

Assessing an F-35-based nuclear deterrent

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Introduction

There have been [reports](#) that a proposal to replace the UK's current submarine-based nuclear deterrent with an aircraft-based system is being considered as part of Labour's Defence Review led by Shadow Defence Secretary Emily Thornberry.¹

The plan would see the cancellation of the Vanguard-successor submarine programme, terminating the UK's current Continuous At-Sea Deterrent (CASD) posture. A capability based on free-fall nuclear bombs, a type of deterrent last relied on by Britain in the 1950s and 1960s, would be developed as an alternative.

The policy recommendation, [drafted originally](#) for the think tank CentreForum ahead of the 2015 general election, is the work of defence analyst and former RAF Intelligence Branch reservist Toby Fenwick.^{2 3}

Mr Fenwick is a member of the Liberal Democrats and sits on the party's 'Trident Policy Working Group'.⁴

Under the plan, the UK's future fleet of Lockheed Martin F-35 Lightning II multirole fighters, currently being procured by the Ministry of Defence, would be adapted for 'dual-use' to deliver B61-12 guided nuclear bombs. It has been suggested that the aircraft could not provide round-the-clock capability, but could instead mobilise rapidly in the event of a crisis.

The suggestion that the UK's CASD posture could be replaced by an aircraft-based nuclear force has serious implications relating to **disarmament, capability, European extended deterrence** and **costs** and requires careful examination.

The UK's nuclear deterrence posture

The United Kingdom has progressively consolidated its nuclear forces so that only a seaborne, strategic deterrent component remains. The UK's independent nuclear deterrent, commonly referred to as Trident, is comprised of three main elements:

The **Vanguard-class submarine** is the platform that carries the Trident ballistic missile. Four Vanguard class submarines (SSBN) maintain continuous at-sea deterrence (CASD), meaning that one vessel is always on patrol armed with Trident missiles. The Class became operational from 1992 and are due to continue serving until the 2030s. If the UK is to maintain CASD, a new class of SSBN will be required to replace Vanguard once the submarines reach their end of service-life.

The **Trident II D5 ballistic missile**, which has a range of over 4,000 nautical miles, is the delivery vehicle for the UK's nuclear warheads. Under limits imposed in the 1998 Strategic Defence Review (SDR) and the 2010 Strategic Defence and Security Review (SDSR), each Vanguard submarine now only deploys with eight operational missiles and no more than 40 nuclear warheads.

The UK's stockpile of **nuclear warheads**. The infrastructure for building and maintaining the UK's nuclear stockpile is located at two Atomic Weapons Establishment (AWE) sites in Berkshire.

¹ http://www.huffingtonpost.co.uk/2016/02/18/jeremy-corbyns-trident-re_n_9264014.html

² <http://www.centreforum.org/assets/pubs/retiring-trident.pdf>

³ http://www.huffingtonpost.co.uk/2016/02/18/jeremy-corbyns-trident-re_n_9264014.html

⁴ Ibid.

Summary of criticisms against an F-35-based nuclear deterrent proposal

Disarmament

- Critics argue that any amount of nuclear sharing, utilising 'dual-use' aircraft, violates Article I of the Nuclear Non-Proliferation Treaty (NPT). Under Toby Fenwick's proposal, Italy, a non-nuclear nation under the terms of the NPT, would remain part of NATO's nuclear sharing arrangements.
- It is suggested that the B61-12 bomb's combination of accuracy, low-yield and ground penetration capability will make it the most useable nuclear bomb in NATO's nuclear arsenal.
- If the UK were to develop the new capabilities envisaged by Toby Fenwick it would mean embarking on a testing programme. This would not only be expensive, but would more than likely breach the Nuclear Test-Ban Treaty.
- It is argued that only the complete removal of NATO's aircraft-delivered tactical nuclear weapons from Europe, and basing European extended deterrence on strategic nuclear forces alone, will create the necessary political environment needed for Washington and Moscow to reduce Russia's own arsenal of tactical nuclear weapons.

Capability

- An F-35-based nuclear force would be unable to strike the full range of targets necessary to inflict unacceptable damage on a hostile state and, therefore, would not achieve credible deterrence.
- Air bases and aircraft carriers are susceptible to both nuclear and conventional pre-emptive strikes as well as terrorism. Whilst in the air, aircraft would be much more vulnerable to surface-to-air missiles compared to the current Trident II ballistic missile.
- An aircraft-based system would require a visible deployment during a time of crisis, which would have a potentially de-stabilising and escalatory effect in any diplomatic crisis since other nations would be able to spot when the UK was mobilising its nuclear forces.
- In light of Russia's nuclear arsenal modernisation programme, a UK independent nuclear deterrent based solely on the B61-12 free-fall bomb, would have a very limited ability to act as an effective deterrent against possible future threats.
- Consolidation of aircraft-delivered tactical nuclear weapons into two countries, the UK and Italy, would further legitimise a NATO nuclear deterrence posture that is unfit for the post-Cold War, 21st century security environment.
- The US' and UK's strategic ballistic missile systems, underpinned by the UK as a second centre of decision making, help assure Eastern European allies of NATO's ability to defend them. Reducing the credibility of NATO's nuclear deterrent would likely be met by opposition in Eastern Europe, and could introduce greater uncertainty into the European security environment.

Costs

- Toby Fenwick's paper underestimates the value of maintaining an indigenous shipbuilding capability in the UK.
- Fenwick's miscalculation regarding the capability of an F-35-based nuclear force directly leads him to significantly underestimate what the cost of an effective F-35-based nuclear deterrent would be.
- There are serious questions over whether the UK would be able to operate the number of required aircraft needed to maintain a credible nuclear deterrent, if indeed this type of platform is suitable for this role at all.
- The US-led F-35 programme has been fraught with technical and financial problems, involving many other partner nations. Relying on this platform to provide the UK's nuclear deterrent would be a huge risk, especially when compared to the stability of the UK's sovereign submarine industry.
- The decommissioning of the Trident-based system would likely run into several billions.

Toby Fenwick's proposal in context

Toby Fenwick presents a proposal that, if enacted, would run counter to various nations current policies relating to strategic nuclear deterrence and, in particular, European extended deterrence. His paper also highlights the debate surrounding the future of US tactical nuclear weapons that are currently based in five European North Atlantic Treaty Organisation (NATO) countries that participate in the Alliance's nuclear sharing arrangements.

His proposal recommends the consolidation of all Europe's aircraft-delivered tactical nuclear weapons (TNWs) into two countries: the UK and Italy, whereby 100 'anglicised' B61-12 free-fall nuclear weapons would be procured by the Ministry of Defence. Other countries participating in the F-35 programme, or planning to operate the aircraft, would retain the capability to deliver B61-12 bombs, but would not store these TNWs.

What constitutes credible deterrence?

From the outset, policy makers should acknowledge that the question of what constitutes 'credible' deterrence has preoccupied legions of analysts for decades and has generated rivalling schools of thought. The issue, therefore, given the absence of solid proof, remains one of competing assumptions.⁵ However, despite the absence of empirical evidence, each and every view relating to nuclear weapons policy and deterrence theory *cannot* be held at equal value.⁶

Credibility and the Duff Group Criteria

In drawing up a proposal for a nuclear deterrent based on the F-35 delivering free-fall bombs, Toby Fenwick asks the question "what level of nuclear capability does the UK require?"

Fenwick looks to the 1979 Duff-Mason Group report for guidance in determining the criteria needed for an effective nuclear deterrent. The criteria study, focussed on the notion of what was deemed as unacceptable damage to the Soviet Union, was led by Antony Duff of the Foreign Office. Three options for creating unacceptable damage were identified:⁷

1. Destruction of the main government centres (both the above and below ground) within the Moscow outer ring road and, outside it, a selected number of alternative bunker locations which are associated with the centralised system of command and control of the Soviet Union at national level.
2. Breakdown level damage to Moscow as a city and Leningrad (St. Petersburg) and two other large cities.
3. Damage to a number of cities, but excluding Moscow. Two variants are suggested –

⁵ [http://nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209\[1\].pdf](http://nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209[1].pdf)

⁶ Ibid.

⁷ Hennessy, P. and Jinks, J. *The Silent Deep: The Royal Navy Submarine Service Since 1945*, Penguin, 2015 Pg. 476

- 3a. Breakdown level damage to Leningrad and about 9 other major cities;
- 3b. Grave damage, not necessarily to breakdown level, to 30 major targets, including Leningrad and other large cities and possibly selected military targets.

The report said that any of these would be adequate, but that Option 1 would provide a more certain deterrent than Option 2, and that Option 2 would provide a more certain deterrent than Option 3. Options 1 and 2 are often referred to as the 'Moscow Criterion'.

It was considered that any one of these options would constitute unacceptable damage, and that, if the UK's nuclear capability fell short of meeting one of them or its equivalent, there would be room for significant doubt about its adequacy.⁸ However, the study's assessment rested on the employment of missile systems in all three options, and did not envisage using aircraft-based forces alone. Indeed, it is claimed that option 3b was only inserted to appease the then foreign secretary, David Owen, who favoured a scaled-down deterrent, using nuclear-armed cruise missiles based on board the Royal Navy's general purpose attack submarines (SSN).⁹

Toby Fenwick claims that today's Russia, which lacks the coercive power of the Soviet state, or smaller or less developed nuclear states – e.g., Pakistan or North Korea – have power structures that are less survivable than those of the former Soviet Union, meaning that the amount of damage representing unacceptable loss – when deterrence is achieved – is likely to be smaller still than Option 3a and 3b.¹⁰

However, Fenwick maintains that, for the purposes of his paper, unacceptable loss is still based on the Duff Group's Options 3a or 3b. His claim that an F-35-based force could achieve deterrence based on these options, or indeed lower levels of unacceptable damage, will be examined later in this paper.

Importantly, the Duff Group report also emphasised the importance of the UK as a second centre of decision making, meaning that not all nuclear decisions in the NATO alliance are left entirely to the United States President. It could therefore be argued that if the UK retired Trident, and instead adopted a system based on Fenwick's proposal, the effectiveness of this second centre of decision making would be weakened. Toby Fenwick's analysis of the Duff Group criteria ignores this aspect of the UK's missile-based nuclear deterrent, whilst not offering an explanation as to how he would address this problem if the UK did indeed procure a less-capable aircraft-based nuclear force.

⁸ Ibid.

⁹ Ibid.

¹⁰ <http://www.centreforum.org/assets/pubs/retiring-trident.pdf> Pg. 25

What is nuclear deterrence?

Definitions of deterrence vary, but a popular definition, put forward by the late prominent scholar, Kenneth Waltz, is that *nuclear weapons dissuade states from going to war more surely than conventional weapons do*. Credibility and capability are central to deterrence because of their influence over severity and surety of punishment.

The credibility of a specific deterrence posture is a subjective judgement based on assessment of the threat and achievability of genuine deterrence from potential aggressors.

The MoD defines deterrence in the following terms:

The convincing of a potential aggressor that the consequences of coercion or armed conflict would outweigh the potential gains. This requires the maintenance of a credible military capability and strategy with the clear political will to act.

The Government's 2013 Trident Alternatives Review described the UK's nuclear force as:

"a political tool of last resort rather than a war fighting capability"

and as

"A minimum nuclear deterrent capability that, during a crisis, is able to deliver at short notice a nuclear strike against a range of targets at an appropriate scale and with very high confidence."

Credibility criteria

A credible and effective nuclear deterrent is underpinned by five criteria: readiness, reach, resolve, survivability/invulnerability and destructive power.

Extended deterrence

The nuclear arsenal of a state protects first and foremost that very state from external aggression. Nuclear weapons are therefore closely tied to notions of national sovereignty. There is widespread agreement, however, that nuclear deterrence can also be extended to non-nuclear allies. In principle, all that is required is a declaration by the nuclear weapons state that it will retaliate on an attack on its ally with nuclear means. Whether such a promise will be perceived as credible, however, is quite another matter. (Michael Rühle, *Comparative Strategy*, 2009)

Nuclear sharing

Nuclear sharing is a concept in NATO's policy of nuclear deterrence, which involves member countries without nuclear weapons of their own in the planning for the use of nuclear weapons by NATO, and in particular provides for the armed forces of these countries to be involved in delivering these weapons in the event of their use. In the late 1960s, the NATO Nuclear Planning Group was created to address the European desire to exert influence on US nuclear planning. These nuclear sharing arrangements would ease European, notably German, concerns with regard to signing the Non-Proliferation Treaty.

2013 Trident Alternatives Review

In May 2011 the Coalition Government confirmed that, in order to assist the Liberal Democrats in making the case for alternatives to an SSBN-based CASD system, a study into the costs, feasibility and credibility of alternative systems and postures would be undertaken.¹¹ The Review was led by the Cabinet Office, with ministerial oversight provided by the then Chief Secretary to the Treasury, Danny Alexander.

The Review, published in 2013, looked at a number of alternative platforms/systems and postures, including air-launched free-fall nuclear bombs deployed aboard fast jets, and concluded that CASD is the most “resilient” posture and guarantees the quickest response, effectively ruling out land and air-based delivery systems.

The Review stated:

“The highest level of assurance the UK can attain with a single deterrent system is provided by SSBN submarines operating a continuous at sea deterrence posture. [...] Adopting a non-continuous posture introduces some vulnerability due to the potential ability of an adversary to target the UK during a period when no boat is covertly deployed” (pg. 5).

“None of these alternative systems and postures offers the same degree of resilience as the current posture of Continuous at Sea Deterrence, nor could they guarantee a prompt response in all circumstances” (pg. 10).

And further warned:

“Any uncertainty about the UK’s sovereign ability to use its deterrent would diminish the deterrent effect” (pg. 24).

However, in Toby Fenwick’s paper, the Trident Alternatives Review’s analysis is labelled as fundamentally flawed as it omitted costings based on an F-35/free-fall bomb option. This is a valid criticism, but this paper does not seek to redress the apparent failings of the Trident Alternatives Review’s analysis. Instead it addresses the credibility of Toby Fenwick’s proposal.

¹¹ <http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7353> Pg. 76

B61-12 Guided Nuclear Bomb: Encouraging new mission sets and usability?

Central to the proposal put forward by Toby Fenwick in early 2015 is the development of a delivery system based on the F-35 Lightning II and the US B61 Mod-12 (B61-12) guided nuclear bomb, currently under development in the United States.

The B61-12 is an upgraded version of the B61, which was designed in 1963. Once it is declared operational, the B61-12 will be carried by US and NATO nuclear-capable bombers and fighter aircraft, including the F-35.¹² The development of the B61-12 is often referred to as the B-61 Life Extension Programme (LEP) and it is expected that the weapon will begin replacing all the US' existing nuclear gravity bombs from the mid-2020s.¹³

The thermonuclear bomb is guided by an internal guidance system allowing mid-flight manoeuvre towards its target. The B61-12 reportedly has four selectable yields — 0.3, 5, 10 and 50 kilotons.^{14 15} A drop test, conducted in late 2015, indicated that the B61-12 is three times more accurate than existing non-guided gravity bombs. The test also demonstrated the B61-12's [surface penetration capability](#), which has further implications for the types of targets that can be held at risk with the bomb.^{16 17 18}

B61-12 Guided Nuclear Bomb

The B61-12 is a modernised version of the B61 bomb developed in the middle of the 1960s. It is classed as a tactical nuclear weapon (TNW).

The programme will see the four existing B61 versions consolidated into one type.

With a reported accuracy of less than 30 metres, low selectable nuclear yield, and ground penetration capability, the B61-12 could encourage the US military to employ the bomb in new mission sets.

The weapon could prove highly effective as a nuclear 'bunker buster'.

It is argued that the B61-12 represents a new nuclear bomb type that introduces a new capability not currently in the global nuclear stockpile.

Some commentators have questioned whether the development of the B61-12 may be in violation of the US' 2010 Nuclear Posture Review that states the life extension programmes for nuclear munitions can "not support new military missions or provide for new military

¹² The US Air Force is planning to integrate B61-12 with F-15E, F-16C/D, and B-2A aircraft, and eventually the F-35A Lightning II. The F-35A will later replace the F-16s. The US Air Force plans to equip all its F-35 variants in Europe with nuclear capability by 2024. See: <https://fas.org/blogs/security/2014/03/b61-12integration/>

¹³ <http://www.gao.gov/assets/680/674960.pdf> Pg. 2

¹⁴ <http://www.defensetech.org/2014/02/28/nuclear-bomb-upgrade-could-violate-key-treaty/>

¹⁵ The explosion over Hiroshima in 1945 had an estimated yield of 15 kilotons, see: <http://atomicarchive.com/Docs/pdfs/00313791.pdf> The B61-12's four selectable yields enable the bomb's explosive force to be adjusted before launch from a high of 50,000 tons of TNT equivalent to a low of 300 tons — 98 percent smaller than the Hiroshima explosion.

¹⁶ A video of the test, demonstrating the B61-12's ground penetration capability and accuracy, is available at: <https://www.youtube.com/watch?v=UwANHyPW3Tg>

¹⁷ https://fas.org/blogs/security/2016/01/b61-12_earth-penetration/

¹⁸ <http://nnsa.energy.gov/mediaroom/pressreleases/b61-b61-12-lep-life-extension-program-snl-lanl-sandia-national-laboratory>

capabilities.”¹⁹ Others have suggested that the bomb’s combination of accuracy and low-yield make the B61-12 the most usable nuclear bomb in the United States’ arsenal.²⁰

Hans Kristensen, a fellow with the Federation of American Scientists, has said that the bomb’s accuracy, lower yield and penetrative capabilities would allow the US military to employ the weapon in new mission sets and that military thinkers could be encouraged to start imagining a wider variety of situations in which the use of nuclear weapons would be acceptable.²¹



Prototype inert B61-12 fitted to a US Air Force F15-E

In a recent report, Kristensen alluded to how the bomb’s capabilities allow it to destroy targets that would have previously necessitated the use of a larger but more indiscriminate weapon. The bomb’s relatively low yield would produce less nuclear fallout than earlier versions of free fall nuclear weapons, something which would limit unintended casualties from a nuclear attack.²²

However, this lower fallout, combined with the bomb’s capability, also lowers the cost and scope of a nuclear strike – which could in turn increase the possibility that the bomb would actually be used in a military engagement.²³

Employing the B61-12 against hardened targets and underground facilities

It is widely acknowledged that many states around the world have realised that current non-nuclear penetrating weapons are relatively ineffective in destroying underground facilities.²⁴ As a result, the use of underground facilities is expanding as potential adversaries conceal and protect their most vital national security functions and activities.²⁵

North Korea is continuing efforts to construct and use underground facilities to protect and strengthen the defence of key elements of its leadership and military, including important parts of its nuclear programme.^{26 27} China, considered a frontrunner in underground facility

¹⁹ <http://www.defensetech.org/2014/02/28/nuclear-bomb-upgrade-could-violate-key-treaty/>

²⁰ <http://nationalinterest.org/blog/the-buzz/the-most-dangerous-nuclear-weapon-americas-arsenal-13433>

²¹ <http://uk.businessinsider.com/this-bomb-may-be-the-most-dangerous-in-us-arsenal-2015-7?r=US&IR=T>

²² http://fas.org/programs/ssp/nukes/publications1/Brief2014_PREPCOM2.pdf

²³ <http://uk.businessinsider.com/this-bomb-may-be-the-most-dangerous-in-us-arsenal-2015-7?r=US&IR=T>

²⁴ www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA560679

²⁵ Ibid.

²⁶ Ibid.

²⁷ <http://docs.house.gov/meetings/AS/AS00/20160302/104618/HHRG-114-AS00-Wstate-StewartV-20160302.pdf>

technology, is placing more of its military personnel, activities and key strategic leadership underground. Crucial parts of Syria's WMD, chemical and biological programmes are also protected underground, and Russia, well known for its massive and deep underground facilities, is in the middle of upgrading underground facilities responsible for housing its central command and control and strategic nuclear forces.²⁸

Once operational, the B61-12 would give US military planners the option of developing F-35-based nuclear strike missions that could destroy hardened targets and underground facilities. Under Toby Fenwick's plan, the UK would be given a similar capability, and could deploy F-35s armed with B61-12s from either the Queen Elizabeth-class aircraft carriers or established land bases.



A US Air Force F-15E drops an inert B61-12 during testing in October 2015. Official images from the test indicate that the B61-12 demonstrated accuracy of less than 30 metres and that the guided bomb has earth-penetrating capability that could be used against underground and hardened targets.

²⁸ www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA560679

Mission in mind?

Questions have been asked about whether this new capability could lead to more military options, including nuclear strike, being considered at the expense of negotiation and diplomatic efforts to control nuclear proliferation, particularly in the case of the US-led effort to address North Korea's nuclear and ballistic missile programmes. With regard to this issue, the UK Government continues to state its concern at North Korea's development of nuclear weapons and missile technology, and has warned that the country now faces an increasingly robust international response.²⁹ There have been suggestions that the development of the B61-12 was designed with North Korea in mind, although realistically the programme simply represents the modernisation of the US' aircraft-based TNW arsenal.³⁰

Some US Government officials involved in the B61-12 programme, including retired General James Cartwright, a former vice-chairman of the US Joint Chiefs of Staff and previously head of the United States Strategic Command, which has military authority over the nation's nuclear arms, have acknowledged that smaller yields and better targeting can make the arms more "thinkable" in terms to use.³¹

Critics further add that the B61-12 bomb, combined with the capability of the F-35 platform adapted for nuclear missions, undercuts efforts to make Russia reduce its TNW inventory and signals that it is acceptable for Moscow to modernise its TNW systems.³² Russia has labelled the testing of the B61-12 as "irresponsible" and "openly provocative".³³

Responding to what proved to be misinterpreted news reports regarding possible US plans to deploy B61-12 bombs at Büchel Air Base in Germany, replacing its current nuclear arsenal there, President Putin's Spokesman, Dmitry Peskov, argued that such a step would upset the

F-35 Lighting II: Key Facts

The US-led multinational project is the most expensive defence procurement programme in history. It was previously known as the Joint Strike Fighter programme.

The stealthy multirole combat aircraft is designed to perform ground attack and air defence missions.

Entering service with the RAF and the Royal Navy from 2018 onwards. The UK's F-35Bs, unlike the F-35A, are not configured to carry the B61-12. Under Fenwick's proposal, the MoD would instead procure the F-35C and adapt it for the nuclear mission.

Will partner Typhoon to provide the RAF's future fast-jet combat fleet and provide strike capability for the Royal Navy from the new aircraft carriers.

²⁹ <http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2016-02-11/HCWS537/>

³⁰ http://www.nytimes.com/2016/01/12/science/as-us-modernizes-nuclear-weapons-smaller-leaves-some-uneasy.html?_r=0

³¹ Ibid.

³² http://fas.org/programs/ssp/nukes/publications1/Brief2014_PREPCOM2.pdf

³³ <http://217.218.67.231/Detail/2015/07/13/420137/Europe-Russia-Deputy-Defense-Minister-Anatoly-Antonov-US-nuclear-test-B6112-nuclear-bomb-NATO>

strategic balance in Europe saying, “without a doubt it would demand that Russia take necessary countermeasures to restore the strategic balance and parity.”³⁴

Even if the harsh rhetorical responses from Moscow in response to the development of the B61-12 lack credibility, the rise of rhetoric related to the development of the weapon is cause for concern.

European Extended Deterrence and nuclear sharing

Since the 1960s, NATO has been practicing what came to be known as ‘nuclear sharing’: The US deploys aircraft-delivered tactical nuclear weapons under its strict control in Europe, for use by European allies who maintain aircraft capable of delivering these weapons.³⁵ It is widely known and accepted that the United States currently deploys 160-200 bombs at six bases in Belgium, Germany, Italy, the Netherlands, and Turkey.³⁶ These countries operate what are known as, dual-capable aircraft (DCA) – allied and US fighter aircraft that are configured to perform either conventional or theatre nuclear missions, using B61-variant gravity bombs, in the event of a major war.³⁷

There have been four purposes of this arrangement. First: Deterrence. During the Cold War, US nuclear forces were stationed in Europe to better deter the Soviet Union, which had conventional superiority; today the supposed purpose is to better hedge against Russian recidivism. Second: Transatlantic ties. The purpose of US nuclear weapons in Europe has been to bind the US to the European continent by making the US commitment more credible and visible. Third: Non-proliferation within the NATO alliance. US nuclear bases in Europe were meant to prevent US allies from developing their own nuclear weapons. And fourth: Cooperation. The purpose here is to give European allies a voice in NATO’s nuclear force planning.³⁸

The end of the Cold War radically changed the context of Western security, and, hence, NATO’s nuclear sharing arrangements. With the decline of Russia’s conventional military superiority, it has been argued that one of the traditional roles of US nuclear weapons under this arrangement has disappeared.³⁹

³⁴ http://netk.uni-nke.hu/uploads/media_items/csds-analyses-2015-16-the-modernization-of-the-b61-gravity-bombs-and-the-problem-of-misconceptions-peczeli-a-1.original.pdf Pg. 6

³⁵ Tactical nuclear weapons (TNW) are also known as non-strategic nuclear weapons (NSNW).

³⁶ In the past US nuclear weapons have been deployed to the UK. Although there was little public discussion of this issue during the Bush Administration, reports indicate that the United States withdrew its nuclear weapons from the RAF Lakenheath air base in 2006. It made these changes quietly and unilaterally, in response to US and NATO security requirements, without requesting or requiring reciprocity from Russia. See <https://www.fas.org/sgp/crs/nuke/RL32572.pdf> Pg. 17

³⁷ The only operational European dual-capable aircraft (DCA) are the Tornado and the F-16. Both first flew in 1974 and they are due to be retired within a decade.

³⁸ <http://www.nonproliferation.eu/web/documents/other/brunotertrais4e9bffa28b1f5.pdf> Pg. 111

³⁹ [http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209\[1\].pdf](http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209[1].pdf) Pg. 12

Beginning in the early 1990s, NATO member states reduced the number of sub-strategic nuclear weapons in Europe by more than roughly 90 percent since the early 1970s, when the deployment of nuclear weapons in Europe reached its high point in terms of size and diversity. The range of delivery systems was also drastically reduced, and in its own documents NATO has confirmed that by 2003 the number of different types of nuclear system deployed in Europe had been reduced from 13 in 1971 to one – the US B-61-variant gravity bombs carried on dual-capable aircraft.⁴⁰

NATO expansion, taking in a number of former members of the Warsaw-pact, has fundamentally altered the Alliance's nuclear dimension.⁴¹ But, despite the change to European political order, new members have been ruled out of a direct role in NATO's nuclear mission – a result of the NATO-Russia Founding Act of 1997 which declared that the alliance has “no intention”, “no plan” and “no reason” to deploy nuclear weapons on the territory of new members.⁴² Equally important, the Act also declared no need to change any aspect of NATO's nuclear posture or nuclear policy.

Some have contended that NATO's current nuclear posture does not match the political and military challenges ahead and thus cannot satisfy NATO's deterrence needs in a cohesive and credible manner.⁴³ Indeed, it is now widely recognised that the Alliance is witnessing a growing difference of opinion between member states over the utility of nuclear weapons deployed under the nuclear sharing arrangement. This has placed the issue of nuclear sharing back at the top of the NATO agenda.⁴⁴

Many people, in both Europe and the US, believe that nuclear sharing arrangements are a relic of the Cold War. Others, however, including officials in newer NATO nations, have argued that US non-strategic nuclear weapons in Europe not only remain relevant militarily, in some circumstances, but that they are an essential indicator of the US' commitment to NATO security and solidarity. Some analysts have noted that some of the newer NATO allies, such as Poland and the Baltic states, feel threatened by Russia and its arsenal of non-strategic nuclear weapons and that they would view the withdrawal of US nuclear weapons as a change in the US' and NATO's commitment to their security.⁴⁵

The 2010 NATO Strategic Concept sought to address these issues. The concept called for NATO to maintain “an appropriate mix of nuclear and conventional forces” and to “ensure the broadest possible participation of Allies in collective defence planning on nuclear roles”.⁴⁶

⁴⁰ http://www.bits.de/NRANEU/docs/090311_Future_Role_of_Nuclear_Weapons_in_NATO.pdf Pg. 26

⁴¹ [http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209\[1\].pdf](http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/nato-nuclear-policies/PDF/ruehle0209[1].pdf) Pg. 12

⁴² http://www.nato.int/cps/en/natohq/official_texts_25468.htm

⁴³ http://www.nti.org/documents/1152/NTI_Framework_Chpt4.pdf Pg. 83

⁴⁴ <http://www.tandfonline.com/doi/pdf/10.1080/09662839.2011.626404> Pg. 550

⁴⁵ <https://www.fas.org/sgp/crs/nuke/RL32572.pdf> Pg. 28

⁴⁶ <http://web.b.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=dcb20874-997e-4a19-ab9c-cc720b36715d%40sessionmgr120&vid=12&hid=101> Pg. 162

However, some experts believe that the new concept places significantly less emphasis on non-strategic nuclear weapons than did its predecessors.⁴⁷

Credible European extended deterrence in today's context

Both Russia and the United States are undergoing massive modernisation efforts to upgrade their strategic and non-strategic nuclear warhead delivery systems.

Russia's nuclear force modernisation is part of a wide-ranging and ambitious modernisation programme of its entire armed forces.⁴⁸ In the framework of this effort all Soviet-era nuclear weapons will be replaced. On land, this includes the development of the SS-27 ICBM, the RS-26 nuclear

The B61-12 bomb will have a very limited ability to hurt the greater strategic balance between Washington and Moscow

ballistic missile and a new "heavy" ICBM. At sea, eight Borei-class submarines will be introduced into the stockpile, each equipped with 16 or 20 Bulava nuclear ballistic missiles (SLBMs). In the air, the current Tu-160 Blackjack, Tu-95MS Bear, and Tu-22M bombers are undergoing upgrades, and a new replacement bomber, as well as a new air-launched cruise missile is also underway. In the field of tactical nuclear weapons, new SS-26 Iskander-M short-range ballistic missiles are replacing the nuclear-capable SS-21s, and Moscow will also deploy a new fighter bomber.⁴⁹

In light of this modernisation effort, it is unsurprising that some have said that the nuclear sharing arrangement, utilising the upgraded B61-12 gravity bomb, will have a very limited ability to hurt the greater strategic balance between Washington and Moscow.

A number of former senior NATO and United States officials have called for the US and NATO to agree to the removal of B-61 tactical nuclear bombs now deployed in Europe, citing that these weapons have no military utility, pose unnecessary security risks, are unpopular among the populations of the countries where they are stored, and have become potent symbols among non-nuclear-weapon states of what they see as the US' unwillingness to pursue disarmament in good faith as required under the Non-Proliferation Treaty. Most importantly

⁴⁷ Ibid.

⁴⁸ As well as updating its nuclear forces, Russia's armed forces modernisation programme has made major changes to the structure of the country's ground forces in a way that has optimised it to field a handful of powerful conventional brigades. However, western-based analysts suggest that the Russian military is going to find it increasingly hard to add truly modern, rather than modernised, conventional equipment to its inventories in large numbers as the Russian defence budget is set to decline from 2016 under the strain of declining oil prices and dwindling state financial reserves. See <https://janes.ihs.com/Janes/Display/1760321>

⁴⁹ http://netk.uni-nke.hu/uploads/media_items/csds-analyses-2015-16-the-modernization-of-the-b61-gravity-bombs-and-the-problem-of-misconceptions-peczeli-a-1.original.pdf Pg. 6

of all, it is concluded that their deterrence function can be covered by US and NATO strategic nuclear forces.⁵⁰

Further, the future of DCA capability in the five nuclear sharing countries remains uncertain. The F-16s and Tornados that make up the DCA fleets of the five European nuclear sharing states are reaching the end of their operational lifespans.

Some countries will be able to maintain their DCA role by purchasing the F-35A. The conventional take-off-and-landing variant of the F-35 will be made dual-capable for the US Air Force by 2024 in order to carry the B61-12 nuclear bomb when it enters service in the early 2020s. The Netherlands, Turkey and Italy all plan to purchase the F-35A, which means that their DCA capability will continue, provided their current fleet of F-16 and Tornado dual-capable aircraft are maintained until the F-35A replacements enter operational service.⁵¹

Belgium has not yet officially chosen a replacement for its fleet of F-16A/Bs, but given that the DCA capability is a part of Belgium's fighter requirements, the F-35A appears to be the only option.⁵²

Despite much speculation and misreporting, the future of Germany's DCA capability is much more uncertain and the possible deployment of the B61-12 to Germany has created intense debates within the country. Germany is not planning to purchase the F-35A or any other fighter aircraft until at least the 2030s – relying instead on the Eurofighter Typhoon. The Tornado currently provides Germany's nuclear DCA capability, but the aircraft has a limited shelf life and is due to be retired in the mid-2020s. Whilst the Typhoon can now be considered a true multi-role fighter, it is not presently DCA capable, but experts say it could be adapted.

Regardless of whether the five European nuclear sharing states opt to procure aircraft that maintain a DCA capability, within Belgium, Germany, and the Netherlands, there now exists broad parliamentary and popular support for a withdrawal of US nuclear weapons from their territories.⁵³ The leaderships of each of these countries have, to a degree, recognised this and in the months prior to the completion of NATO's 2010 Strategic Concept there were calls for the US to end nuclear sharing arrangements in Europe. For example, the late former German foreign minister, Guido Westerwelle, stated that he supported the withdrawal of US nuclear weapons from Germany. Some reports indicate that Belgium and the Netherlands also supported this goal.⁵⁴

Despite the uncertainty regarding the future of nuclear sharing and questions over the deterrence value of DCA forces, some in the United States Congress have called for the US to consider expanding its deployment of dual-capable aircraft and nuclear bombs into eastern

⁵⁰ http://www.nti.org/documents/1152/NTI_Framework_Chpt4.pdf

⁵¹ <https://rusi.org/publication/rusi-defence-systems/forced-evolution-europe%E2%80%99s-tactical-nuclear-capability>

⁵² Ibid.

⁵³ https://www.armscontrol.org/system/files/Tactical_Nuclear_Report_May_11.pdf Pg. 23

⁵⁴ <https://www.fas.org/sgp/crs/nuke/RL32572.pdf> Pg. 18

NATO nations, in response to Russia's aggression in Ukraine.⁵⁵ Such action would contravene the NATO-Russia Founding Act of 1997, but any nation that operated a dual-capable aircraft, such as the F-35A, could theoretically perform a nuclear mission.⁵⁶ Furthermore, NATO's Baltic members and Poland argue that Russia is in clear violation of the Act and that the alliance is no longer obliged to adhere to it.⁵⁷

The missile and submarine-based strategic nuclear forces of the United States and UK should help assure the eastern allies of NATO's ability to defend them

There is little evidence that NATO has requested, or would welcome, deploying a DCA capability to Eastern Europe and some have argued that such steps could ignite a new arms race that could further undermine security in Europe.⁵⁸ However, it is widely known that Poland in particular views Europe's DCA forces as a useful and operationally relevant deterrent capability – one which it wishes it had.⁵⁹

NATO has adjusted its conventional force posture and operations in response to Russia's actions in Ukraine. According to NATO documents, these conventional forces, when backed by the missile and submarine-based strategic nuclear forces of the United States and UK, should help assure the eastern allies of NATO's ability to defend them.⁶⁰

This firmly places the role of strategic nuclear ballistic missiles and conventional forces at the heart of NATO's extended deterrence posture in Europe. The UK's nuclear deterrent is assigned to NATO and its primary function is to contribute to the Alliance's collective defence.⁶¹ Therefore any plan that suggests replacing a key element of NATO's strategic force with an arguably less credible alternative as a primary deterrent must be critically evaluated.

⁵⁵ <https://www.fas.org/spp/crs/nuke/RL32572.pdf> Pg. 30

⁵⁶ The F-35A, the conventional take-off-and-landing variant of the F-35, will be made dual-capable for the USAF by 2024 in order to carry the B61 Mod 12 nuclear bomb when it enters service in the early 2020s.

⁵⁷ <http://blogs.wsj.com/brussels/2014/09/03/qa-1997s-nato-russia-founding-act/>

⁵⁸ <https://www.fas.org/spp/crs/nuke/RL32572.pdf> Pg. 30

⁵⁹ <https://rusi.org/publication/rusi-defence-systems/forced-evolution-europe%E2%80%99s-tactical-nuclear-capability>

⁶⁰ <https://www.fas.org/spp/crs/nuke/RL32572.pdf> Pg. 30

⁶¹

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/478933/52309_Cm_9161_NSS_SD_Review_web_only.pdf Pg. 34

Critiquing Toby Fenwick's 'consolidation and partial withdrawal' proposal.

Options for NATO's extended deterrence and nuclear sharing arrangements, similar to Toby Fenwick's proposal, have been considered by NATO planners and academics in recent years.⁶² Most of the analysis focuses on withdrawing B61-variants from Europe completely, but the option to consolidate DCA forces to two locations, as suggested by Fenwick, has also been examined.

Consolidation would not have a significant effect on US non-proliferation efforts.

Fenwick argues that retiring Trident and offering to co-host NATO's DCA B61-12 European stockpile with Italy, would demonstrate the UK's "commitment help Belgium, Germany and the Netherlands deliver an important domestic policy" and "take a concrete step down the nuclear ladder and towards future nuclear disarmament as the international situation allows in accordance with the UK's nuclear Non-Proliferation Treaty obligations."⁶³ Similar proposals, generally referred to as a 'consolidation strategy' within the security analysis community, have drawn criticism on a number of grounds.

First, it is argued that consolidation would not have a significant effect on US non-proliferation efforts. Critics argue that any amount of nuclear sharing violates Article I of the Nuclear Non-Proliferation Treaty (NPT).⁶⁴ Article I of the NPT states:

"Each nuclear-weapon State Party to the Treaty undertakes not to transfer to any recipient whatsoever nuclear weapons or other nuclear explosive devices or control over such weapons or explosive devices directly, or indirectly; and not in any way to assist, encourage, or induce any non-nuclear weapon State to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, or control over such weapons or explosive devices."

Whether the United States bases its TNWs in five European nations or only one or two is irrelevant to the political question of whether any US policy of nuclear sharing with non-nuclear members of the NPT violates Article I. Therefore, under Fenwick's plan, Italy, a non-nuclear nation under the terms of the NPT, would remain part of NATO's nuclear sharing arrangements. In the eyes of critics, this would continue to place the US and Italy in violation of the NPT.

While consolidation would decrease the scope of that violation, it would not reduce the ability for states to continue criticisms that the United States is in non-compliance with the treaty. As

⁶² http://www.nti.org/documents/1152/NTI_Framework_Chpt4.pdf Pg. 85

⁶³ <http://www.centreforum.org/assets/pubs/retiring-trident.pdf> Pg. 5 and 46

⁶⁴ <http://csis.org/blog/middle-ground-nato%E2%80%99s-nukes>

a result, only the complete withdrawal of TNWs on European soil would garner potential non-proliferation benefits.⁶⁵

If the UK were to develop the new capabilities envisaged by Toby Fenwick it would also likely mean embarking on a testing programme. This would not only be time consuming and expensive, but would more than likely breach the Nuclear Test-Ban Treaty.

Second, it is unlikely that the consolidation of B61-12 TNWs to sites in the UK and Italy would create political momentum for US-Russian cooperation and future arms control efforts.⁶⁶ Russia does not seem truly interested in reducing its TNWs. Instead, Moscow has assigned them as a replacement for the conventional capabilities that it now lacks.⁶⁷ Further complicating matters, the 2010 NATO Strategic Concept has linked any future decision on reducing NATO's nuclear weapons to parallel measures taken by Moscow to reduce the vast amount of Russian TNWs in Europe.⁶⁸

Consolidation will not solve NATO's fundamental problem of sustaining a nuclear posture that does not match today's deterrence requirements

Fenwick argues that maintaining TNWs in Europe is a better path to US-Russian cooperation because it retains important leverage for the United States in future arms control negotiations. In his view, whilst consolidation would not directly improve US-Russia relations or increase the prospect of Russian action on its TNW arsenal, it would retain a bargaining

chip for future US-Russia arms control negotiations. This fails to address the fundamental issue at hand: A consolidation of TNWs in Europe will not solve NATO's fundamental problem of sustaining a nuclear posture that, following the end of the Cold War, does not match today's deterrence requirements.⁶⁹

Because NATO's forward deployed TNWs have lost most of their functions following the end of the Cold War and are increasingly losing the support of NATO allies, it is argued that they can be withdrawn to the United States. Extended deterrence in today's political environment can be maintained with strategic nuclear forces – such as submarines – alone. For example, the United States has extended its nuclear umbrella over Japan, South Korea, and Australia for two decades without having stationed nuclear weapons on the soil of these countries.

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ <https://www.fas.org/sgp/crs/nuke/RL32572.pdf> Pg. 4

⁶⁸ www.nti.org/documents/1152/NTI_Framework_Chpt4.pdf Pg. 86

⁶⁹ Ibid. Pg. 86

It is argued that only the complete removal of US TNWs from Europe, basing European extended deterrence on strategic nuclear forces alone, will likely create the necessary political environment needed for Washington and Moscow to reduce Russia's arsenal of TNWs.⁷⁰

Third, the credibility of air-based nuclear forces as an effective deterrent has been called into question. It is argued that the real challenge for a DCA force is successfully accomplishing a nuclear strike. Realistically, the only imaginable targets for DCA aircraft would be outside of NATO airspace, which would put them at ranges that would require mid-air refuelling for the strike. Once the decision to carry out a nuclear strike is made, such a mission is fraught with many challenges.⁷¹

Karl-Heinz Kamp, former Director of Research at the NATO Defence College, and advisor for the NATO Expert Group on the 2010 Strategic Concept, and Major General Robertus Remkes, former Director, Strategy, Policy and Assessments for United States Europe Command, describe a DCA deterrent as a mission of "seven consecutive miracles":⁷²

1. Surviving a first attack by an adversary
2. Receiving the authority to arm the weapons and conduct a nuclear strike
3. Taking off and proceeding to the target without malfunction or technical difficulties
4. Rendezvous with a tanker and getting enough fuel to make it to the target
5. Surviving air and surface defences along the way (attack phase vulnerability)
6. Locating and correctly identifying the target
7. Dropping the weapon and that it functions correctly

In sum, Kamp and Remkes, conclude that any attempt to use the B61-12 will be challenged by the visibility of the many actions required to prepare the weapon and crews for such an attack. These factors fundamentally limit the credibility of a deterrent based on DCA forces and, in terms of deterrence, it is not plausible that NATO would consider using such a vulnerable system when a nuclear task could also be fulfilled by strategic weapons.

Finally, in view of the above-mentioned insight that nuclear weapons have to be militarily useable (in a plausible manner) in order to have a political deterrence effect, Kamp and Remkes recognise that the conceptual plausibility of maintaining aircraft-based TNWs on European soil in today's security environment is close to nil. They reaffirm the belief that a NATO nuclear posture based on nuclear sharing and DCA forces does not suit today's post-Cold War environment, and thus, cannot satisfy NATO's deterrence needs in a cohesive and credible manner.

⁷⁰ Ibid. Pg. 86

⁷¹ Ibid. Pg. 81

⁷² Ibid. Pg. 82

Vulnerability

Particular attention needs to be paid to Toby Fenwick's modelling of a UK-conducted nuclear strike using the B61-12 based on a F-35 DCA platform and, in particular, his assumptions when considering the vulnerability of this system.

Fenwick's paper correctly identifies that vulnerability takes two forms: first; the vulnerability of the bases where aircraft are based to a surprise attack. Second; vulnerability in the attack phase of a nuclear mission – when the aircraft and their weapons are denied the ability to complete a mission or are destroyed (“mission kill” and “hard kill”).

When thinking about the vulnerability of an aircraft-based nuclear force, its visibility, compared to a CASD posture should also be considered. Visibility is escalatory, and an aircraft-based system would require a visible deployment during a time of crisis, which would have a potentially de-stabilising and escalatory effect in any diplomatic crisis since other nations would be able to spot when the UK was mobilising its capabilities. UK aircraft would also require permission to transit the airspace of other states, which would be clearly visible, thus reducing its effect as a deterrent.

Vulnerability on the ground and on aircraft carriers

Unlike the current CASD posture, which is by default invulnerable to a surprise nuclear attack, an aircraft-based deterrent would be susceptible to pre-emptive strikes. Whilst they were on the ground aircraft would be at risk to conventional and nuclear attacks as well as terrorism. At sea, when a fleet of DCA capable aircraft were aboard an aircraft carrier, they would be exposed as that ship itself could be detected and would therefore be vulnerable to an array of anti-ship weapon systems.

It should also be noted that countries participating in NATO's nuclear sharing arrangements, operating DCA aircraft, appear to have been targeted for nuclear destruction by Warsaw Pact planners during the Cold War. In 2005 Poland's former defence minister, Radosław Sikorski, published a Warsaw Pact map dating from 1979 showing detailed plans for Soviet nuclear strikes against Western Europe. The map indicated that Soviet nuclear forces would have struck Germany, the Netherlands, Denmark and Belgium in response to a NATO first strike.⁷³ However, the two European



Poland's former defence minister, Radosław Sikorski, presents a 1979 Warsaw Pact map showing potential nuclear attacks on Belgium, Germany and the Netherlands. Each of those countries continue to participate in NATO's nuclear sharing arrangements, operating DCA aircraft. The map also shows that the UK and France would have been spared.

⁷³ <http://www.theguardian.com/world/2005/nov/26/russia.poland>

countries operating an independent nuclear deterrent system, Britain and France, were not targeted in the plan.

Vulnerability in the attack phase

Underpinning Toby Fenwick's proposal is his assertion that a DCA force comprising of a number of F-35 aircraft, would be capable of conducting a successful nuclear strike, causing widespread damage against chosen target(s).⁷⁴

Fenwick assesses that an F-35-based force would survive the attack phase due to the following factors:

1. The stealthy characteristics (also known as Low Observability – LO) of the F-35, giving the aircraft a low radar cross-section (RCS).
2. The approximate 40km standoff range of the B61-12
3. F-35/supporting aircraft electronic warfare (EW) capability (also known as jamming)
4. Superior training and tactics of UK pilots

With regards to assessing the F-35's stealthy characteristics, Fenwick's primary source is Lockheed Martin's F-35 website. The manufacturer describes the F-35s LO (stealth) capability in the following terms:

"The F-35 achieves low observable (LO) stealth performance through its fundamental design. The F-35's external shape, internal carriage of weapons and fuel, embedded mission systems sensors, and state of the art manufacturing processes all contribute to the F-35's unique stealth performance."⁷⁵

Adding

"In general, stealth is the ability to evade detection by radar, infrared sensors or emission interception. Stealth provides greater survivability and access, allowing aircraft to operate in contested areas, including anti-access/area denial environments that legacy fighters simply cannot penetrate or evade. US Air Force leadership considers advanced stealth technology "the price of admission" into modern warfare."⁷⁶

Whilst it is generally accepted that the F-35 with its stealthy design, coupled with its advanced radar and EW capability, can get much closer to modern aerial (and ground-based) threats than more traditional fighter platforms like the Typhoon without being engaged, it is still risky

⁷⁴ <http://www.centreforum.org/assets/pubs/retiring-trident.pdf> Pg. 55

⁷⁵ <https://www.f35.com/about/capabilities/stealth>

⁷⁶ Ibid.

to suggest that the UK's nuclear deterrent should be based on an aerial platform that has not been tested operationally against real-world threats.⁷⁷

However, Fenwick's own modelling suggests that large numbers of F-35s, attacking targets protected by advanced Russian air defence systems, should remain undetected up to the point of B61-12 release.⁷⁸ This claim rests on a number of assumptions as well as Fenwick's assessment of the capabilities of a single hostile air defence brigade operating the Russian S-400 Triumf (also known as the SA-21 GROWLER) surface-to-air missile system.

In Fenwick's modelling he assumes the target is coastal and defended by a single, co-located S-400 Triumf brigade. This has a number of implications. First, a deterrence posture cannot be based on countering coastal targets alone. Second, this assumption ignores the principle of attacking targets based in the interior of a hostile nation, protected by multiple integrated air defence systems, facing all aspects of the aircraft.

Fenwick's modelling, based on 80 B61-12s being launched simultaneously at a single coastal city-scale target from 80 F-35s, leads him to suggest that in a 'worst case' scenario one or two bombs would penetrate an enemy's advanced air defence system, implying widespread destruction. Once released, most of the B61-12s would be destroyed in the air by the S-400 air defence brigade's interceptor missiles, which would prioritise destroying the incoming bombs rather than the aircraft delivering them. However, Fenwick does suggest that the F-35's EW capability would likely ensure more B61-12s reached their target. This, in his view, would achieve deterrence.

But this does not take into account a scenario where a target is hundreds of miles within the interior of a hostile nation, or where the mission is against multiple targets as required by the Duff Group's Option 3a and 3b level of inflicted unacceptable damage.

It is also important to note, as Fenwick does, that an aircraft's radar cross-section depends on which direction a radar is looking at the aircraft, known as the aspect. The F-35 has the lowest RCS when

F-35 Lighting II: Stealth Characteristics

The F-35's stealthy characteristics provides greater survivability and access to contested air space.

The aircraft has a reduced radar cross – section (RCS) compared to previous generation aircraft.

In order to reduce its RCS, the F-35 carries its weapons internally – although it does have external pylons that can carry missiles, bombs, and external fuel tanks at the expense of increased RCS, and thus reduced stealth.

When its internal weapons bay is opened, prior to the release of a weapon, the F-35's low RCS is increased, risking detection by hostile air defence systems. The F-35 reportedly has a much higher rear RCS aspect.

Fenwick's proposal would utilise a modified aircraft carrier-based F-35C, capable of carrying the B61-12 in its internal weapons bay.

⁷⁷ The UK's F-35s are currently in the operational test and evaluation stage and therefore the amount of information available about the aircraft's capabilities is limited. However, for a useful analysis of the F-35's potential see: https://rusi.org/sites/default/files/20160201_whp_maximum_value_from_the_f-35_web.pdf

⁷⁸ <http://www.centreforum.org/assets/pubs/retiring-trident.pdf> Pg. 55

viewed from the frontal aspect, but reportedly has a much higher rear RCS aspect.^{79 80} This makes the aircraft more vulnerable to radar (and surface-to-air missiles) positioned to its rear and further calls into question Fenwick's modelling, where the strike scenario is based on a fleet of F-35s approaching a coastal target from presumably uncontested sea, free of air defence systems.

In Fenwick's modelling the number of warheads that reached the target was relatively low, even in a comparatively 'easy' mission. Therefore, applying the same methodology, it has to be assumed that the same number of aircraft attacking inland targets, passing over advanced air defence units along their ingress route, would fare much worse.

Fenwick simply has not modelled how a fleet of 80 UK DCA F-35s would fare against a number of interior-based targets defended by multiple integrated air defence brigades, facing all aspects of the aircraft. As outlined earlier, the Duff Group's Option 3a and 3b, on which Fenwick's analysis is supposedly based, requires unacceptable damage to be inflicted on multiple targets. Rates of mission kill and hard kill losses to UK aircraft incurred in Fenwick's own modelling suggest Option 3a and 3b would not be achieved by an F-35-based nuclear force. His modelling also suggests that an F-35-based force would also be unable to inflict unacceptable damage at a level much lower than in the Duff Group's Options 3a and 3b.

It is unrealistic to suggest that hostile air defence systems deployed along the ingress route of a DCA fleet attacking a range of targets that fulfil the Duff Group's Options 3a and 3b could be countered. The required number of F-35s would be too high to carry the pre-requisite number of both B61-12s required for the nuclear strike mission, and the air-to-ground missiles needed to counter air defence systems. In the event of a nuclear strike mission scenario, it is also very uncertain whether allies such as the United States would add their own valuable F-35 assets, capable of countering air defences, to a UK mission.

Costs

Toby Fenwick's paper underestimates the value of maintaining an indigenous shipbuilding capability in the UK and there are numerous cost implications and problems with using the F-35 as a nuclear delivery platform.

There are serious questions over whether the UK's planned order of 138 aircraft would be enough to operate the F-35 in a DCA role under a NATO nuclear sharing arrangement. Using Toby Fenwick's own modelling, it is likely that a fleet of F-35s participating in a nuclear mission based on Duff Group criteria targets would incur considerable losses. Therefore, these losses would represent a large proportion of the UK's entire F-35 fleet, needed for both conventional and nuclear missions.

⁷⁹ Ibid. Pg. 96

⁸⁰ <http://www.ausairpower.net/PDF-A/DT-CVLO-Mar-2012.pdf> Pg. 9

Despite this, Toby Fenwick claims that there is “no reason” why the UK would need to procure more than 138 aircraft already planned if his proposal was adopted.⁸¹ However, as outlined earlier, it is assessed that a UK F-35-based nuclear force would not be capable of achieving nuclear deterrence. A much greater number of F-35s would be required to fulfil this role, if indeed this type of platform is suitable at all. Fenwick’s miscalculation regarding the capability of an F-35-based nuclear force directly leads him to significantly underestimate what the cost of a more effective F-35-based nuclear deterrent would be.

Further to this, the F-35 programme has been fraught with technical and financial problems, and has involved complex negotiations with a number of other partner nations. Relying on the platform to provide the UK’s nuclear deterrent would be a huge risk, especially when compared to the stability of the UK’s sovereign submarine construction industry. Also, if the Trident system was decommissioned, it is likely that this would cost several billions.⁸²

Conclusion

At a time when the nature of security in Europe has been transformed, the maintenance of a credible and effective deterrence posture becomes more, not less, important. A CASD posture may have grown out of the ‘Moscow Criterion’ but has developed to be able to meet a wider range and more discriminate range of targets wherever threats emerge, which is appropriate to today’s security landscape. Based on Toby Fenwick’s own modelling, an F-35-based UK DCA force would be unable to strike the full range of targets necessary to inflict unacceptable damage on a hostile state and, therefore, would not achieve credible deterrence. At the same time, if the UK adopted this system, it would further legitimise a NATO nuclear deterrence posture that is unfit for the post-Cold War, 21st century security environment.

⁸¹ Fenwick’s proposal would convert UK F-35 orders from the F-35B short-take off vertical landing (STOVL) variant to the F-35C aircraft carrier Catapult Assisted Take-Off But Arrested Landing (CATOBAR) variant. The F-35B’s internal weapons bay is too small to accommodate a B61-12.

⁸² <http://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7353> Pg. 50