

Constructive Approaches to Limiting the Spread of Nuclear Weapons: Some Proposals for Government Action

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List of Abbreviations

ABM	Anti-Ballistic Missile Treaty
CTBT	Comprehensive Test Ban Treaty
CFE	Conventional Forces in Europe
CD	Conference on Disarmament
FMCT	Fissile Material Cut-off Treaty
HEU	Highly Enriched Uranium
IAEA	International Atomic Energy Agency
ICBM	Inter-continental Ballistic Missile
NPR	Nuclear Posture Review
NPT	Nuclear Non-proliferation Treaty
ORG	Oxford Research Group
RNEP	Robust Nuclear Earth Penetrator
START	Strategic Arms Reduction Treaty

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Executive Summary

The current US administration's suspicion of arms control and disarmament agreements has led to a downgrading of multilateral routes to arms control, in favour of unilateral and pre-emptive approaches. This attitude, coupled with recent international events, may have increased, rather than decreased, the motivations for nuclear proliferation and may propel non-nuclear states more rapidly towards creating a crude but usable nuclear device to function as both deterrent and bargaining chip. Moreover, the risk that terrorists will acquire nuclear explosives is probably increased by current nuclear policies. Further proliferation can only increase the risk that terrorists will acquire and possibly use nuclear explosives. This paper argues that the current US-led approach to non-proliferation is counter-productive, and that the best hope for nuclear non-proliferation lies in a return to, and strengthening of existing multilateral mechanisms.

The British government is in a particularly good, and possibly unique, position to exert international influence in this sphere; based in no small measure on its considerable track record of leadership and advocacy in the international disarmament arena. Based on the advice of key international non-proliferation experts drawn together for an intensive consultation in October 2003, we identify five specific areas in which the UK could take realistic steps to reduce the risk of further nuclear proliferation. These are:

- 1. Strengthen the International Atomic Energy Agency (IAEA) by a) significantly increasing the Agency's budget and b) making Additional Protocol to Nuclear Non-Proliferation Treaty (NPT) Safeguards Agreements mandatory**
- 2. Lead efforts to ban the production of fissile material for use in nuclear weapons**
- 3. Discourage the US from developing new 'usable' nuclear weapons, particularly 'bunker busters'**
- 4. Lead efforts to secure a provisional entry into force of the Comprehensive Test Ban Treaty (CTBT) to strengthen the current moratorium on nuclear testing and make it more difficult to break**
- 5. Advocate full compliance with the letter and spirit of the Non-Proliferation Treaty and the NPT 2000 Review Conference '13-steps' contained within the Final Document.**

In 2004 we see specific opportunities for the UK government to engage with:

- (a) the UN through the NPT discussions;**
- (b) the EU, particularly during last months of Ireland's presidency in the first half of 2004; and**
- (c) the G8, specifically during the June meeting in the USA.**

1. Motives For Acquiring Nuclear Weapons

Countries want nuclear weapons for a number of reasons. Some countries want them to solve **real or perceived security needs**.

Israel, for example, feared, with some reason, that some Arab countries wanted to destroy her when the country was born in 1948 and for some time afterwards. Israel was therefore intent on developing nuclear weapons, as a deterrent or as a weapon of last resort, and began to do so in the 1950s, deploying some in the 1973 war and continuing to be able to deploy them ever since. Likewise, India perceives threats to its security from China and Pakistan.

Prestige is another reason. The fact that all permanent members of the United Nations Security Council are nuclear-weapon powers is not lost on non-nuclear states. Nuclear weapons can give a state a dominant position in its region and boost its international profile. This was one factor in India's decision to undertake a series of nuclear weapon tests in 1998. Conversely, the risk of loss of prestige is a reason why countries with nuclear weapons, such as France and Britain, are not prepared to give them up.

Political leaders may want to develop, maintain or modernise a nuclear weapons capability for **internal political reasons** – to boost their domestic power or to deflect attention from social or economic problems. India may have acquired nuclear weapons partly for this last reason, partly to impress Pakistan, and partly to improve its security against China.

There may also be a **domino effect** in some regions. If one country acquires nuclear weapons, neighbouring countries may feel obliged to follow suit. Pakistan, for example, felt itself to be under great pressure to test nuclear weapons when India did so. And India felt under pressure to acquire a nuclear capability after China did.

If North Korea has fabricated nuclear weapons and if Iran has a nuclear-weapon programme, one of the reasons is the perceived threat from the USA. **Fears of attack or coercion**, heightened by America's attack on Iraq in 2003, had been reinforced by the 2001 US Nuclear Posture Review (NPR) that suggested that so-called "advanced concepts", such as low-yield and earth-penetrating weapons, described as "usable", should be explored to provide important advantages for enhancing America's military and deterrence posture. The NPR even listed countries that might be attacked with the new nuclear weapons in a pre-emptive strike. The list included Iran and North Korea.

There are also other reasons. For example, Iran and North Korea seek regional dominance and consider the acquisition of nuclear weapons as a way of achieving this. They also want to deter neighbours from attacking or coercing them.

2. The Transition to Counter-proliferation: Encouraging Nuclear Proliferation

The contrast between the policies of the first Bush administration, after the end of the Cold War in the early 1990s, and the second Bush administration from 2001, is one that demonstrates powerfully the move away from arms control and towards a vigorous pre-emptive counter-proliferation policy by the United States.

At the end of the Cold War, the first Bush administration accepted the need for further cuts in both tactical and strategic nuclear arsenals and pursued them with some success. The former were undertaken on a unilateral but reciprocated basis, with the withdrawal of several thousand warheads, and the latter was negotiated in conjunction with Russia. Perhaps most significant was the willingness of the first Bush administration to use the Strategic Arms Reduction Treaty (START) agreement and the NPT as a basis for securing the withdrawal of nuclear arms from Ukraine, Belarus and Kazakhstan, through the 1992 Lisbon Protocol, and their pledge to join the NPT and remain non-nuclear states.

That administration was certainly not in the business of wholesale nuclear disarmament, and studies conducted by the Pentagon at that time, such as the Reed Report, actively promoted new uses for nuclear weapons in relation to states such as China and Iran. However, the administration did oversee substantial cutbacks in overall nuclear forces and remained reasonably committed to the arms control process.

The contrast with the post-2000 world is very strong. The second Bush administration has proved to be deeply suspicious of arms control and disarmament agreements, and has moved steadily towards adopting a policy of pre-emption of threats stemming from the proliferation of nuclear, chemical and biological weapons.

Even prior to the 2000 election, Republican opinion in Congress was such that it was impossible to obtain ratification of the CTBT, and there was opposition to the Anti-Ballistic Missile Treaty (ABM) and to aspects of negotiations on anti-personnel landmines and the traffic in light weapons. After the election, the incoming Bush administration went much further, not least with the appointment of senior officials to the National Security Council, the State Department and the Department of Defense who were deeply suspicious of arms control and the multilateral route.

There have, in the past 30 months, been a series of moves consolidating the changed policy that have included withdrawal from the Anti-Ballistic Missile Treaty, abandoning efforts to ratify START II, and opposition to proposals for the control of the weaponisation of space. Perhaps most significant has been the opposition to the protocol developed after extensive negotiations to strengthen the 1972 Biological and Toxin Weapons Convention, leading to the effective abandonment of a potentially important agreement.

The downgrading of the multilateral route to arms control and disarmament has been accompanied by a much more robust policy of counter-proliferation. This includes a strong focus on the requirement, where necessary, to pre-empt the acquisition of weapons of mass destruction by states considered potential threats to the United States, its allies and its interests. This was most clearly expressed early in 2002, especially in the State of the Union Address and President Bush's West Point speech, and includes the designation of an 'axis of evil' comprising Iraq, Iran and North Korea as primary components, with Syria, Libya and Cuba as adjuncts.

In the first major example of pre-emption, the Saddam Hussein regime in Iraq was removed in 2003, although it is has subsequently proved impossible to find the large quantities of chemical and biological weapons that were the stated motivation for the war.

Current US counter-proliferation policy involves a range of instruments for control, some of them bilateral and some still multilateral, but it forms part of a wider security policy that is rooted in the need for “full spectrum dominance” based on an effective global military capability. This includes the development of national and theatre missile defences, the maintenance of existing nuclear arsenals, and the planned development of new nuclear weapons that are particularly suitable for small-scale use in a counter-proliferation context.

This robust security paradigm is, to an extent, shared by some allies such as the UK, but is regarded with some suspicion by others, not least the Germans and the French, although France also maintains and enhances its own nuclear forces.

In the wider world, US security policy is viewed with much concern, and is seen by many opinion formers as part of a wider intention to foster a ‘New American Century’ based more on military force than international law, determined to preserve US dominance and resist the rise of peer competitors, and administered by the United States and a coalition of willing allies.

These policies have led to an increase in anti-American attitudes across much of the world, but in the current context it is the attitude of potential proliferators that is more significant.

Two elements are relevant here, and both have much to do with perception:

1. Discrimination

The first is that the United States is seen to have a highly selective approach to the control of proliferation. Israel, for example, is

singled out as a country that has not faced any US opposition in developing a formidable arsenal of nuclear and thermonuclear weapons.

Furthermore, both India and Pakistan appear free to develop their nuclear forces. There may have been previous US disapproval, but this is now thoroughly muted as both countries become important players in President Bush's ‘war on terror’. These three examples contrast with the policies of the Bush administration towards the ‘axis of evil’ and lead to the conclusion that US counter-proliferation policy is highly selective.

2. Perverse Incentives

The second element is that the Iraq War and Afghanistan are seen to give notice to other ‘rogue states’ that the United States is clearly willing to use force, but the effect of this may now be to encourage certain of these states to develop a crude but usable deterrent as soon as possible.

Iran is also significant here, in that the US perception is clearly of a substantial long-term threat from Iran, a perception shared and encouraged by Israel. From Tehran's perspective, though, it has long considered the US a threat to its potential dominance of the Gulf region and it now faces US bases being established in Afghanistan to the East and Iraq to the West. These are in addition to an existing US presence in Kuwait, Bahrain, Oman and Qatar and an overwhelming US naval dominance by the Fifth Fleet in the Persian Gulf, the Arabian Sea and the Indian Ocean. It thus sees itself as largely surrounded by a superpower that has characterised it as part of an ‘axis of evil’, and has in the past supported the Shah's rule to the extent of fostering the destruction of a previous regime in the early 1950s. On the basis of such a world-view, the policy of the Iranian government should be expected to be one of clandestine development of a minimal deterrent.

Perhaps most surprising is the apparent consideration, by Saudi Arabia, of the possible acquisition of a deterrent system, given the recently strained military relations with Washington. In part, this stems from the recognition of the extraordinary power of the United States, not least in conjunction with Israel, but it still represents an unexpected complication for US counter-proliferation policy.

The United States has developed a more forceful and vigorous policy of counter-proliferation that extends to the pre-emption of potential threats, a policy that has already been implemented in Iraq. It is a policy that does not find full favour with some of its allies but, more significantly, may already be proving to be counterproductive.

3. What the British Government could do to Limit the Spread of Nuclear Weapons.

Introduction

The US Government's strategy to deal with nuclear proliferation is a central part of the 'war on terror'. The strategy, outlined in recent official documents, involves a largely unilateral approach using coercion and force as primary tools, at the expense of multilateral cooperative non-proliferation mechanisms, however imperfect they may be.

Many argue that Washington's strategy is counter-productive because such an approach makes the acquisition of nuclear weapons an increasingly attractive option to those who feel threatened by the US. An attack by the US is, it is argued, unlikely against a country with its own nuclear weapons.

This report argues that the current US strategy of pre-emptive action to counter the spread of nuclear weapons will lead to widespread instability and the further proliferation of nuclear weapons. While recognising the limits of current cooperative non-proliferation mechanisms for dealing with nuclear proliferation, and acknowledges that these mechanisms need to be strengthened. However, Oxford Research Group (ORG) considers an approach based on universal multilateral cooperative security mechanisms to be by far the most effective method of reducing the threat from nuclear weapons.

In October 2003, ORG organised and facilitated a two-day residential off-the-record consultation at Charney Manor, near Oxford, to develop a set of non-military and politically realistic proposals to reduce the risk of further nuclear proliferation. Fourteen specialists on nuclear proliferation, experienced diplomats and senior former or serving UK and US government officials, as well as knowledgeable individuals from other disciplines, came together for a fresh and critical look at current multilateral and unilateral efforts to deal with nuclear proliferation. The delegates explored where there might be room for manoeuvre on new initiatives, which existing proposals need to be reinforced and how that might be achieved and where the major blockages to further progress currently lie.

The following recommendations on what the British government could realistically do to reduce the risk of further nuclear proliferation emerged from the discussions. The recommendations were not reached by consensus and ORG takes sole responsibility for the following presentation of the outcome of the consultation.

- 1. Britain could encourage the US not to develop new, low-yield, 'usable' nuclear weapons, particularly the development**

of nuclear weapons designed to attack targets deep underground (so-called ‘bunker busters’) because of the destabilising effect such developments will have on the NPT and policies of current and potential nuclear weapon states.

2. Britain could strengthen efforts to negotiate a Fissile Material Cut-off Treaty (FMCT), to ban the production of fissile material for use in nuclear weapons. The UK government should in particular encourage Washington to initiate the negotiation of an FMCT.
3. Britain should encourage measures to strengthen the IAEA, particularly by increasing the Agency’s budget and by making Additional Protocols to the Safeguards Agreements, entered into by parties to the NPT and the IAEA, mandatory.
4. Britain could take the lead in securing a provisional entry into force of the CTBT. This would strengthen the current moratorium on nuclear testing and make it more difficult for any state to undertake or resume tests.
5. Britain could take a much a stronger position on advocacy of the 13-steps agreed at the 2000 Review Conference of the NPT. The UK, as an established nuclear weapon state, could define how it has adhered to the NPT, encourage adherence to the 13-steps that remain applicable and encourage other nuclear weapon states to work towards the implementation of the 13-steps.

Each of these recommendations is discussed below in detail.

Recommendation 1:

Preventing the Development of Low-Yield or Earth-Penetrating Nuclear Weapons, a.k.a ‘Mini-Nukes’ and ‘Bunker Busters’

Those who believed that the nuclear arms race would end with the Cold War are increasingly

disturbed by the arguments of some politicians, military officers, defence bureaucrats and senior scientists in America’s nuclear weapon laboratories that the US should develop and deploy a new generation of low-yield nuclear weapons as well as higher-yield ‘bunker busters’ that can be delivered with great precision on hardened and deeply-buried targets. These ‘mini-nukes’, with less than a 5 kiloton (kt) yield, and the Robust Nuclear Earth Penetrator, with a considerably higher yield, would be designed for use in conflicts with Third World countries or for attacks on terrorist groups, particularly ones armed with chemical or biological weapons and operating out of hardened, underground facilities, rather than for deterring warfare with another nuclear power.

Because low-yield nuclear weapons blur the distinction between modern precision-guided conventional weapons and nuclear ones, critics have argued that the deployment of these ‘mini-nukes’ would increase the probability that nuclear weapons would be used.

For this reason, the US Congress in 1994 passed a law prohibiting the US nuclear-weapon laboratories from undertaking research and development that could lead to a new nuclear weapon of less than 5 kilotons (5 kt). A decade later, this law has been repealed by the 2004 Defense Authorization Act and the same bill provided funds for research on a new, higher yield “bunker buster” nuclear bomb.

The 2001 US Nuclear Policy Review (NPR) that suggested that so-called ‘advanced concepts’, such as low-yield and earth-penetrating weapons, should be explored to provide “important advantages for enhancing the nation’s deterrence posture”, stimulated the discussion about low-yield nuclear weapons and more powerful bunker busters. A member of the National Security Agency testified that a ‘Robust Nuclear Earth Penetrator’ (RNEP) would be the first element of the advanced concepts programme. In support of the programme to develop the new

weapons the NPR called upon the US Department of Energy to revitalise the entire nuclear production and testing infrastructure and accelerate plans to build a Modern Pit Facility to produce cores for up to 900 nuclear weapons a year (money for this project was also included in the 2004 US defense budget).

Advocates of mini-nukes and RNEPs suggest that they would significantly reduce collateral damage when used to attack hardened, deeply buried targets, compared to the use of a higher yield nuclear weapon exploded on the surface. This presumably makes their use easier to contemplate. But critics point out that no earth-penetrating weapon could penetrate deep enough into the earth to contain its blast and would ventilate, injecting into the atmosphere a cloud of radioactive material. Nuclear-weapon scientists at the Nevada Test Site have discovered that a nuclear weapon with a yield of as little as that equivalent to 100 tonnes of TNT (0.1 kt or 0.8 per cent of the yield of the nuclear weapon that destroyed Hiroshima) would have to penetrate to a depth of about 57 metres to be confident that its blast effects would be contained and would not release into the atmosphere significant amounts of radiation. Other experts put the depth at 70 metres. This does not take into account that, as the weapon penetrated the earth, the weapon would bore out and leave behind a chimney through which radioactive fallout and debris would escape into the atmosphere.

The result would inevitably be a large crater and a cloud of radioactive fallout that would shoot out like a fountain and seriously contaminate a large area surrounding ground zero with deadly radioactivity. About 50 percent of the total radioactivity produced in the explosion would be spread far and wide as local fallout that would cause substantial collateral damage to civilians. The remainder would be confined to the highly radioactive crater.¹

¹ Robert W. Nelson, in a report done for the Federation of American Scientists, writes that “[i]n order to be fully contained, nuclear explosions at the Nevada Test Site must be buried at a depth of 650 feet for a 5-

The properties of a warhead that determine the depth to which it could penetrate include its shape, the hardness of its casing, its momentum on striking the surface, the type of ground (soft or hard) above the buried target, and its explosive yield. The earth-penetrating nuclear weapon in the current American arsenal is the B-61 modification 11 (B61-11), first deployed in 1997. The yield of the weapon can be varied between 0.3 and 300kt, although the 2001 US Nuclear Posture Review describes the B61-11 as a “single-yield, non-precision weapon”. Designed to penetrate to explode at a depth of 15 metres, tests showed that, dropped from an altitude of 12 kilometres, it could penetrate only between 2 and 3 metres of frozen tundra or 6 metres of dry soil.

Critics have argued that the US military does not need nuclear weapons to attack underground targets – and to be fair, the military itself has been consistently cool to the idea of battlefield nuclear use. It already has in its arsenal a number of conventional weapons capable of destroying hardened targets buried within about 15 metres of the surface and protected by concrete and hardened steel. In fact, the conventional GBU-37 guided bomb is probably capable of disabling a silo based ICBM (intercontinental ballistic missile) – a target formerly considered vulnerable only to nuclear attack.²

kiloton explosion – 1300 feet for a 100-kiloton explosion. Even then, there are many documented cases where carefully sealed shafts ruptured and released radioactivity to the local environment.”

² According to Lisbeth Gronlund and David Wright of the Union of Concerned Scientists, “the two largest conventional EPWs [Earth Penetrating Weapons] (called GBU-28 and GBU-37) use the same body but different guidance systems. The bodies are long tubes, a third of a meter (14.5 inches) in diameter and four meters (12.8 feet) long, that weigh over two tons and contain nearly 300 kilograms (630 pounds) of high explosive. Both are dropped from aircraft, and tests have shown they can penetrate six meters of concrete or 30 meters of earth. The GBU-28 is laser guided and the GBU-37 is guided by the Global Positioning System, which reportedly makes it more accurate than the GBU-28 and allows it to operate under all weather conditions. Very high accuracy increases the ability of these weapons to destroy shallow hardened targets with known locations (such as missile silos) but not deeply buried targets.”

Nevertheless, the US decided to produce the B61-11 by taking the nuclear explosive component from an earlier nuclear-weapon and package it in a new hardened bomb casing with a newly designed nose cone design to give the weapon a capability to penetrate the ground. Official US policy at the time was not to develop new types of nuclear weapons. However, the Department of Energy and the nuclear-weapon laboratories have argued that the B61-11 is merely a 'modification' of an existing delivery system, using an existing 'physics package' or nuclear explosive core.

The need to protect the electronics of the weapon while it burrows into the ground severely limits the impact velocities of the weapon to less than about three kilometres per second if the casing is made from the very hardest steels. The maximum penetration depth is roughly 10 times the length of the warhead – about 30 metres for a 3-4 metre long warhead like the GBU-37. To prevent serious damage to the warhead and its contents the impact velocity must, in practice, be much less than this and the penetration depth would be correspondingly less. Therefore it is simply not possible for a warhead relying on kinetic energy to penetrate deeply enough into the earth to contain a nuclear explosion and to prevent serious radioactive contamination of the surrounding area.

The most vocal proponents of the development of new types of low-yield and bunker buster weapons come from the American nuclear weapons laboratories, Los Alamos and Lawrence Livermore, from defence intellectuals and from hawks in the Bush Administration. The staffs at the laboratories have been chafing under the last decade's restrictions on their nuclear-weapon activities, and have been keen to generate a new mission, and the associated funding, to keep them in operation for the foreseeable future.

The nuclear weapons laboratories feel particularly threatened by the Comprehensive Nuclear Test Ban Treaty that essentially limits them to maintaining the stockpile of weapons already in the US arsenal. This mundane task is not very attractive to bright young scientists and they are slowly leaving for other jobs.

There is, therefore, much pressure to generate a new mission that requires a new weapon-development programme. It should, however, be emphasised that further research and development work is not needed to produce any new low-yield or 'bunker buster' nuclear weapons. Such a wide range of physics packages has already been developed that it would be possible to choose one to produce a nuclear weapon suitable for virtually any practicable purpose.

The US weapons laboratories argue that the development and deployment of a new earth-penetrating warhead capable of destroying a deeply buried and hardened bunker would require full-scale nuclear testing. The missile casing, the physics package and the electronics must all function, it is said, under extreme conditions. The weapon detonates and produces a reliable yield shortly after suffering an intense shock deceleration. But there must be great confidence that the actual nuclear yield is not significantly greater than predicted – a bow in the direction of those who somewhat deceptively claim the new weapons will reduce collateral damage. And there must be great confidence that the actual nuclear yield is not significantly less than predicted – a bow in the direction of those who claim that the new weapons will be capable of destroying deeply buried, hardened facilities. Very low yield weapons are sensitive to exacting design tolerances. All these factors, according to weapons laboratories, require that any new 'bunker buster' be tested.

These arguments are supported by defence intellectuals and those in the Bush administration who believe a credible nuclear

deterrent – one which blurs the line between conventional and nuclear weapons and that the US can reasonably threaten will be used – will keep rogues and terrorists at bay. (This outcome is, of course, extremely unlikely: new nuclear weapons are more likely to stimulate the acquisition of new chem/bio/nuclear weapons by rogues and terrorists.) The purveyors of the “credible nuclear deterrent” argument are thus strongly opposed to multilateral treaties, like the CTBT, that constrain America’s ability to pursue its own nuclear options. For some, simply to destroy these treaties is the real and only reason for the political support for mini-nukes and the Robust Nuclear Earth Penetrator. The strong practical, political, legal and moral barriers to actually using nuclear weapons to attack non-nuclear states or the actual need for any new types of nuclear weapon is not part of the argument.

One final, but critical point:

Resumed testing by the US would threaten the integrity of another key multi-lateral treaty, the NPT and probably accelerate its disintegration.

When the NPT was indefinitely extended in 1995, an outcome all the nuclear-weapons states in the Treaty strongly supported, many non-nuclear weapon states were sceptical about the commitment of the five NPT nuclear weapons states to diminish their arsenals and reliance on nuclear weapons. To seal the extension, the nuclear weapons states agreed to three undertakings:

- 1) a CTBT by 1996;
- 2) the early conclusion of an FMCT; and
- 3) systematic and progressive efforts globally to eliminate nuclear weapons.

None of these three undertakings have been fulfilled, in large part (but not entirely) because of the policies of the five nuclear weapons states. At the 2000 NPT Review Conference, similar promises were confirmed and/or reinforced, including the intention to attach a diminishing importance to the role of nuclear weapons.

If the US or any other nuclear weapons state were to resume testing in order to develop new weapons or refine older ones, it would be much clearer that the promises of both 1995 and 2000 have not been kept. The non-nuclear weapons states would get an unambiguous confirmation that the NPT extension in 1995 had been agreed to under false pretences. For many, this would be a definite sign that the nuclear weapons states did not intend to honour their commitments and that the NPT was unravelling.

Recommendation 2:

Getting an FMCT negotiated

One of the most difficult problems associated with nuclear non-proliferation and disarmament is how to effectively manage and control two of the world’s most dangerous materials: plutonium and highly enriched uranium (HEU). These ‘fissile materials’ are the explosive ingredients of nuclear weapons and their continued production and proliferation continues to pose a major threat to international security in the post-Cold War world.

A FMCT would ban any further production of fissile materials for use in nuclear weapons and nuclear explosives and is, therefore, a vital component of any coherent international nuclear non-proliferation strategy and an urgent next step towards nuclear disarmament.

It has been assumed for some time that the next negotiated nuclear arms control measure will be an FMCT and that the negotiations will take place in the Conference on Disarmament (CD) in Geneva. Yet FMCT negotiations within the CD have been in a state of deadlock for some time. However, a FMCT remains a priority, and its importance has only increased with current heightened concerns about weapons of mass destruction proliferation.

A FMCT would further tighten international controls on fissile material, raising the bar to nuclear weapons proliferation. It would contribute significantly to nuclear

disarmament objectives by capping the amount of fissile material available for weapons use, locking in nuclear disarmament gains. Confidence that there is no fresh production of fissile material for nuclear weapons would contribute to an environment conducive to further progress on nuclear disarmament. A FMCT would also be non-discriminatory, applying the same obligations to all signatory states.

A FMCT would confirm the moratorium on fissile material production already maintained by the US, UK, France and Russia, while extending the prohibition to include China, India, Pakistan and Israel. This would effectively cap the production of nuclear weapons. A mandate exists within the CD to start negotiations, but linkages to other issues have prevented this. A new draft work programme has now been tabled. Although not ideal, it does not conflict with stated US or UK interests. A US/UK lead in approving the draft work programme at the CD resumes could enable consensus to be reached, ending the CD's seven-year deadlock and unblocking the FMCT negotiations. This would strengthen the NPT by implementing one of the 13 steps.

China has recently made concessions on FMCT negotiations. The UK should encourage the US to make parallel concessions and agree to the start of negotiations.

Recent developments have brought home the fragility of the international regime to prevent the spread of nuclear weapons to new countries. The first is the indication of the extent of the black-market in nuclear technology and equipment. It became known in January 2004 that Pakistan's chief nuclear scientist and father of the country's nuclear weapon programme, Abdul Qadeer Khan, set up an extensive illegal international network to sell abroad nuclear technologies and equipment, including blueprints for centrifuges for the enrichment of uranium and a design of a nuclear weapon stolen from the Pakistani government.

The network sold uranium hexafluoride, the gas that centrifuges transform into the highly enriched uranium needed to fabricate nuclear weapons. Khan and his associates provided Iran, Libya and North Korea with designs for effective centrifuges, components for centrifuges and, in some cases, with complete centrifuges. They used a factory in Malaysia to manufacture centrifuge parts and they purchased, using front companies, other necessary parts in Africa, the Middle East and Europe. The Khan network supplied their wares to Iran, Libya and North Korea.

These startling developments provoked President Bush to announce, in a speech on February 11, 2004 at the National Defense University, Washington D.C., new measures to counter the threat of nuclear weapons. President Bush should be praised for grappling with the serious danger of civil nuclear fuel technology that could help governments and terrorists produce highly enriched uranium and plutonium, the key materials in nuclear weapons. It is clearly a step in the right direction.

However, the proposals concentrate on the problem of the spread of highly enriched uranium to Third World countries and gives little attention to the much more serious problem of plutonium – a far greater global danger. He should have called for the elimination of the use of plutonium fuels in nuclear-power reactors. Plutonium is far too expensive and dangerous to use in civil nuclear programmes and it is simply not necessary to use plutonium as a civil nuclear fuel.

What is required is a ban on the production and use of weapon-usable nuclear materials (HEU and plutonium) in all civil nuclear programmes, in all countries, developing and industrial. A FMCT is a vital step in this direction.

Recommendation 3:

Measures to strengthen the IAEA

The IAEA's safeguards budget is only about US\$100 million per year. The Agency has, therefore, to rely on voluntary funding to finance almost one-fifth of its safeguards activities. This state of affairs inevitably undermines the Agency's ability to conduct credible verification.

In the light of the cases of Iraq and North Korea, the IAEA's Standing Advisory Group on Safeguards Implementation (SAGSI) has admitted that the current safeguards system must be strengthened if confidence in and the credibility of the system are to be enhanced. The group recommended some additional safeguards measures: the use of techniques to monitor the environment (air, soil, and water) at nuclear facilities to detect the presence of radioisotopes and other materials typical of nuclear activities; inspecting areas beyond the strategic points within declared facilities; increasing unpredictability in the location and timing of routine inspections; and conducting special inspections at sites when there are indications of potential undeclared activities or sites, after consultation with the state concerned.

The IAEA Board of Governors approved an Additional Protocol to IAEA Safeguards Agreements designed to enhance significantly the credibility of the safeguards system. The main aim of the Additional Protocols is to enable the IAEA to provide assurance about both declared and possible undeclared activities by providing as complete a picture as possible of nuclear activities. The Agency is allowed adequate rights of access, including no-notice access, and enables it to use the most advanced technology for the implementation of verification. Under the Additional Protocol, states are required to provide the Agency with an extra declaration containing information covering all aspects of their nuclear and nuclear fuel cycle activities. The Agency has the right to collect environmental samples anywhere it has the right of access. It will use remote monitoring

technology extensively to improve the efficiency of the safeguards system. Ratification of the Additional Protocol is not mandatory, not even for states concluding new safeguards agreements with the IAEA. As of end September 2003, there were 188 States Party to the NPT (North Korea announced its immediate withdrawal from the Treaty on 10 January 2003; its withdrawal took effect on 10 April 2003). Of these, 51 non-nuclear-weapon States partly had not fulfilled their legal obligation to conclude the required safeguards agreement. Between May 1997, when the Model Additional Protocol was adopted, and the end of September 2003, Additional Protocols had been signed with only 78 countries; of these Additional Protocols, 37 were in force.

In the speech on nuclear proliferation made by President Bush on February 11, 2004 at the National Defense University, he stated that all exports from the main nuclear suppliers, the 40 countries in the Nuclear Suppliers' Group, should be made conditional on the importers agreeing an Additional Protocol with the IAEA. He also stated that the IAEA's capabilities to detect cheating and to respond to violations of treaty provisions must be enhanced. Putting into effect Bush's proposals will cost money, not least for an increase in the budget of the IAEA. There is little sign that this will be forthcoming.

In the light of this situation, the British Government should encourage measures to strengthen the IAEA, particularly by increasing the Agency's budget and by making mandatory Additional Protocols to the Safeguards Agreements entered into by NPT parties and the IAEA.

Recommendation 4:

Provisional application of the Comprehensive Nuclear Test Ban Treaty: raising the political stakes to prevent further nuclear testing

In view of the difficulty of meeting the stringent requirements for CTBT entry into force in the near future and to raise the

political cost of a resumption of nuclear testing:

states which have already ratified the treaty should discuss in 2004 taking the further legal step of provisionally applying the CTBT, to increase its chances of entry into force.

The need to show that the CTBT is fully viable and strongly supported is urgent in light of the US failure to ratify the agreement, continuing debates within the Bush Administration on renouncing President Clinton's 1996 signature on the test ban treaty and resuming testing to develop new nuclear weapons and missions.

In accordance with its strategy of eroding confidence in the CTBT and multilateral arms control, the Bush administration has made repeated statements against the treaty and boycotted the 2001 and 2003 Article XIV meetings of signatories and ratifiers.

Britain, together with France and Russia, should play a leading role in enhancing the CTBT's credibility through provisional application or an alternative high profile political push, which would be widely supported by the rest of the world.

Provisional application, which has precedents (and provided a useful bridge to entry into force) in the recent cases of the Conventional Forces in Europe (CFE) Treaty and the UN Convention on the Law of the Sea, would constitute an important confidence-building mechanism, reinforce the legal standing of the CTBT, encourage further ratifications, and deter any state from conducting a nuclear explosion in the future. The role of provisional application is not to waive the entry into force requirements, but to strengthen a treaty if its entry into force becomes unreasonably obstructed or delayed due to political blackmail or transitory conditions, or for reasons that a significant number of potential parties are willing to move beyond, at least temporarily. The CTBT's current situation is so vulnerable that it now meets the criteria.

If the US withdraws its signature the CTBT is unlikely to survive, which will severely undermine the credibility of the nuclear non-proliferation and international legal regimes. If the US resumes tests, China and then others are likely to follow. A series of qualitative developments will ensue, increasing the likelihood that new nations will consider developing nuclear weapons and that, coupled with the changes in US policy, will make nuclear weapons themselves appear more "usable" or likely to be used.

Provisional application – or at least an early move towards it – is needed now to send an unmistakable political signal to those who are threatening the norm against testing, that the CTBT remains internationally alive and important and that the political costs to the United States of breaking its moratorium or removing its signature would be unacceptably high.

As of April 5th 2004, the CTBT had been signed by 171 states and ratified by 110. Despite such a high level of support, it cannot yet enter into force because the stringent provisions of Article XIV of the treaty make entry into force conditional on the signature and ratification of 44 named states with nuclear capabilities and facilities. Of these 44, 32 have signed and ratified. The major problem lies with India, Pakistan and North Korea, which have not signed; and the US and China, which have signed but not ratified. Significantly, the US, China, India and Pakistan, together with Britain, France and Russia, have declared moratoria on conducting further tests. China's ratification is now anticipated within the next year and UK efforts to encourage China's formal adoption are very important.

The Bush administration has made its opposition to the CTBT so clear that many in Washington consider the treaty to be dead, and compare resistance to it to the ABM where international opposition to US withdrawal was threatened but in the end did not materialise. It is vital that test ban supporters expose the flaw in this reasoning and bring the importance of the CTBT back to

the attention of US lawmakers and public, not so much to demand ratification (for which there is little hope in the near term), but to prevent a resumption of US nuclear testing.

Analysts close to Washington warn against relying on the US keeping its moratorium if George W. Bush is re-elected in 2004. They point to the Pentagon's persistent calls for new nuclear weapons, which would require testing and to the Energy Department's plan to shorten the length of time required to reopen the Nevada nuclear test site. Although Congress has so far refused budget funding for the testing of new weapons, the arguments in favour are being deliberately linked to two popular themes: terrorism (bunker busters and mini-nukes); and missile defence (nuclear interceptors). If Bush is re-elected, the pressure on Congress to vote the money will be redoubled. If a significant number of US allies and Nuclear Weapon States bring the CTBT into effect for themselves, this will reinforce international support for the treaty, make it politically more costly to breach the moratorium, and encourage the test ban supporters in Congress.

Although US representatives continue to repeat that its moratorium will be maintained, senior officials in the departments of Defence, Energy and State, together with the National Security Council, have debated the pros and cons of withdrawing the US signature and continuing to fund the international monitoring system or pulling US funding out of the verification regime currently being established by the CTBT Organisation in Vienna. The US has already backed out of funding the on-site inspections component of CTBT verification. In these inter-agency discussions, the argument has been made that withdrawing President Clinton's signature would not only set aside the permanent, zero yield test ban, but would end international pressure on the US and remove the possibility and expectation of future US ratification.

Mounting evidence, outlined in numerous briefings and leaked documents, indicates that the Bush administration is keeping to the moratorium not from conviction, but to

neutralise criticism while it prepares the ground to resume testing and kill off the CTBT. Only a concerted political effort involving many high-profile US allies can now save the treaty. It is significant that the important relationship between the CTBT and the NPT is being largely ignored by the Bush administration, which professes to want to strengthen the NPT. If the CTBT is killed off, the NPT may not survive.

A small group of ratifiers, preferably including Britain, France and Russia, should take the initiative to circulate a proposal among states which have ratified the CTBT. The next step would be for a larger group of the ratifiers to convene a 2-3 day special conference, inviting all CTBT ratifiers (and signatories as observers) to negotiate and agree to a protocol on provisional application.

Recommendation 5: Supporting the 13 steps

The 2000 NPT Review Conference agreed 13 practical steps towards implementing key aspects of the treaty.

These may be summarised as follows:

1. Rapid entry into force of the Comprehensive Test Ban Treaty.
2. Test moratorium pending entry into force of CTBT
3. Negotiate a treaty banning fissile material production for weapons.
4. Establish a body under the Committee of Disarmament to deal with nuclear disarmament.
5. Acceptance of irreversibility of nuclear arms control and disarmament measures.
6. Commitment of nuclear weapon-states to weapons elimination under NPT Article VI.
7. Steps by such states to achieve elimination including early emphasis on non-strategic weapons, greater transparency of procedures, reducing operational status of systems and

- diminishing the role of nuclear weapons in security policies.
8. Early entry into force of START III and related treaties and preserving and strengthening of the ABM treaty.
 9. Completion and implementation of Trilateral Initiative between the US, Russia and the IAEA.
 10. Placing of excess fissile material under IAEA or other international verification and disposition of such material for peaceful purposes.
 11. Re-affirmation of the ultimate objective of general and complete disarmament.
 12. Regular reporting within the NPT framework.
 13. Further developments of verification procedures required to provide assurance of compliance with nuclear disarmament procedures.

Since 2000, political trends have worked against these proposals. Specifically, prospects for ratifying the CTBT are much reduced, the ABM treaty is dead, nuclear modernisation by the US is back on the table and a resumption of nuclear testing by the US is now possible and could be followed by four other countries (Russia, China, India and Pakistan).

In the past ten years all five declared nuclear weapons states have already modernised their systems, as have the three undeclared states, and an additional state (North Korea) has announced its withdrawal from the NPT and is now considered to be a nuclear weapons-state. More generally, and in the context of a response to chemical and biological weapons use, three states (the US, UK and France) have in different ways indicated a willingness to see a role for nuclear weapons.

Given this overall deterioration in the nuclear weapons environment, the UK has the capacity, even in current circumstances, to influence trends in a more positive way.

- **Publicly renew its commitment to the CTBT and confirm that Britain is will**

be bound to a full test moratorium until the CTBT comes into force.

- **Confirm commitment to NPT Article VI involving the eventual elimination of nuclear weapons, to the negotiation of a fissile material control treaty and to the establishment of a CD committee focussing on nuclear disarmament.**
- **Commit the UK to a nuclear no-first-use policy, to the further downgrading of the alert status of nuclear forces, to no further modernisation of UK nuclear forces, to (reaffirming its Negative Security Assurances and eliminating consideration of the use of nuclear forces in non-nuclear conflicts.**

Such steps would put the UK in a powerful position as the leading nuclear weapons-state in advocating full compliance with the letter and spirit of the Non-Proliferation Treaty.

Conclusions

The British government has, on a number of occasions, made clear its commitment to preventing the spread of nuclear weapons to countries that do not have them and to measures to strengthen the NPT. In the light of these commitments, O.R.G. recommends that: Britain should encourage the US not to develop new 'usable' nuclear weapons, particularly mini-nukes and bunker busters because of the destabilising effect such new nuclear weapons will have; Britain could strengthen efforts to ban the production of fissile material for use in nuclear weapons, in particular the government should encourage Washington to initiate the negotiation of an FMCT; Britain should encourage measures to strengthen the IAEA by increasing the Agency's budget and by making Additional Protocols to NPT Safeguards Agreements mandatory; Britain could take the lead in securing a provisional entry into force of the CTBT to strengthen and make more difficult to break the current moratorium on nuclear testing; and should strongly advocate the 13-steps agreed at the 2000 NPT Review Conference.

- 5 -

Why the UK Government is in a Unique Position to take these Proposals Forward

Progress on the five multilateral nuclear non-proliferation measures outlined in this report will require the support and leadership of the United States. That support and leadership is currently not forthcoming, despite the fact that fight against the proliferation of nuclear weapons is at the top of the United States national security agenda.

In the absence of US leadership the British government is in a unique position to take these five proposals forward at this critical juncture for three reasons:

1. The UK government continues to enjoy a close relationship with the United States government and the Prime Minister is widely respected in Washington for his stand with President Bush against Iraq.
2. The UK is a long-standing strong supporter of IAEA safeguards and the non-proliferation regime. The UK has a good record of: giving strong diplomatic support; providing an effective program of technical assistance to the IAEA safeguards system; and contributing the expertise and assistance of a number of UK nationals. The UK has also signed and ratified the Comprehensive Test Ban Treaty.
3. The UK agreed to the 13-steps in the 2000 NPT Review Conference final document.

These steps include:

- **Early entry into force of the Comprehensive Test Ban Treaty;**
- **Immediate commencement of negotiations a treaty to ban production of fissile material for nuclear weapons or other nuclear explosive devices with a view to its conclusion within five years; and**
- **Unequivocal undertaking by the nuclear-weapon states to accomplish the eventual total elimination of their nuclear arsenals leading to nuclear disarmament to which all States Parties are committed under Article VI**

Key opportunities to drive home the non-proliferation agenda are available in 2004. The UK's influence on the UN NPT review process could be positively affected by the personal efforts of Jack Straw as UK Foreign Secretary to vigorously promote the 13-steps. The European Union is well-placed to promote non-military solutions to proliferation, and the UK may have particularly strong opportunities to push non-proliferation up the agenda during Ireland's Presidency which takes place during the first half of 2004. The G8 is becoming an increasingly important arena for discussion of non-proliferation issues, particularly through its counter-terrorism wing. The UK could ensure that multilateral approaches are on the agenda of the June meeting in the USA.

Appendix

Current Nuclear Forces: A Country-by-Country Breakdown

There are three different types of nuclear-weapon states. They are: the established nuclear states (defined in the NPT as those that had “exploded a nuclear explosive device prior to January 1, 1967”) are China, France, Russia, the UK and the USA; states that are known to have tested nuclear weapons since 1967 – India and Pakistan; and countries that have fabricated nuclear weapons but have not tested them – Israel and probably North Korea. Today, therefore, there are nine nuclear weapon states. In addition, there are countries that have possessed and subsequently renounced nuclear weapons, such as South Africa, Ukraine and Kazakhstan; countries that do not have nuclear weapons but do have such advanced nuclear technology that they could fabricate nuclear weapons very quickly – the so-called latent nuclear-weapon states – such as Japan, Brazil, Germany and South Korea; and countries that are actively seeking nuclear weapons, such as Iran. There are about 30,000 nuclear weapons in the world currently. **Appendix 1** provides a detailed country-by-country breakdown of existing weaponry.

Table 1: The Nuclear Arsenals

Country	Total number of nuclear weapons deployed, January 2003			Notes
	Strategic	Tactical	Total	
USA	6,140	1,120	7,260	In addition, about 3,300 nuclear warheads and 5,000 plutonium cores in store
Russia	4,852	3,380	8,232	Includes 1,200 nuclear warheads on anti-ballistic missiles around Moscow, in addition, about 10,000 warheads in storage or waiting dismantlement.
China	282	120	402	
France	348		348	
UK	185		185	

The United States currently has some 7,260 nuclear warheads actively deployed with a further 3,300 in reserve or awaiting dismantling. Most weapons are strategic but there are substantial numbers of tactical bombs of the B-61 group, including the B61-11 earth-penetrating bomb developed in the 1990s. The US retains a limited pit production facility for producing new nuclear weapons although no new designs are currently in production.

There have been clear moves towards the development of new designs, especially of small nuclear weapons for specific uses in counter-proliferation activities such as destruction of deeply buried targets. There are also proposals for investing in the refurbishment of the Nevada Nuclear Test Site to make it easier and quicker to resume nuclear testing should that be considered necessary.

Much of the Russian nuclear infrastructure is in a thoroughly run-down condition. There are reported to be over 8,200 warheads in active deployment and 10,000 in reserve or more awaiting

disassembly, but the actual numbers of active warhead may be very much lower, especially given the current condition of the Russian submarine fleet.

Russian nuclear policy appears now to concentrate on retaining a relatively small core of nuclear forces, including a process of progressive modernisation such as the enhancement of the Tu-160 strategic bomber. While the United States and Russia have agreed to cut their nuclear forces to around 1,700 – 2,200 active strategic warheads by 2012, the agreement does not include tactical systems, nor does it involve dismantling existing warhead which can therefore be maintained in reserve.

The British, French and Chinese nuclear forces have all undergone a transition since the end of the Cold War but, in all cases, withdrawal of obsolete weapons has been accompanied by a modernisation of key systems. Furthermore, all three states aim to continue their nuclear status for the foreseeable future, with an emphasis on versatile forces appropriate for tactical and strategic uses.

The UK has withdrawn its tactical nuclear bombs but now fields the Trident submarine-launched ballistic missile (SLBM) in both strategic and sub-strategic (i.e. tactical) modes, with the latter involving a much smaller warhead yield while retaining full range capabilities. Total warhead numbers are under 200. France has withdrawn land-based tactical and theatre missiles but maintains aircraft-delivered nuclear weapons and is modernising its SLBM fleet with the deployment of the *Triumphant*-class boats, two of which are in service with two more under construction. It maintains a warhead total of about 350.

China has diverse nuclear forces totalling about 400 warheads, primarily configured for regional purposes but with a small intercontinental capability. This last component would be capable of rapid enlargement and enhancement should the United States develop a comprehensive national missile defence system, and there are indications that the future Chinese nuclear posture would move in this direction, although with some reluctance on grounds of cost.

Israel first developed nuclear weapons in the 1960s and had a limited capability by the time of the Yom Kippur/Ramadan War of October 1973. It has since built up substantial nuclear forces including aircraft-delivered free-fall bombs and up to 100 warheads carried by variants of the Jericho land-based ballistic missile with a range of up to 1,800 km. The total arsenal is likely to be around 200 warheads, including fusion weapons. Israel may also have tactical artillery shells and may be developing a warhead for use on a submarine-launched cruise missile.

India first tested a nuclear device in 1974 but developed a nuclear arsenal more recently and may have tested fusion as well as fission devices. Its warhead inventory may be slightly smaller than that of Pakistan but is currently being expanded. India has a mix of aircraft and missile delivery systems, including the 2,000-km range Agni II missile, first tested in January 2001.

Pakistan has short- and medium-range aircraft and missile delivery systems for a small but developing nuclear arsenal based on enriched uranium implosion devices. Numbers of warheads are difficult to estimate but are currently likely to be less than fifty.

North Korea is believed to have produced a very limited number of nuclear warheads, perhaps only two and of low yield, from supplies of reprocessed plutonium, and may also have a limited capability for uranium enrichment to weapons-grade levels. It has recently claimed, though, to have completed six warheads. Iran is at a much earlier stage of development of nuclear

capabilities. Both countries are subject to aggressive assessments by US intelligence sources that tend to make sound judgements difficult.

Global sticks of fissile material

The two fissile materials normally used in nuclear weapons are uranium and plutonium.

Weapon-grade highly enriched uranium is manufactured in enrichment plants. As of 1997 there were 26 enrichment plants in operation or under construction around the world.³ Weapon-grade plutonium is manufactured in spent nuclear fuel reprocessing plants. As of 1997 there were a total of 23 reprocessing and plutonium production plants in operation or under construction.⁴

A uranium-based nuclear weapon needs between 15 to 56kg highly enriched uranium depending on the sophistication of the design. A plutonium-based nuclear weapon needs between 4 to 13kg of weapon-grade plutonium. Since 1945 just over 3,000 tonnes of plutonium and highly enriched uranium have been produced for civil and military purposes.

Civil fissile material: Approximately 1,000 tonnes of this was produced for, or in, civil nuclear reactors or other civil nuclear facilities and consists almost entirely of reactor-grade plutonium. The vast majority (around 75%) is found in unprocessed spent fuel at nuclear reactor sites, with the rest contained in new nuclear fuel elements or in radioactive waste. About 60% of the 1,000 tonnes of civil fissile material is under full IAEA international safeguards including all the Nuclear Non-Proliferation Treaty's non-nuclear-weapon states and Britain and France under Euratom safeguards (the European Atomic Energy Commission). The remaining 40% is held in the USA and Russia.

Military fissile material: The remaining 2,000 tonnes of fissile material was produced for military purposes. Most of this, around seven eighths, is highly enriched uranium and the rest is military plutonium. Of this, approximately 95% is owned by the USA and Russia and is mainly held in nuclear warheads, military reserves, naval propulsion reactors and associated production facilities. The remaining 5% is found in China, France and Britain. India, Pakistan and Israel also have strategically important amounts of fissile material that are part of their nuclear weapon programmes. However, only a fraction is currently under international safeguards. Writing in 'The Challenges of Fissile material Control' in 1998, Professor William Walker estimated that the required quantity of military fissile material for use in nuclear weapons would probably fall below 400 tonnes leaving around 1,500 tonnes of excess materials to deal with.⁵ See Oxford Research Group's 2003 'FMCT Handbook' for further information.

³ A. Schaper, 'A Treaty on the Cutoff of Fissile Material for Nuclear Weapons - What to Cover? How to Verify?', Peace Research Institute Frankfurt, 1997, pp38 - 41.

⁴ A. Schaper, 'A Treaty on the Cutoff of Fissile Material for Nuclear Weapons - What to Cover? How to Verify?', Peace Research Institute Frankfurt, 1997, pp38 - 41.

⁵ Figures used in this section are taken from D. Albright 'Chapter 1: International Fissile Material Control Efforts' and D. Albright & L. Barbour 'Chapter 5: Separated Neptunium 237 and Americium' in D. Albright & K. O'Neill (Eds.), 'The Challenges of Fissile Material Control', Institute for Science and International Security, 1999, Washington, DC, 1999. These figures in turn are based on updated values from D. Albright, F. Berkhout and W. Walker, 'Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies', Oxford, Stockholm International Peace Research Institute (SIPRI) and Oxford University Press, 1997. For further information about these figures please visit www.isis-online.org