateral strategy to strengthen legally-binding obligations on states to strengthen export controls, to combat supply chains, and to prevent old or unused materials from falling into the wrong hands.

2-8. But proliferation risks remain. Most countries around the world with industrialised economies have the capability rapidly to develop and manufacture large scale chemical and biological weapons. Also, we are concerned at the continuing proliferation of ballistic missile technology. Fewer states have acquired nuclear weapons capabilities than some foresaw when the NPT entered into force in 1970. For example, South Africa and Libya have both renounced former nuclear weapons programmes. However, the number of states with nuclear weapons has continued to increase. Most of the 40 members of the Nuclear Suppliers Group, an organisation of suppliers of nuclear equipment and material who act together to reduce the risks of nuclear weapons proliferation through the implementation of suitable export controls, have the technical ability and means to initiate a viable nuclear weapons programme. Whilst the size and readiness of global nuclear capabilities has reduced markedly since the end of the Cold War, large nuclear arsenals remain and some are being modernised (details are set out in Box 2-2).



Dismantling the Libyan nuclear programme

Our International Legal Obligations

2-9. The UK's retention of a nuclear deterrent is fully consistent with our international legal obligations. The NPT recognises the UK's status (along with that of the US, France, Russia and China) as a nuclear weapon State. The NPT remains the principal source of international legal obligation relating to the possession of nuclear weapons. We are fully compliant with all our NPT obligations, including those under Article I (prevention of further proliferation of nuclear weapon technology) and Article VI (disarmament).

2-10. Article VI of the NPT does not establish any timetable for nuclear disarmament, nor for the general and complete disarmament which provides the context for total nuclear disarmament. Nor does it prohibit maintenance or updating of existing capabilities. Nevertheless, we will continue to press for multilateral negotiations towards mutual, balanced and verifiable reductions in nuclear weapons.

2-11. In 1996 the International Court of Justice delivered an Advisory Opinion which confirmed that the use, or threat of use, of nuclear weapons is subject to the laws of armed conflict, and rejected the argument that such use would necessarily be unlawful. The threshold for the legitimate use of nuclear weapons is clearly a high one. We would only consider using nuclear weapons in self-defence (including the defence of our NATO allies), and even then only in extreme circumstances. The legality of any such use would depend upon the circumstances and the application of the general rules of international law, including those regulating the use of force and the conduct of hostilities.

Conclusions

2-12. We see no reason to change the judgement reached in the 2003 Defence White Paper that the conditions for complete UK nuclear disarmament do not yet exist. For this judgement to change, there would need to be much greater progress, first towards reductions in existing nuclear stockpiles, and second in securing global adherence to obligations not to proliferate nuclear weapons or related technology, under the NPT and other treaties and export control regimes.

Box 2-2: Current Global Nuclear Capabilities

The Nuclear Weapons States Recognised Under the NPT

The **US** nuclear deterrent consists of systems launched from submarines, silos and aircraft. The US Navy retains a force of 14 Ohio-class SSBNs, each carrying up to 24 Trident D5 missiles. US silo-based systems currently comprise 500 Minuteman inter-continental ballistic missiles (ICBMs), following withdrawal of the Peacekeeper system. This has reduced from over 1000 in 1990 and is planned to reduce to 450 from 2007. A modernisation programme will sustain the Minuteman force until the 2020s. The US has air-delivered cruise missiles and free-fall bombs delivered by a range of aircraft. By 2012, under the terms of the Strategic Offensive Reductions Treaty, total US operationally deployed strategic nuclear warhead numbers will reduce to a maximum of 2,200.

Russia deploys strategic nuclear weapons in a triad of land, sea and air based systems and, in addition, retains a very large stockpile of non-strategic nuclear weapons. Its strategic arsenal comprises some 520 inter-continental ballistic missiles, more than 250 submarine-launched ballistic missiles and about 700 air-launched cruise missiles. Under the terms of the Strategic Offensive Reductions Treaty, Russia will reduce the number of its operationally deployed strategic nuclear warheads to a maximum of 2,200 by the end of 2012. Russia continues to modernise its nuclear arsenal. Currently it is deploying the new SS-27 (Topol-M) inter-continental ballistic missile and has recently been testing a new submarine-launched ballistic missile.

Since the end of the Cold War, **France** has scaled back its nuclear arsenal, with the withdrawal of four complete weapons systems, as well as a general reduction of its nuclear holdings. The French nuclear deterrent is now based on two systems: submarine-launched ballistic missiles and air-launched cruise missiles. A new French ballistic missile, the M51, is in development and recently has been flight tested. It will be carried on board a new class of four SSBNs, the last of which is due to come into service in 2010. France is also developing a new air-launched cruise missile for deployment on the Rafale aircraft around 2009. Total warhead numbers are around 350.

China is modernising its nuclear forces. Its strategic capability currently comprises a silo-based ICBM force of around 20 missiles. It also deploys a larger number of nuclear-armed intermediate and medium range ballistic missiles, all of which are believed to carry single warheads. New projects include mobile ICBMs, an ICBM equipped with multiple warheads, a submarine-launched

strategic ballistic missile and, potentially nuclear-capable, cruise missiles.

Other States

India conducted its first nuclear test in 1974 and in 1998 both India and **Pakistan** conducted tests. They are now capable of delivering nuclear weapons by fixed-wing aircraft and land-based ballistic missiles. Development work on warheads and delivery systems continues in both countries. Both countries are working on cruise missiles and India is developing a submarine-launched ballistic missile capability, which could eventually be nuclear-armed.

North Korea attempted a nuclear test in October 2006 and is assessed to have enough fissile material for a small number of nuclear weapons. North Korea has short and medium range ballistic missiles in service and, with the launch of the Taepo Dong-1 as a satellite launch vehicle in August 1998, demonstrated some of the key technologies required for long range multi-stage missiles. The much larger Taepo Dong-2, which could be configured either as a satellite launch vehicle or as a ballistic missile, was launched in July 2006 but suffered an early in-flight failure. If developed successfully, the Taepo Dong-2 would have the capability to reach Europe.

Israel is not a signatory of the NPT and is believed to have a nuclear weapons capability. Israel possesses short and intermediate range missiles which are believed to be capable of delivering nuclear warheads.

Section 3: Nuclear Deterrence in the 21st Century

3-1. Section 2 concluded that, despite our best efforts, the conditions have not yet been met to enable the UK to give up its nuclear deterrent. This section sets out in more detail the reasons for retaining a deterrent.

The Original Rationale for the UK's Nuclear Deterrent

3-2. During the Cold War, the UK's nuclear deterrent was intended to address on the threat to the UK's vital interests from the Soviet Union. NATO did not possess sufficient conventional military forces to be confident of defeating an attack by the Warsaw Pact, and there were significant concerns that the Soviet Union might have considered that the potential advantages of a conventional and chemical attack on Western Europe outweighed the military risks. Furthermore, this threat from the Warsaw Pact was backed up by a large arsenal of nuclear weapons, against which conventional military forces could not have hoped to prevail. Since then, successive governments have felt it important to retain an independent deterrent as an essential contribution to our security.

The UK Approach to Nuclear Deterrence

3-3. The fundamental principles relevant to nuclear deterrence have not changed since the end of the Cold War, and are unlikely to change in future. In terms of their destructive power, nuclear weapons pose a uniquely terrible threat and consequently have a capability to deter acts of aggression that is of a completely different scale to any other form of deterrence. Nuclear weapons remain a necessary element of the capability we need to deter threats from others possessing nuclear weapons.

3-4. Five enduring principles underpin the UK's approach to nuclear deterrence:

- *our focus is on preventing nuclear attack*. The UK's nuclear weapons are not designed for military use during conflict but instead to deter and prevent nuclear blackmail and acts of aggression against our vital interests that cannot be countered by other means.

- *the UK will retain only the minimum amount of destructive power required to achieve our deterrence objectives*. Since 1997, the Government has made a series of reductions in the scale and readiness of our nuclear forces in line with changes in the global security environment. We are now taking further measures to reduce the scale of our deterrent. We are reducing the number of operationally available warheads from fewer than 200 to fewer than 160, and making a corresponding reduction in the size of our overall stockpile.

- *we deliberately maintain ambiguity about precisely when, how and at what scale we would contemplate use of our nuclear deterrent*. We will not simplify the calculations of a potential aggressor by defining more precisely the circumstances in which we might consider the use of our nuclear capabilities. Hence, we will not rule in or out the first use of nuclear weapons.

- *the UK's nuclear deterrent supports collective security through NATO for the Euro-Atlantic area*. Nuclear deterrence plays an important part in NATO's overall defensive strategy, and the UK's nuclear forces make a substantial contribution.

- *an independent centre of nuclear decision-making enhances the overall deterrent effect of allied nuclear forces*. Potential adversaries could gamble that the US or France might not put themselves at risk of a nuclear attack in order to deter an attack on the UK or our allies. Our retention of an independent centre of nuclear decision-making makes clear to any adversary that the costs of an attack on UK vital interests will outweigh any benefits. Separately controlled but mutually supporting nuclear forces therefore create an enhanced overall deterrent effect.

Insuring against an Uncertain Future

3-5. It is a key responsibility of government to be sure that the UK is properly protected should the future turn out to be less secure than we hope. There are limits to the extent to which intelligence can inform us about medium to long-term changes in the nuclear capabilities of others, or give prior warning of a possible change in intent by an existing nuclear weapon State. We must therefore be realistic about our ability precisely to predict the nature of any future threats to our vital interests over the extended timescales associated with decisions about the renewal of our nuclear deterrent.

3-6. Our assessment of the potential security environment between 2020 and 2050, the period relevant to the decisions set out in this White Paper, highlights some trends that give rise to significant causes for concern. In spite of the successes of arms control activities in slowing the proliferation of nuclear weapons, the number of states with nuclear capabilities has continued to grow. We do not assume that this trend will endure and we will continue to do all we can to slow or reverse it. But we cannot discount the possibility that the number of states armed with nuclear weapons may have increased by 2050.

3-7 In addition, there are a range of other risks and challenges to future global stability. Weak and failing states will continue to offer safe havens for international terrorists and potentially create wider instability. Increasing pressure on key resources such as energy and water (which could be driven by a range of factors, potentially including population growth, increasing global economic development and climate change) may increase interstate tension. The rapid and uncontrollable development of militarily-relevant technology by the civil sector will make potential adversaries increasingly capable. These factors potentially could lead to increasing levels of international instability and risk of interstate conflict. We are concerned that, over the period from 2020 to 2050, this potential prospect, combined with possible further nuclear proliferation, could lead to an increased risk of conflict involving a nuclear-armed state.

3-8. Currently no state has both the intent to threaten our vital interests and the capability to do so with nuclear weapons. However, the fact that such a conjunction does not exist today is not a reliable guide to the future. The risks set out above raise the possibility that, at some stage in the future, nuclear capabilities and hostile intent will become dangerously aligned. We can foresee nuclear risks in three specific areas:

Re-emergence of a Major Nuclear Threat

3-9. There are risks that, over the next 20 to 50 years, a major direct nuclear threat to the UK or our NATO Allies might re-emerge. A state's intent in relation to the use or threat of use of existing capabilities could change relatively quickly: for example, there was little prior warning of the collapse of the Soviet Union. We will continue to work actively with all our friends and partners to enhance mutual trust and security, but we cannot rule out, over the 2020-2050 timescale, a major shift in the international security situation which puts us under threat.

Emerging Nuclear States

3-10. Over the next 20 to 50 years, one or more states could also emerge that possess a more limited nuclear capability, but one that poses a grave threat to our vital interests. We must not allow such states to threaten our national security or to deter us and the international community from taking the action required to maintain regional and global security. The UK's continued possession of a nuclear deterrent provides an assurance that we cannot be subjected in future to nuclear blackmail or a level of threat which would put at risk our vital interests or fundamentally constrain our foreign and security policy options.

State-Sponsored Terrorism

3-11. We know that international terrorists are trying to acquire radiological weapons. In future, there are risks that they may try to aquire nuclear weapons. While our nuclear deterrent is not designed to deter non-state actors, it should influence the decision-making of any state that might consider transferring nuclear weapons or nuclear technology to terrorists. We make no distinction between the means by which a state might choose to deliver a nuclear warhead, whether, for example, by missile or sponsored terrorists. Any state that we can hold responsible for assisting a nuclear attack on our vital interests can expect that this would lead to a proportionate response.

3-12. A key element of our ability to exercise effective deterrence in such circumstances is our capability precisely to determine the source of material employed in any nuclear device. We will retain and strengthen the world-leading forensic capability at the Atomic Weapons Establishment, Aldermaston in this area. We will also continue to work to strengthen international expertise in this field.

Conclusions

3-13. In view of the continued existence of large nuclear arsenals, the possibility of further proliferation of nuclear weapons in combination with the risk of increased international instability and tension, we believe that a nuclear deterrent is likely to remain an important element of our national security in the 2020s and beyond. We have therefore decided to make the minimum investment required to sustain this capability over that period. We judge that this continues to be a price worth paying.

Box 3-1: Responses to Counter-Arguments

A number of arguments have been made in recent years to the effect that the UK unilaterally should give up its nuclear deterrent. Some of these are set out below, along with the reasons that we do not accept them:

1. *The main threat to the UK is from terrorism, against which nuclear weapons are useless*. Nuclear weapons were designed to deter a specific range of threats. We still need to insure against those threats, even though new threats such as terrorism have emerged. The UK has an intensive strategy for managing the risks from terrorism and we maintain a range of capabilities to deal with them. As noted in Section 3, we believe that retention of an effective nuclear deterrent by the UK has a role to play in reducing the potential threat from state-sponsored nuclear-armed terrorists.

2. *It is hypocritical for the UK to maintain its deterrent while arguing that countries such as Iran and North Korea cannot develop one*. The NPT recognised the UK, the US, France, Russia and China as nuclear weapon States and established other signatories as non-nuclear weapon States. We have an excellent track record in meeting our NPT obligations. Iran and North Korea signed the NPT, so pursuit of nuclear weapons programmes is in breach of the Treaty.

3. *If the UK unilaterally gave up its nuclear deterrent, this would encourage others to follow suit*. There is no evidence or likelihood that others would follow the UK down a unilateralist route. There would need to be compelling evidence that a nuclear threat to the UK's vital interests would not re-emerge in future before we could responsibly contemplate such a move. It would be highly imprudent to mortgage our long term national security against any such assumptions.

4. *The money required to maintain a nuclear deterrent should instead be invested in our conventional capabilities*. Nuclear weapons remain a necessary element of the capability we need to deter threats from others possessing nuclear weapons. Conventional forces cannot deliver the same deterrent effect. Since 1997, the Government has made significant additional resources available to Defence, providing many new capabilities to enable us to undertake those military tasks that cannot be achieved by nuclear deterrence. The investment required to maintain our deterrent will not come at the expense of the conventional capabilities our armed forces need.

5. *The UK retains nuclear weapons because of the international status that this might bring, in particular the UK's permanent seat on the United Nations Security Council*. We maintain our nuclear forces as a means of deterring acts of aggression against our vital interests and not for reasons of status.

6. *The UK does not require a nuclear deterrent as we are already protected by the US nuclear deterrent*. A potential adversary

might miscalculate the degree of US commitment to the defence and security of Europe. An independent deterrent provides the assurance that it can be used to deter attacks on our vital interests. An independent centre of nuclear decision-making in the UK also reinforces the overall deterrent effect of allied nuclear forces and thus enhances our security and that of NATO allies.

7. *Replacing Trident is illegal.* Maintaining a minimum nuclear deterrent is fully consistent with all our international legal obligations, including those under the NPT (as set out in paragraphs 2-9 to 2-11).

8. *Ballistic missile defence could take the place of the UK's nuclear deterrent.* Ballistic missile defences are only designed to be able to defend against limited missile attacks. They do not, on their own, provide a complete defence against the full range of risks set out in this White Paper. They should be regarded as complementary to other forms of defence or response, potentially reinforcing nuclear deterrence rather than superseding it.

9. *All the UK needs is a dormant nuclear weapons capability, from which we could re-establish a deterrent if and when specific threats emerge.* Any UK decision to give up an active credible nuclear deterrent system would, for political and cost reasons, be extremely difficult to reverse. In practice, the timeframe for re-establishing a credible minimum deterrent would probably be longer than the likely warning of any change in intent of an established nuclear power or any covert programme elsewhere to develop nuclear weapons. Also, any move from a dormant programme towards an active one could be seen as escalatory, and thus potentially destabilising, in a crisis.

Section 4: Ensuring Effective Deterrence

4-1. If they are to have the required deterrent effect, our nuclear forces need to continue to be credible against the range of risks and threats described in Section 3. This section describes the key characteristics that are necessary to establish this credibility.

Invulnerability and Readiness

4-2. A deterrent system must be able to function irrespective of any pre-emptive action that might be taken by a potential aggressor. Also, it is important for safety and security reasons that our nuclear forces are protected properly at all times against actions ranging from a full scale strategic nuclear strike to a terrorist attack. There are a number of ways in which this might be achieved: by making the system invulnerable to attack; by having a sufficiently large capability that even a full scale attack would not prevent the launch of an effective counter strike; by making the system difficult to target, most obviously by making it undetectable; and by holding the system continuously at a sufficiently high level of readiness that it could be launched before any pre-emptive strike takes effect.

4-3. Our preference is for an invulnerable and undetectable system, which allows us to maintain it at a minimum level of scale and readiness, but we believe that it should also be capable of being held at high readiness for extended periods of time. It should be possible, both overtly and covertly, to increase or decrease its readiness thereby giving the Government maximum flexibility in terms of setting and adjusting our nuclear deterrent posture: this is especially important during a crisis.

Range

4-4. There is increasing uncertainty about the nature of future risks and challenges to UK security. Whereas during the Cold War the likely source of threats was well established, the position is more uncertain now and may be even less clear by the 2020s. Therefore we believe that our nuclear deterrent should retain our existing capability to deter threats anywhere in the world.

4-5. Closely linked to the range of our nuclear capability is the question of whether we should plan on simultaneously or near simultaneously having to deter more than one threat against our vital interests. While it is theoretically possible to envisage some eventualities where this question might arise, we do not believe that this factor should determine either the nature or scale of our deterrent system.

Independence

4-6. The UK's nuclear forces must remain fully operationally independent if they are to be a credible deterrent. It is essential that we have the necessary degree of assurance

that we can employ our deterrent to defend our vital interests. The UK's current nuclear deterrent is fully operationally independent of the US:

- decision-making and use of the system remains entirely sovereign to the UK;
- only the Prime Minister can authorise the use of the UK's nuclear deterrent, even if the missiles are to be fired as part of a NATO response;
- the instruction to fire would be transmitted to the submarine using only UK codes and UK equipment;
- all the command and control procedures are fully independent; and
- the Vanguard-class submarines can operate readily without the Global Positioning by Satellite (GPS) system and the Trident D5 missile does not use GPS at all: it has an inertial guidance system. There is nothing in the planned Trident D5 life extension programme that will change this position.

4-7. We continue to believe that the costs of developing a nuclear deterrent relying solely on UK sources outweigh the benefits. We do not see a good case for making what would be a substantial additional investment in our nuclear deterrent purely to insure against a, highly unlikely, deep and enduring breakdown in relations with the US. We therefore believe that it makes sense to continue to procure elements of the system from the US.

4-8. The US has never sought to exploit our procurement relationship in this area as a means to influence UK foreign policy nor does this relationship compromise the operational independence of our nuclear deterrent.

Scale

4-9. We need to make a judgement on the minimum destructive capability necessary to provide an effective deterrent posture. This judgement requires an assessment of the decision-making processes of future potential aggressors, and an analysis of the effectiveness of the defensive measures that they might employ. Retaining some degree of uncertainty over the nature and scale of our response to any particular set of circumstances is an important part of our overall deterrence posture. However, we believe that our existing capability to deploy up to 48 warheads on the submarine on deterrent patrol is sufficient. As with our current deterrent, the ability to vary the numbers of missiles and warheads which might be employed, coupled with the continued availability of a lower yield from our warhead, can make our nuclear forces a more credible deterrent against smaller nuclear threats.

Section 5: Deterrent Options, Solutions and Costs

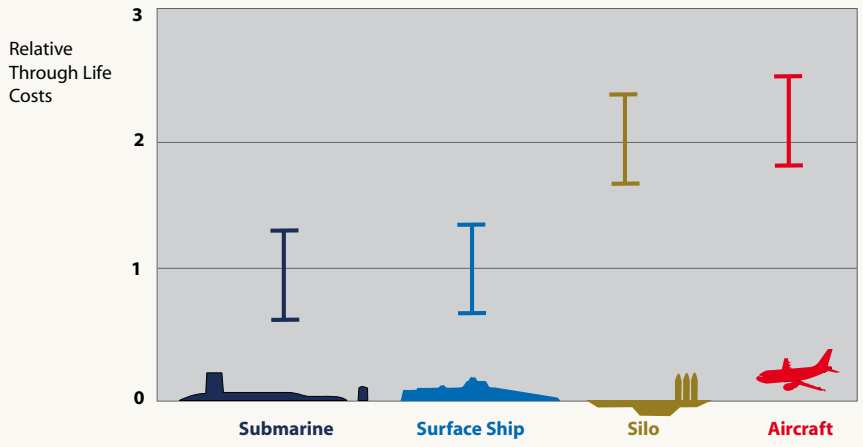
5-1. The previous two sections have described why we wish to retain a nuclear deterrent, and the key attributes we believe that it should continue to have. This section sets out the various options that we have considered and the extent to which each option meets our requirements. It also sets out our proposed solution and how much this will cost.

The Options

5-2. Four generic options were subjected to detailed assessment and comparative costing: a large aircraft equipped with cruise missiles; silo-based ballistic missiles; and both surface and sub-surface maritime platforms equipped with ballistic missiles. Table 5-1 shows their relative through-life costs.

5-3. The process by which these options were identified, and the details of our assessment of them, is set out in Annex B. We rejected the large aircraft option primarily because of vulnerability to pre-emptive attacks and because of the costs involved in procuring new large aircraft and the supporting refuelling tankers, providing new infrastructure, and designing and procuring a new cruise missile. Silo-based systems in the UK could be a credible deterrent only against states with a limited nuclear capability, and even then there would be significant additional costs compared to a submarine-based system capable of

Deterrent Options Costs **Table 5-1**



deterring all credible threats. A deterrent based on surface ships would be less capable, more vulnerable and no less expensive than a submarine-based solution.

5-4. We considered the relative merits of deploying cruise or ballistic missiles on a submarine. Any programme to develop and manufacture a new cruise missile would cost far more than retaining the Trident D5 missile. In capability terms, cruise missiles are much less effective than a ballistic missile (see Box 5-1). Therefore it was clear that, in terms of both cost and capability, retaining the Trident D5 missile is by far the best approach.

Next Steps

5-5. We have decided to maintain our existing nuclear deterrent capability by replacing the Vanguard-class submarines with a new class of submarines and we plan shortly to commence detailed concept work. We believe this programme will be sufficiently mature for us to place a contract for their detailed design by around 2012 to 2014.

5-6. We have started to consider some of the fundamental design issues. We believe that the new submarines will need to be nuclear powered, as conventional propulsion systems cannot currently generate sufficient power and endurance to meet our requirements. We envisage that the design of the new SSBNs will maximise the degree of commonality with other in-service submarines where this can be done in a cost-effective manner. The scope for this will be determined during the next phase of work. However, some changes to the design of the Vanguard-class will be required, to take account of equipment obsolescence, the need to continue to meet modern safety standards and to maximise the scope to make the new SSBNs

Box 5-1: Comparison of Cruise and Ballistic Missiles

Tomahawk Land Attack Missile

Ballistic missiles, such as the Trident D5 missile, have a number of design advantages over cruise missiles:

Payload: Ballistic missiles can carry multiple warheads, compared to the single warhead that can be carried by a cruise missile.

Range: Ballistic missiles have a range typically up to around 12,000 kilometres, compared to a maximum of 2,000 to 3,000 kilometres for a cruise missile.

Speed: Ballistic missiles can travel at speeds in excess of ten times the speed of sound whilst cruise missiles are currently sub-sonic.

Vulnerability: Compared to ballistic missiles, cruise missiles are more prone to interception, largely because of their slower speed and lower trajectory. Ballistic missile defences are being developed by a number of countries, but we believe that it is highly unlikely that the effectiveness of the UK Trident D5 missile force will be jeopardized, even over the planned extended in-service life of that missile. A less vulnerable delivery system also enables us to maintain a lower stockpile of warheads.

capable of adapting to any changes in our requirements and to any new technological developments.

5-7. A critical feature of the credibility of a deterrent is its invulnerability to pre-emptive action. At present, we achieve this invulnerability by maintaining a submarine permanently on patrol (see Box 5-2). That requires a fleet of four Vanguard-class submarines. At any one time, one of the Vanguard-class submarines is normally undergoing an extensive refit that takes it out of the operational cycle for around four years. Three submarines normally are required to be operationally available in order to sustain continuous deterrent patrols, although continuous deterrence can be maintained for limited periods when only two are available.

5-8. We have reviewed once again the operational posture of our submarines and have confirmed that, for the foreseeable future, we should continue to retain a submarine continuously on deterrent patrol.

5-9. We are not yet in a position to make a firm judgement about how many submarines we require in future because we do not yet understand comprehensively the likely operational availability of the replacement SSBNs. We will investigate fully whether there is scope to make sufficiently radical changes to the design of the new SSBNs, and their operating, manning, training and support arrangements, to enable us to maintain continuous deterrent patrols with a fleet of only three submarines. A final decision on the number of submarines that will be procured will be made when we know more about their detailed design.

5-10. We have decided to participate in the Trident D5 life extension programme, at a cost of some £250 million, which is very significantly less than it would cost to acquire an alternative delivery system. This will enable us to keep this missile in service until the early 2040s. We will continue to participate in the joint UK/US support arrangements for the D5 missile at the facilities at Kings Bay, Georgia. This arrangement represents excellent value for money. We anticipate that the first life-extended D5 missiles will enter service with the Royal Navy towards the end of the next decade.

Costs and Funding

5-11. The procurement costs involved in sustaining our independent deterrent capability will need to be refined as work on the concept and assessment phases is taken forward with industry. More accurate cost estimates will be available by the time we come to place a contract for the detailed design of the submarines in the period 2012 to 2014. Our initial estimate is that the procurement costs will be in the range of £15-20 billion (at 2006/07 prices) for a four-boat solution: some £11-14 billion for the submarines; £2-3 billion for the possible future refurbishment or replacement of the warhead; and £2-3 billion for infrastructure over the life of the submarines. There would be savings from a three-boat solution but these would not be in proportion to the reduction in the number of submarines. These costs will fall principally in the period 2012 to 2027. The comparable cost for the Trident system was some £14.5 billion at today's prices. These costs are also comparable to the procurement costs of major weapons systems such as Typhoon aircraft. Depending on future decisions, there could also be the cost of starting to replace the D5 missile from the 2030s. At this range, any estimate of cost would be highly speculative: the equivalent cost for the Trident D5 missile was some £1.5 billion at today's prices.

5-12. It is not possible to be sure what the size of the defence budget will be

over the timescales involved but the procurement costs are likely on average to be the equivalent of around 3% of the current defence budget over the main period of expenditure. This is around the same as for the Trident programme. In meeting our public spending commitments, the MOD continues to pursue a high level of efficiency savings

5-13. We will continue the programme of investment in sustaining capabilities at the Atomic Weapons Establishment (AWE), both to ensure we can maintain the existing warhead for as long as necessary and to enable us to develop a replacement warhead if that is required. Additional investment averaging £350 million per annum over the years 2005/06 to 2007/08 was announced last year. Further investment will be necessary, and early in the next decade the costs of AWE are likely – at their peak – to be the equivalent of about 3% of the current defence budget (compared to about 2.5% today).

5-14. Once the new fleet of SSBNs comes into service, we expect that the in-service costs of the UK's nuclear deterrent, which will include AWE's costs, will be similar to today (around 5-6% of the defence budget).

5-15. The investment required to maintain our deterrent will not come at the expense of the conventional capabilities our armed forces need. Decisions on the level of our investments in nuclear and conventional capability will be taken in the Comprehensive Spending Review, the results of which will be announced next year.

Box 5-2: SSBN Operations

The rationale for continuous deterrent patrolling (which the UK has maintained since 1969, and mirrors how the US and France operate their SSBNs) is that:

- the submarine on patrol is invulnerable to an attack. For example, we are confident that our SSBNs on deterrent patrol have remained completely undetected by a hostile or potentially hostile state. This means we have an assured nuclear deterrent available at all times;
- unlike any other nuclear weapon State recognised under the NPT, the UK has reduced to a single deterrent system: a single platform, delivery system and warhead design. If we ceased continuous deterrent patrols, a single deterrent force in a single location would be unacceptably vulnerable when a submarine was not on patrol;
- invulnerability and assuredness of capability are key components of the credibility of our deterrent, and also enable us to keep only a minimum deterrent. Greater vulnerability could necessitate increases in the scale of our nuclear deterrent;
- our deterrent's invulnerability and assuredness contribute to stability, as this removes any incentive pre-emptively to attack our nuclear forces;
- if we ceased continuous deterrent patrols, we could be deterred or prevented from deploying an SSBN in a crisis; and
- the Royal Navy has a clear and demanding operational target, which it has met since 1969. This is good for motivation and morale. If the requirement was for less than constant readiness, it would be harder to motivate the crews, and others who support the deterrent, on whom the effectiveness of the capability ultimately depends.

Section 6: Industrial Aspects

6.1 Designing and building new SSBNs, and integrating them with other elements of the overall system, will be a significant technical challenge for the Ministry of Defence and for industry. Nuclear powered submarines carrying ballistic missiles represent, in engineering terms, one of the most complex and technically demanding systems in existence.

HMS ASTUTE under construction at BAE Systems Submarines, Barrow-in-Furness (picture courtesy of BAE Systems)

6.2 In our Defence Industrial Strategy, published in December 2005, we explained that the UK's fleet of nuclear powered submarines requires a specialist subset of skills within the maritime industry. Over many years the UK has developed a high level of expertise in the design, manufacture and maintenance of nuclear powered submarines. The early stages of the programme to build the new Astute-class conventional role submarines were, however, difficult, in part due to less than optimal industrial and design arrangements, resulting in a submarine design that could not initially be built at planned cost. Lessons have been learnt from that programme. Nevertheless, more change is needed for industry to be able to deliver a new programme on time and at an acceptable cost. We believe that the imperative for change is well recognised.

6.3 It would be our intention to build the new SSBNs in the UK, for reasons of national sovereignty, nuclear regulation, operational effectiveness and safety, and maintenance of key skills. But this is dependent on proposals from industry that provide the right capability at the right time and offer value for money. For the reasons set out in the Defence Industrial Strategy, progress towards industrial consolidation and a sustainable industrial base, will be an important ingredient. Final decisions will be taken in the lead up to the placing of a contract for the detailed design of the submarines.

6.4 For the replacement SSBN programme we expect that there will be a much greater collaborative effort between the MOD and industry than has been the case in the recent past.

6.5 The current industrial structure limits the scope for system-level competition in the UK. Therefore a key to successful procurement in the UK would be to work closely with industry right down the supply chain to put in place sustainable collaborative arrangements that run through the life of the platform. This is important for driving down the whole-life costs of the programme. We will also seek to bear down on the costs by sourcing some sub-system elements from overseas in line with the policy set out in the Defence Industrial Strategy.

Safety and Regulation

6.6 Safety will be a key element of the design and operation of the replacement SSBNs. The operation of our nuclear-powered submarines is regulated by independent safety authorities within the MOD, whilst the Nuclear Installations Inspectorate license facilities for reactor construction and deep maintenance. A fundamental principle applied by those authorities is that successful safety risk management is founded in a proper understanding of nuclear technologies.

Disposal Policy

6.7 The disposal of the Vanguard-class submarines is still some way off, and it is therefore too early to estimate the possible decommissioning costs. When the Vanguard submarines leave naval service, they will be subject to a process known as Defuel, De-equip and Lay-up Preparation, which will involve spent nuclear fuel and other materials being removed for storage at Sellafield, and any remaining irradiated material being secured within the reactor compartment. In line with current practice for other submarines now leaving service, the submarines themselves with then be stored afloat at Devonport, pending final disposal. Afloat storage has proved to be a safe arrangement for over 20 years.

6.8 We are examining options for the disposal of defuelled nuclear powered submarines, including future storage of the resulting intermediate level radioactive material. This work is linked closely to the work of the Committee on Radioactive Waste Management, which has recently reported on the wider question of the storage of UK nuclear waste. We are also working with industry to ensure that any future nuclear submarine is designed to facilitate the safe decommissioning and storage of nuclear materials.

Section 7: Future Decisions

7-1. The plans set out in this White Paper will enable the UK to maintain an effective and operationally independent nuclear deterrent until the early 2040s, when the Trident D5 missile is due to be withdrawn from service. A number of additional decisions will need to be taken over the coming years: these are illustrated in Table 7-1.

Submarines

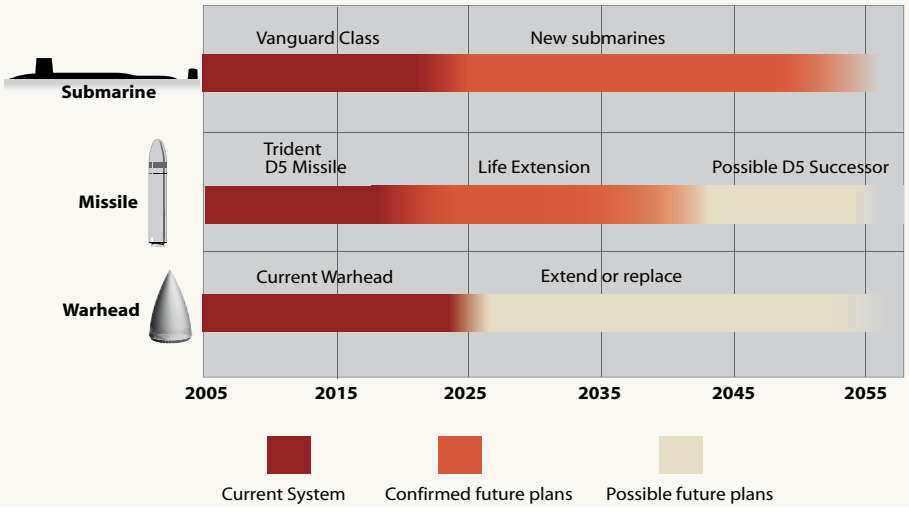
7-2. As described in Section 5 and 6, we need in future to take further decisions on the new class of SSBNs, including on their detailed design and on the number of submarines to be procured.

Warheads

7-3. The UK produced a new nuclear warhead to coincide with the introduction into service of the Trident system. This warhead was designed and manufactured in the UK by AWE, although it was decided that it would be more cost effective to procure certain non-nuclear components of the warhead from the United States.

7-4. The current warhead design is likely to last into the 2020s, although we do not yet have sufficient information to judge precisely how long we can retain it in-service. Decisions on whether and how

Future UK Deterrent Plans **Table 7-1**



we may need to refurbish or replace this warhead are likely to be necessary in the next Parliament. In order to inform these decisions, we will undertake a detailed review of the optimum life of the existing warhead stockpile and analyse the range of replacement options that might be available. This will include a number of activities to be undertaken with the United States under the 1958 UK-US Agreement for Cooperation on the Uses of Atomic Energy for Mutual Defence Purposes.

The Delivery System

7-5. We expect that the new class of SSBNs will have a design life of at least 25 years. On this basis, the new SSBNs would be unlikely to start going out of service until the 2050s, which will go beyond the planned life of the Trident D5 missile, even when its life is extended out to the early 2040s. Further investment will be necessary if we wish to sustain an effective nuclear delivery system throughout the life of the new submarines. Decisions on whether we wish to acquire a successor to the life extended D5 missile, and what form any successor might take, are unlikely to be necessary until the 2020s.

7-6. We have sought, and received, assurances from the US Government that, in the event they decide to develop a successor to the D5 missile, the UK will have the option of participating in such a programme. We have also received an assurance that any successor to the D5 should be compatible, or can be made compatible, with the launch system to be installed in our new SSBNs. These and other assurances will be set out in an exchange of letters between the Prime Minister and the President of the United States, the texts of which will be published.

7-7. These agreements will ensure that, if future UK Governments wish, they will have the option of retaining a nuclear deterrent capability throughout the lives of the new class of SSBNs.

Annex A: The UK's Non-Proliferation Efforts

International Atomic Energy Agency (IAEA): The UK is working closely with the IAEA to develop assurances of supply for nuclear fuel, which provide energy security without the need for proliferation of sensitive enrichment technology. Our latest "enrichment bond" proposal, involving advance consent for exports of low enriched uranium, has been very well received. We also continue to press for agreement to the IAEA's Additional Protocol to be made a condition of supply before a state can receive any sensitive nuclear technology. We have agreed an Additional Protocol to our Safeguards Agreements with the IAEA, and all UK enrichment and reprocessing facilities are now liable to international safeguards inspections.

Iran/IAEA: Since 2003, the UK, France and Germany have been leading international diplomatic efforts to convince Iran fully to co-operate with the IAEA over international concerns about its nuclear programme. Latterly, this has involved working closely with the US, Russia and China in the UN Security Council. This led, in July this year, to the adoption of UNSCR 1696.

Middle East WMD Free Zone: The UK continues to support the creation of an effective and verifiable chemical, biological, radiological and nuclear-free zone in the Middle East, in keeping with the resolution on the Middle East at the 1995 NPT Review and Extension Conference.

UNSCR 1540: The UK was one of the leading proponents of UN Security Council Resolution 1540, which established legally-binding obligations on all UN Member States to take steps to combat proliferation of weapons of mass destruction through national legislation, co-operative action, development of effective export controls and physical protection of WMD related materials. In September 2004, the UK was one of the first states to comply with the national implementation reporting requirements of UNSCR 1540.

Libya/AQ Khan: The UK played a key role in the process that led to Libya's announcement, in December 2003, that it would eliminate its chemical, biological and nuclear programmes and limit its missile projects. This process contributed to the discovery and dismantling of the proliferation activities being pursued by the AQ Khan network.

Proliferation Security Initiative (PSI): The UK has been involved actively in driving forward the PSI, which aims to prevent the acquisition and development of chemical, biological, radiological and nuclear weapons by states of concern and non-state actors, together with those who supply such programmes through trafficking in sensitive materials, equipment and technology.

Export Control Regimes: The UK is a leading and active member of the Nuclear Suppliers Group, the Australia Group, the

Missile Technology Control Regime and the Zangger Committee - arrangements which aim to minimise the risk of assisting Chemical, Biological, Radiological and Nuclear weapons and ballistic missile proliferation through more effective national level export licensing measures.

G8 Global Partnership Co-operative Threat Reduction: The UK has committed up to $750 million over ten years to this work and currently supports projects to help dismantle old Russian nuclear submarines, dispose of 34 tonnes of plutonium in Russia, destroy Russia's stocks of chemical weapons (a total of 40,000 tonnes) and create new employment for former Soviet weapons scientists. Such efforts prevent the materials used to make chemical, biological, radiological and nuclear weapons, and the weapons themselves, from falling into the wrong hands.

Global Initiative to Combat Nuclear Terrorism (GICNT): The UK is an Initial Partner Nation of the GICNT, unveiled by the Presidents of the United States and Russia in July this year. The initiative calls for co-operation in efforts directed at, among other things, improving control of nuclear materials, and detecting and suppressing illicit trafficking of such materials.

Norwegian 7 Country Initiative: The UK is an active member of the 7 Country Initiative, which aims to foster fresh thinking on how we can take forward the three pillars of the NPT – access to nuclear technology for exclusively peaceful purposes, non-proliferation and disarmament.

Chemical Weapons Convention (CWC)/Biological and Toxin Weapons Convention: We are working with the European Union to encourage and help all countries accede to both treaties and to implement fully their obligations. In the last 5 years over 20 additional countries have joined the CWC.

Annex B: Options Assessment Process

B-1. Before arriving at decisions, we undertook a thorough review of the widest possible range of options to replace the Vanguard-class submarines. We then used a detailed assessment process to narrow the range of options under consideration to four generic options: a large aircraft equipped with cruise missiles; silo-based ballistic missiles; and both surface and sub-surface maritime platforms equipped with ballistic missiles. Some flexibility was included within these options to enable trade-offs to be made between potential costs and capability. There was also scope to consider variants between the four options: for example, although cruise missiles were considered as part of the air-launched option, the analysis also enabled consideration of the possibility of delivering cruise missiles from a submarine or surface ship.

B-2. We discarded some of the other possible options for the following reasons. We rejected the possibilities of employing short- and medium-range aircraft operating from the UK or overseas, or short- or medium-range land-based missiles, on the grounds that these options lacked sufficient range. Even aircraft launched from aircraft-carriers would not meet our range criteria. Furthermore, these options would be vulnerable to pre-emptive attacks whilst on the ground or at sea, or to interception by air defence systems whilst in the air.

B-3. We rejected mobile land-based systems because of the serious concerns at the technological risks involved with developing such systems, given that no such capability is currently readily available from reliable sources. We also perceived major vulnerability and security difficulties in operating any such system within a relatively small and densely populated island such as the UK.

B-4. The only ballistic missile which we considered in any detail in the analysis was the Trident D5 missile. In capability terms, this missile meets all our likely future operational requirements. And the costs of retaining this missile in service out to the early 2040s are greatly exceeded by the potential costs and technical risks associated with any programme to acquire an alternative ballistic missile system. There would be some costs and risks associated with adapting the Trident D5 missile for use in a surface ship or silo because of the likely need for an extensive engineering and test programme. But adapting the Trident D5 missile would still be likely to represent, by some way, the most cost-effective delivery system for any UK silo- or surface ship-based deterrent.

The Four Generic Options

B-5 We undertook a cost and capability-based assessment of the four generic options against the basic requirements for our nuclear deterrent described in Section 4. The conclusions of this analysis are as follows:

Option 1: A long-range aircraft equipped with cruise missiles

Airbus A350

Platform:
- 20 large converted civil aircraft plus 20 refuelling aircraft
- Range (with refuelling) in excess of 20,000km
- Capacity to carry four large cruise missiles

Delivery system:
- Subsonic cruise missile (new development or off-the-shelf purchase)
- Range up to 3,000 km
- New nuclear warhead

Infrastructure and Support:
- Two large main operating bases (one new, one a modified existing base)
- New nuclear storage facilities and command and control system
- Extensive new training burden

Operational Posture:
- Impracticable to sustain continuous airborne deterrent patrols
- Aircraft normally retained at high alert on the ground

B-6 **Assessment:** The combination of a long-range aircraft armed with cruise missiles suffers from several major drawbacks. The whole system would be vulnerable particularly to pre-emptive attacks: whilst on the ground, to conventional and nuclear missile threats, and to terrorist attacks, and once airborne, to surface-to-air and air-to-air missiles. Similar concerns would also apply to the airborne refuelling tankers, which would be essential if the aircraft were to be able to meet the requirement to be able to deter threats anywhere in the world. Cruise missiles are also significantly more vulnerable to being intercepted than ballistic missiles because they fly at much lower speed and altitude.

B-7 Even with a fleet of 20 large aircraft, we would also face a major challenge in terms of guaranteeing a sufficient capability to establish an effective deterrence posture. Also we had concerns about meeting readiness requirements: measures to increase the readiness of aircraft on the ground would be visible and therefore potentially escalatory in a crisis.

B-8 Finally, in terms of costs, assuming a fleet of 20 aircraft, this option was the most expensive of the four generic options, with through-life costs more than double those of a submarine option, the main cost drivers being procurement of the new aircraft and delivery system and the extensive new infrastructure requirements. Overall, this was the most expensive and by some distance the least capable option.

Option 2: A large surface ship, equipped with Trident ballistic missiles

An artist's impression of a ballistic missile surface ship (picture courtesy of the US Department of Defense)

Platform:
- Three large conventionally-powered ships, each approximately 30,000 tonnes
- Additional air defence and anti-submarine warfare destroyers/frigates plus support from a conventional role submarine

Delivery System:
- Adapted Trident D5 missile

Infrastructure and Support:
- Minor modification and upgrading of existing infrastructure
- At least three additional Royal Fleet Auxiliary ships to provide at-sea support

Operational Posture:
- Continuous at sea deterrent patrols

B-9 **Assessment:** We concluded that the option of developing large surface ships able to launch ballistic missiles suffered from serious drawbacks, primarily relating to vulnerability and security. Compared to a submarine, a large surface ship is easier to detect and track, including from space-based systems, and also is rather easier to attack, whether from the air or by a submarine. Continuous at sea patrols probably could be sustained with a fleet of only three ships (compared to four for the Vanguard-class SSBNs), because of the more limited refit requirements and the ability to provide stores replenishment and crew rotation whilst deployed on deterrent patrol. But the requirement to procure and maintain three large new ships, as well as a significant number of other supporting assets makes this option at least as expensive as a submarine option. Overall, we concluded that this option would provide less capability with greater vulnerability, and at a broadly similar whole life cost, to a submarine option.

Option 3: A land-based (silo) system equipped with Trident ballistic missiles

Test firing a Minuteman III missile (picture courtesy of the US Department of Defense)

Platform:
- Two silo fields, each with 16 widely dispersed silos

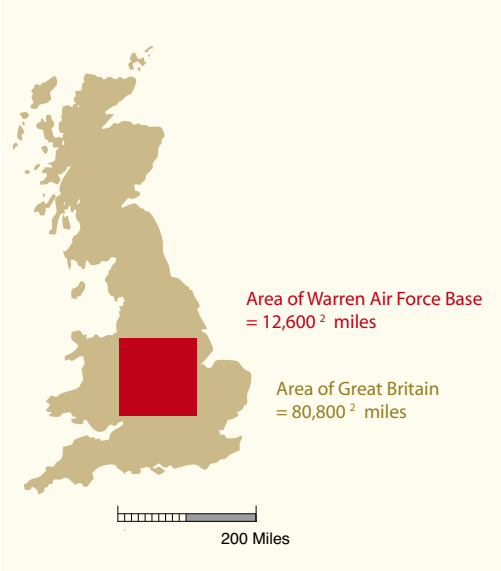
Delivery system:
- adapted Trident D5 missile

Infrastructure and Support:
- Acquisition of new land: each silo field covering several hundred square kilometres

- Construction of the silos plus associated command and control bunkers
- Hardened communications link to political decision-makers to enable very high readiness
- New infrastructure to transport the missiles from the manufacturer to the silos

Operational Posture:

- Continuous deterrent capability, with the ability to hold very high readiness levels for extended periods of time



The area of Frances E Warren Air Base superimposed on Great Britain

B-10 **Assessment:** Silo-based systems suffer from vulnerability to pre-emptive attacks in that they are immobile and impossible to conceal. Whilst it is possible to design and construct silos that have a large degree of self-protection, they remain vulnerable to a well-targeted nuclear strike. The US has overcome this difficulty by retaining land, sea and air-based deterrent systems and by dispersing a relatively large number of ground-based missiles over large areas, so that any one nuclear detonation cannot destroy more than one silo. For example, the 90th Space Wing at Frances E Warren Air Base in Wyoming, with a total of 150 silos, is dispersed across an area of 12,600 square miles, one and a half times the size of Wales. Such an approach is entirely impractical in the UK. Clustering silos together in a small area, for example within the existing boundaries of an RAF base in the UK, would leave them vulnerable to being destroyed by a single incoming nuclear-armed missile.

B-11 The option was considered of holding ground-based missiles at sufficiently high readiness to be launched before any incoming missile reached the target. However, this would not be an effective deterrent posture, as it is possible that there would only be a few minutes warning of a ballistic missile attack on the UK, leaving very little time to make decisions, and it would require an extremely expensive and complex command and control system to retain political control over the launch procedure in such circumstances. Holding our nuclear forces at such high readiness could be highly destabilising in a crisis.

B-12 Overall, this option presented some major practical difficulties, especially in terms of vulnerability, and the through life costs were around twice those for a submarine option.

Option 4: A submarine equipped with Trident ballistic missiles

HMS VANGUARD

Platform:
- A fleet of three or four new SSBNs

Delivery System:
- The Trident D5 missile

Infrastructure:
- Some modernisation of submarine infrastructure at Faslane and Coulport

Operational Posture:
- Continuous at sea deterrent patrols

B-13 **Assessment:** A submarine-based system meets all of our key requirements. The option of a conventionally-powered submarine was rejected because of the impracticality of developing a non-nuclear propulsion system that could generate the necessary power and endurance. Currently, once deployed, the submarine is by far the least vulnerable of the platform options considered. For example, we are confident that, since July 1968, when the first Polaris patrol took place, our SSBN on deterrent patrol has remained completely undetected by a hostile or potentially hostile state.

B-14 We have assessed carefully the potential for future developments in anti-submarine warfare to compromise this position. We believe it is unlikely there will be any radical technological breakthrough which might diminish materially the current advantages of the submarine over potential anti-submarine systems. Over the life of a new class of SSBNs, it is conceivable that unforeseen new technologies could emerge that could enhance the ability of a potential adversary to use air-, sea- or space-based systems to monitor submarine movements. However, even in this eventuality, provided we continue to invest in suitable research and development on effective counter-measures, we believe that it is likely to be possible to use a combination of new technology and new tactics to ensure that the risks to the SSBN on patrol remain manageable. In any event, we judge that a submarine will remain by far the least vulnerable of all the platform options considered.

A Russian Il-38 May Maritime Patrol Aircraft (picture courtesy of the US Department of Defense)

B-15 A submarine-based solution equipped with ballistic missiles also meets our other key requirements. It can be deployed covertly and achieve deterrent effect anywhere in the world. We can also change its readiness state either covertly or, if required as a demonstration of intent, overtly, for example by announcing the deployment of a second SSBN.

Conclusion

B-16 From a capability perspective, we concluded that a submarine-based system offers the most practical and effective means of meeting our future nuclear deterrence requirements. In terms of cost, maintaining a submarine-based deterrent has a significant advantage over the large aircraft and silo-based approaches and is broadly similar to the surface ship option.

Printed in the UK for The Stationery Office Limited
on behalf of the Controller of Her Majesty's Stationery Office
ID 5476717 11/06

Printed on Paper containing 75% fibre content minimum.