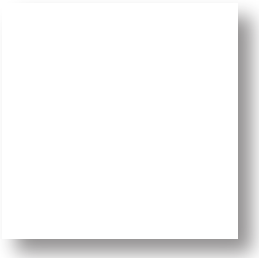
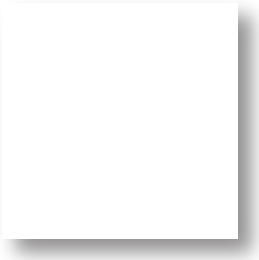
Dropping the bomb:
a post Trident future

Toby Fenwick





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About the author

Toby Fenwick began his involvement with CentreForum in 2011, working with Stephen Williams MP and Portman Capital on CentreForum's bank share distribution proposal. Currently a Senior Policy Adviser for Fleishman-Hillard, Toby holds graduate degrees in international law and international relations from UCL and LSE. A former HM Treasury civil servant, he served in the RAF intelligence reserve from 1995 to 2009, and has written for Chatham House and undertaken research for the Parliamentary Assembly of the Council of Europe.

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Contents

Executive summary

Britain must decide whether or not to renew the Trident submarine launched ballistic missile system in early 2016 by replacing the *Vanguard*-class submarines. Currently, or in the foreseeable future, there is no credible nuclear threat to the UK or her allies that will be deterred by a British nuclear weapons programme that is not already deterred by the United States' nuclear forces. Based on

- the prevailing and any foreseeable strategic situation
- the evolution in the international legal order since the 1980s
- the implications of the national fiscal position

the UK has a unique opportunity to decide whether continuing to field a nuclear weapons system – and in particular Trident missiles from Royal Navy submarines – remains the correct strategic choice in the first half of the 21st century.

I conclude that it is not.

Britain's fiscal position has dictated cuts in public spending. To pay its share of deficit reduction and cover excessive demand on available resources, the MOD must find £74bn of savings over ten years. Given that replacing the Trident submarines will probably cost between £25-£33bn, and the parameters of world relations have changed fundamentally since the end of the Cold War, it is surprising that Trident renewal has instigated so little debate.

When the debate over whether to replace Polaris with Trident began in the late 1970s, London and Paris feared so-called strategic decoupling, under which the Soviet Union's nuclear forces could deter the United States from responding to a Soviet attack confined to Western Europe. Against this backdrop it was judged that a credible threat existed, allowing a case to be made for an independent UK nuclear weapons programme. Purchasing Trident was understood to be the most cost-effective option to deliver a survivable weapons

system that could guarantee Moscow's destruction, overcoming the strategic decoupling problem.

Though advocates claim Trident is necessary to meet the UK's geopolitical and military requirements, the unspoken rationale is that nuclear weapons in general – and Trident in particular – remain essential to retaining the UK's international status. Indeed, some go so far as to link Trident replacement to the maintenance of the UK's Permanent Membership on the UN Security Council.

In reality, the proposition that Britain should invest a sum similar to the cost of High Speed 2 based on fears for international status is remarkable. First, Britain cannot lose its Permanent Seat without agreeing to do so, which negates concerns for international influence. Second, and more importantly, the MoD faces further conventional defence cuts in an attempt to balance its budget. Reallocating funds from Trident to the MoD's conventional forces is a far more effective way of ensuring that Britain can continue to play a major international role.

Indicatively, reallocating 80 per cent of Trident's capital spending could fund substantial elements of the MoD's Future Force 2020 proposals which are otherwise likely to be unaffordable. Further, the opportunity exists to use the savings to reprieve some capabilities scheduled for premature retirement in 2015, such as the Sentinel reconnaissance aircraft.

Given the disproportionate share of the 2010 Strategic Defence and Security Review's cuts, the table below demonstrates how this reallocated investment could provide investment to address the cuts in conventional maritime and air capability.

	Cost (£m)*
Converting four Trident submarines to carry conventional cruise missiles	3217.1
200 Tomahawk cruise missiles to arm the converted Trident submarines	99.2
Three additional *Astute*-class attack submarines	2243.1
40 F-35C Joint Strike Fighter Aircraft	4575.9
Seven of the new Type 26 frigates	2800.0
Four E-2D Hawkeye carrier-borne early warning aircraft	447.1
Eight P-8 Poseidon maritime patrol aircraft	1239.7
Converting HMS QUEEN ELIZABETH to operate conventional take-off and landing F-35C aircraft	1200.0
Total	15823.5

*2011 Pounds. Where required, converted from USD at a rate £1 = $1.55

It is for those who advocate the replacement of Trident and increased spending on the UK's conventional forces to explain where the increase in funding – to something in the order of 3–3.5 per cent of GDP – can be found by tax increases or spending cuts in other Departments through to 2017–18.

It is welcome that the Coalition is conducting a study into the alternatives to like-for-like Trident replacement. However, even if the technical and operational challenges of a cruise missile-based system could be overcome and it offered considerable cash savings, it is hard to see that such a replacement would offer a sufficient security advantage to exceed the opportunity costs of reallocating these funds to the UK's under-resourced conventional forces. The same concerns apply to most notions of increased integration with France.

Withdrawal of the UK's fielded nuclear weapons does not mean that the UK will forego nuclear weapons capability. Instead, this

paper advocates that the UK move to a nuclear threshold posture under which it retains the fissile material and engineering capability to produce nuclear weapons. If there was such a substantial deterioration in the international climate that Britain again required an operationally independent nuclear weapons system, it would then have the requisite infrastructure. Retaining this regeneration capability allows the UK to deploy its scientists and technical specialists to work on verification technologies that will be required for further global nuclear disarmament, known as "nuclear zero".

By scrapping Trident, the UK would be able to use the savings to increase the capacity of its conventional forces. It would also be able to improve significantly its medium term conventional strike capability through converting the *Vanguard*-class submarines to carry conventionally-armed cruise missiles. Ultimately, investing in conventional forces will be far more effective in protecting the UK's international status than replacing Trident.

The following recommendations should be taken as one coherent package.

Policy recommendations

Focus resources on UK conventional forces

***Recommendation one**:* Retire the existing Trident system immediately without replacement and convert the current Trident submarines to a conventional role from 2014 through to life-expiry in 2029 – 32, recycling 100 per cent of the savings into the UK's conventional forces.

Such a conversion replicates the US Navy's so-called "Tactical Trident" programme, which has converted four *Ohio*-class submarines to carry up to 154 cruise missiles as well as Special Forces. In UK service, this would see the converted *Vanguard*-class submarines carrying up to 98 cruise missiles (depending on configuration), providing a survivable, flexible and covert platform capable of striking targets at more than 1200nm range. These converted *Vanguard*-class submarines will provide long-range conventional strike capability when the *Queen Elizabeth*-class carriers and their associated air-wing become fully operational in 2030.

Recommendation two: Commit to continue to meet the NATO 2 per cent of GDP on defence budget benchmark, and honour the one per cent real growth in the equipment budget from 2015.

The UK is only meeting the NATO 2 per cent of GDP target through counting the supplemental costs of the war in Afghanistan, and may fail to meet the target by the end of this parliament. The 2010 Strategic Defence and Security Review (SDSR 10) detailed the blueprint for a balanced conventional force with global deployment capability, known as Future Force 2020. Britain faces a direct financial choice between Future Force 2020 and Trident replacement, as procuring the Trident replacement will render the conventional elements of Future Force 2020 unaffordable under any foreseeable budget through to 2028. This is a true even with the government's commitment to a one per cent increase in the Equipment Programme from 2015-20.

Recommendation three: Retain the UK's ability to design and produce nuclear-powered attack submarines to support the UK's global responsibilities.

Nuclear-powered submarines are likely to remain the covert power projection tools of choice over global ranges for as long as the UK intends to play a military role on a global scale. As there is no certainty of supply from overseas, the UK will need to retain sovereign capability to design, build, operate and decommission nuclear-powered submarines for the foreseeable future. We should also make these nuclear-powered but conventionally-armed submarines available to meet the emerging requirements of Australia and Canada.

Building verification capability to push to worldwide nuclear disarmament

Recommendation four*:* Build on the existing work of AWE Aldermaston with VERTIC and international partners to create the verification mechanisms necessary to achieve and sustain a world without nuclear weapons (nuclear zero) in line with the aspiration of President Obama in his 2009 Prague speech.

The challenge of verifying deep nuclear reductions is significant, but it is essential to achieving and sustaining worldwide nuclear disarmament. Former Foreign Secretary Margaret Beckett expressed a vision of using the expertise of AWE Aldemaston as a laboratory of disarmament in a 2007 speech to the Carnegie Endowment for International Peace. The UK should continue to play a major role in developing the technologies to meet the verification challenge, and the expertise of the staff at AWE Aldermaston will be essential.

Move the UK to nuclear threshold status

In proposing the immediate retirement of the current Trident system, this paper is reflecting the international, fiscal and legal environment. But whilst I seek a nuclear-free world, I understand that the UK may in future require an independent nuclear capability. In moving to nuclear threshold status, the UK retains the ability to regenerate its nuclear capability in the unlikely event that the international situation demands it.

***Recommendation five**:* Renew the US-UK Mutual Defence Agreement for another decade in 2014.

***Recommendation six**:* Retain the Trident Sales Agreement as amended, fully complying with our obligations to the United States Government and to the US Navy.

Britain is committed to co-developing the Common Missile Compartment for future UK/US nuclear powered ballistic missile submarines, and contributing towards the funding of Trident II (D5) SLBM life extension (D5 LEP). The UK will honour its international contractual obligations to the United States, and continue its deep collaboration in submarine technology with the US Navy and American defence suppliers. This ensures that the UK retains the option to design, build and operate a new generation of Trident armed submarines.

***Recommendation seven**:* Retain the UK's existing weapons-grade Uranium and Plutonium subject to the existing safeguards regime.

In 2010 the UK was estimated to hold 21.2 tons of Highly Enriched Uranium (HEU) and 3.2 tons of weapons-grade Plutonium. This is assessed to be sufficient to support the current warhead stockpile and the requirements for submarine nuclear reactors for the next 75 years. Retaining these military stocks provides the basis for a future nuclear weapons programme if required by changes in the international climate.

***Recommendation eight**:* Retain the capability to produce and deploy a nuclear weapon at short (12 months') notice in the event that a credible nuclear threat to the UK emerges.

Such an air-dropped weapon would provide a short-term deterrence and, whilst this reconstitution capability will be indigenous, there are obvious benefits in continuing the UK's nuclear partnership with the United States.

Introduction

In meeting the strategic challenge of restoring the public finances in the 2010 Comprehensive Spending Review (CSR10), only the NHS and DFID were exempt from cuts. Against average cuts of 19 per cent for non-protected Departments, the MoD fared comparatively well: cumulative budget cuts of 8.5 per cent to 2014-15.[1] However, with existing unfunded procurement commitments of £51bn,[2] the £23bn of deficit reduction cuts leaves the MoD with £74bn to find over the next ten years.[3]

£74bn of savings makes painful cuts inevitable. To date, this has been a combination of manpower cuts – 20 per cent of the uniformed strength and 40 per cent of the civilian personnel over four years – and the loss of ships, aircraft and equipment projects. Yet the failure of the MoD to publish the Forward Equipment Programme, along with a National Audit Office (NAO) assessment of the assumptions underlying the Equipment Programme as scheduled in late 2011, strongly suggests that the necessary cuts to bring the Equipment Programme into balance are still being negotiated, and that there is more pain to come for the UK armed forces.

As the MoD's single largest procurement, it was incongruous that the Trident replacement was exempted from the defence review, and stranger still that it was not the subject of public debate.

1 Spending Review 2010, HM Treasury Cm 7942, October 2010. Available from cdn.hm-treasury.gov.uk/sr2010_completereport.pdf

2 The current government inherited unfunded liabilities of £51bn over the decade 2010-11 to 2020-21, to which additional cuts of £23bn were made as part of the UK deficit reduction strategy. M Chalmers 'Looking into the Black Hole: Is the UK Defence Budget Crisis Really Over?', RUSI, September 2011. Available from www.rusi.org/downloads/assets/RUSIBriefingPaperSept2011.pdf

3 'Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review' (SDSR), Cm 7948, The Stationery Office, 2010. Available from www.direct.gov.uk/sdsr

Not only is the Trident replacement likely to cost between £25bn[4] and £33bn[5] in capital costs alone, the probable profile[6] of the spend between 2019 and 2029 suggests that Trident replacement will consume an average of between 20.3 per cent and 31.7 per cent of the MoD's *total* capital budget.[7] Worse, this will occur just at the time that the MoD will be replacing key conventional capabilities for the Royal Navy, British Army and the RAF, setting the stage for a decade-long MoD budget crisis in the 2020s.

Much has been made of the 'unfairness' of funding Trident replacement from the MoD budget and, in the process, explicitly making it compete for funds with the UK's conventional forces.[8] However, the notion that there was ever some special financial provision for the UK's nuclear weapons is a myth – albeit one widely believed. As then Defence Secretary Francis Pym made clear in July 1980: "the provision of the strategic deterrent has always been part of normal defence budgeting. It is a weapons system, like any other weapons system—ships, tanks or whatever it may be."[9]

Thus, short of a significant increase in the MoD capital budget –

4 Outturn price of the Trident replacement was estimated by the MoD at £25bn in May 2011. See www.guardian.co.uk/politics/2011/may/18/new-trident-fleet-funding. All figures in this paper are expressed in 2011 pounds using the November 2011 HM Treasury deflator series available from www.hm-treasury.gov.uk/data_gdp_fig.htm unless otherwise stated.

5 CentreForum analysis of MoD and NAO data. £33bn (£32.591bn) is the 2011 estimate of Trident replacement (£25bn) inflated by the 30.4 per cent overspend of the most recent UK submarine programme, the Astute class recorded for submarines 1 – 5 reported in the 2011 National Audit Office Major Projects Report, Figure 2. See 'Major Projects Report', National Audit Office, Report by the Comptroller and Auditor General, HC 1520-I Session 2010–2012, 15 Nov 2011, available from www.nao.org.uk /publications/1012/major_projects_report_2011.aspx

6 Based on the UK costs and in the absence of a published UK spending profile, I have used the US Navy SSBN(X) profile detailed on Figure 5 of Congressional Budget Office's Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan, 23 June 2011, Congressional Budget Office, Washington DC.

7 CentreForum analysis of MoD, HMT, NAO and CBO data. MoD capital budget uses the 2010 Equipment Programme share of Capital DEL (approximately 87 per cent) and applies this to the budget going forward. MoD budget beyond 2015-16 is constructed by increasing the Capital DEL at 1 per cent real per annum from 2015-16 to 2019-20, and maintaining all other elements flat in real terms. The key variable is how much of the total has been spent in this Parliament: Malcolm Chalmers quotes a figure of £3bn in footnote 14 of 'Looking into the Black Hole'. By contrast, Richard Norton-Taylor, in The Guardian, 30 December 2011 quotes a figure of £5bn www.guardian.co.uk/commentisfree/2011/dec/30/trident-thatcher-ministers-against?INTCMP=ILCNETTXT3487 Thus, the lower bound is achieved by splitting the minimum post-2015 spend of £20bn (£25bn minus £5bn spent in this Parliament) across the CBO SSBN(X) spending profile against the putative MoD budget. The upper bound uses the same methodology but a figure of £29.591bn (£32.591bn minus £3bn spent in this Parliament).

8 See for example www.bbc.co.uk/news/uk-10812825.

9 Hansard, 15 July 1980 at column 1239. hansard.millbanksystems.com/commons /1980/jul/15/strategic-nuclear-deterrent#column_1239.

around 25 per cent in real terms, and with the new level of spending maintained for a decade – the UK is facing a choice between being 'Switzerland with missiles' or having the ability to provide full-spectrum conventional capability from now to beyond 2030. This paper will consider strategic, fiscal and legal issues that should inform the UK's decision on whether to replace Trident.

We will begin our consideration with a review of the UK's nuclear weapons history, before turning to the current strategic context. We will then consider the UK's current nuclear choices and the constraints imposed by the current economic and budgetary issues and the UK's international legal obligations. Finally, we will consider other perspectives, including the impact on the defence industrial base, before drawing conclusions and making recommendations.

I - UK nuclear history

Genesis

British nuclear development began with the 1940 MAUD Committee study that concluded that an atomic weapon was theoretically possible. This pioneering work was passed to the United States in 1941, and led to the UK and Canada joining the Manhattan Project, which ended WWII with the atomic bombing of Hiroshima and Nagasaki in August 1945.

Postwar US-UK nuclear collaboration was stopped by the American McMahon Act in 1946, leading Prime Minister Atlee to authorise the British atomic programme in 1947 over the objections of the Treasury and the Board of Trade.[10] With 1947 cost estimates for the Capenhurst uranium enrichment plant alone at £30 – £40m,[11] the argument was won on the grounds that becoming a nuclear power was an essential prerequisite for the UK to remain at the international "Top Table".[12] This expenditure was doubly remarkable in that 1947 saw the rationing of bread and potatoes for the first time since the outbreak of war in 1939 and, upon regaining office in 1951, Sir Winston Churchill was astonished to learn that more than £100m – £2.44bn in 2011 terms[13] – had been spent by the Atlee Government on the atomic weapons programme with no parliamentary oversight.[14]

10 Now Business Innovation and Skills. See P Hennessy, 'The Secret State: Whitehall and the cold war', 2003.

11 'The Secret State', p. 47, £0.9 - £1.2bn in 2011 pounds using Lawrence H. Officer and Samuel H. Williamson, 'Purchasing power of money in the United States from 1774 to 2010," Measuring Worth, 2011. A second gaseous diffusion plant at Capenhurst was planned in 1957, and in August 1957 its cost was estimated at £137m (£2.57bn in 2011 pounds). See I Clark, 'Nuclear diplomacy and the special relationship: Britain's deterrent and America 1957 - 1962' 1994.

12 GEN 75 Cabinet Committee meeting, 25 Oct 46. 'The secret state', p. 48.

13 £100m at 1951 prices via www.measuringworth.com/uscompare/relativevalue.php gives a 2011 value of £2.4bn; the actual value will be higher as there was significant spending prior to 1951.

14 D Coleman and J Siracusa, 'Real World Nuclear Deterrence' 2006.

Using the expertise gained in the Manhattan Project, British scientists made steady progress. Britain's first atomic bomb – an improved Nagasaki design – was detonated off Western Australia in October 1952.[15] Unfortunately for British national self-esteem, the United States demonstrated the first thermonuclear bomb (H-Bomb) less than a month later[16], joined by the Soviets in 1955.[17] Churchill's 1954 decision to build the H-Bomb mirrored Atlee's reasoning, and over further Treasury objections, the UK's first thermonuclear weapon was detonated in 1957.[18] Following a combination of Britain's successful thermonuclear test and the Soviet launch of Sputnik in 1957, the 1946 McMahon Act restrictions were eased for the UK in 1958.[19] Subsequent British nuclear weapons were based on American designs and built at the Atomic Weapons Establishment, Aldermaston.[20]

The UK as an 'independent decision-making pole' and the emergence of the 'Moscow Criterion'

The cornerstone of British nuclear policy in the cold war was thus: that the Soviet Union would not attack the UK if it believed Britain had an independent nuclear force able to cause damage to the USSR irrespective of the US' response to a soviet invasion of West Germany. Hence, UK nuclear doctrine was based on the unenunciated fear that either the United States might not meet its obligations under the North Atlantic Charter, or that the Soviet leadership may not believe that the United States would meet them. This became formalised as the UK providing an 'independent decision-making pole' within the NATO alliance structure.[21]

Once the independent decision-making pole doctrine was formalised, UK policy makers had to determine what level of assured damage on the Soviet Union would be sufficient to deter Soviet aggression.

15 Designated Operation HURRICANE, the first British atomic bomb was a modification of the Nagasaki 'Fat Man' plutonium implosion weapon, and was detonated below the waterline of the WWII frigate HMS PLYM, with a yield of approximately 25kt. See H Wynn, 'RAF Nuclear Deterrent Forces', 1997.

16 The United States conducted the world's first thermonuclear test on 31 October 1952 at Bikini Atoll, codenamed Ivy Mike. See 'Real world nuclear deterrence'.

17 This was the 'Joe 19' test that demonstrated the Soviet Union had mastered a true thermonuclear warhead rather than the boosted fission device detonated in 1953.

18 R Ruston, 'A say in the end of the world: morals and British nuclear weapons policy'.

19 I Clark, 'Nuclear diplomacy and the special relationship: Britain's deterrent and America 1957 - 1962', 1994.

20 The first warhead design passed to the UK was the W-28, which was anglicized as the RED SNOW warhead, first used in the YELLOW SUN Mark 2 thermonuclear free-fall weapon. See 'Nuclear diplomacy and the special relationship'.

21 'The future of the United Kingdom's nuclear deterrent', December 2006. Available from www.mod.uk/nr/rdonlyres/ac00dd79-76d6-4fe3-91a1-6a56b03c092f/0/defencewhitepaper2006_cm6994.pdf

This was straight-forward. Not only was Moscow the ultimate symbolic and political target, but it became the world's most heavily defended target. Thus, if the UK could successfully deliver up the four one megaton thermonuclear weapons to guarantee Moscow's destruction, the UK had the delivery mechanisms to attack any Soviet target of its choice.[22] This translation of a geopolitical goal into a military requirement became known as the 'Moscow Criterion'.[23]

Britain's nascent nuclear arsenal required a delivery method, so in parallel with the atomic weapon programme it invested heavily in manned bombers. Branded the V-Force, the RAF's V-bombers – Valiant, Victor and Vulcan – provided nuclear Quick Reaction Alert (QRA) against the threat of a Soviet surprise attack from 1 January 1962 to 30 June 1969.[24] The RAF received its first operational atomic weapons as early as November 1953.

Embarrassingly, it could not deliver these weapons until the first modified Valiants became available in February 1956. It was the *Buffalo* test series culminating in the first live drop of a *Blue Danube* atomic weapon over Maralinga, South Australia, on 11 October 1956, which definitively demonstrated that the UK was an operational nuclear power.[25] Britain's first operational thermonuclear weapon – codenamed YELLOW SUN Mk. 2 – was available to the V-Force from 1961.[26] Unfortunately, improving Soviet air defences in the late 1950s made the bombers vulnerable, with no certainty that they would be able to reach Moscow in sufficient numbers to meet the Moscow Criterion. The V-bombers' increasing vulnerability was underlined by the May 1960 shootdown of Gary Powers' U-2 reconnaissance aircraft.

22 In December 1959, Moscow was estimated to require four one- megaton weapons to achieve destruction of 50 per cent of the buildings in the CitMoscowy. See 'Nuclear diplomacy and the special relationship'.

23 A subject that keeps recurring – see www.bbc.co.uk/blogs/newsnight/markurban/2010/04/trident_how_relevant_is_the_mo.html

24 QRA required a minimum of one aircraft per squadron held at 15 minutes notice to launch (Readiness State 15, RS15), with the numbers held at RS15 or less increasing in times of tension. See 'RAF nuclear deterrent forces' pp. 334–9.

25 In that the UK had the indigenous ability to design, produce and operationally deliver an atomic weapon rather than the ability to conduct a nuclear explosion.

26 YELLOW SUN Mk. 2 was the first fielded British thermonuclear weapon, and it used the American W-28 derived RED SNOW thermonuclear warhead, the design of which had been made available under the 1958 arrangements. YELLOW SUN Mk. 1 used the 400kt GREEN GRASS boosted atomic warhead derived from the ORANGE HERALD 720kt design tested at Malden Island on 31 May 1957. Desperate to demonstrate that the UK had joined the thermonuclear club before a US-Soviet test-ban treaty, the fact that ORANGE HERALD was a boosted-fission design remained classified until the end of the cold war. See R Moore 'The real meaning of the words: a pedantic glossary of British nuclear weapons', UK Nuclear History Working Paper Number 1, available from www.mcis.soton.ac.uk/Site_Files/pdf/nuclear_history/Working_Paper_No_1.pdf

Yet having heavily invested in the V-bombers, the UK could not afford to scrap them and move directly to land- or sea-based ballistic missiles. Instead, at a time when defence accounted for 10 per cent of GDP and defence R & D absorbed half of Britain's technical manpower, the UK sought to extend the bombers' life and make significant savings in defence expenditure by using bomber-launched missiles.[27] Initially, this was in the form of the British BLUE STEEL, a rocket-propelled missile with a range of 100 miles.[28] But it was recognised by the early 1960s that 100 miles would still require the V-Force to penetrate increasingly sophisticated Soviet air-defences, leading to the requirement for a stand-off weapon of much greater range.

Britain's solution was to purchase the American GAM-87 Skybolt air-launched ballistic missile. Skybolt would allow the bombers to stand-off up to 1,000 miles, comfortably outside the range of Soviet air defences. However, Skybolt suffered five successive test failures in 1962, and was cancelled that December. Even if it could be made to work, it did not constitute value for money for the United States.[29]

After Skybolt

Skybolt's cancellation left the UK in a quandary. Even with BLUE STEEL, the V-bombers were approaching strategic obsolescence; an indigenous land-based or submarine-launched ballistic missile was deemed unaffordable; and the US State Department was known to oppose the sale of Polaris submarine-launched ballistic missiles. At the December 1962 Nassau summit with President Kennedy, Harold Macmillan secured the supply of Polaris, subject to the UK building its own warheads and submarines. A key element of the agreement was that though the UK Polaris would be subordinated to NATO, the UK had the ability for unilateral use in undefined cases of "supreme national emergency".[30]

In technological terms, the Polaris Sales Agreement meant the United States would supply Britain with American-designed and manufactured missiles carrying British-manufactured British

27 'Nuclear Diplomacy and the Special Relationship', p. 123.
28 BLUE STEEL is described in detail in RAF Nuclear Deterrent Forces, p. 198 – 220. BLUE STEEL was in RAF service from January 1963 to December 1970, latterly in a low-level role which reduced the range to between 25 and 50 miles – see Cold War: Building for Nuclear Confrontation 1946 – 1989, Wayne D. Cocroft, Roger J. C. Thomas, English Heritage, Swindon, 2003, p. 51.
29 RAF Nuclear Deterrent Forces, p. 417.
30 'The Secret State', p. 65.

derivatives of American warhead designs, with a 5 per cent levy towards the United States' research and development costs.[31] As amended for Trident II in 1982, the Polaris Sales Agreement remains the basis for the UK's contemporary nuclear force. However, what had been a wholly-indigenous thermonuclear-capable bomber force in 1957 transitioned into a submarine ballistic missile force that was wholly reliant on American technology and technical assistance when Polaris assumed the strategic deterrent role on 1 July 1969.[32] Since July 1969, the RN has successfully conducted uninterrupted submarine deterrent patrols in a posture known as Continuous At-Sea Deterrence (CASD).

Having relinquished the strategic nuclear role to the Royal Navy's *Resolution*-class submarines and their Polaris missiles, the RAF continued to provide NATO theatre nuclear strike with WE.177 free-fall nuclear weapons. RAF strike aircraft were armed with WE.177 free-fall nuclear bombs through to the retirement of the WE.177B in March 1998.[33]

Polaris, Poseidon and Chevaline

Purchased because of the fear that the V-bombers would fail to meet the Moscow Criterion, it is perhaps ironic that the first studies on improving Polaris' chances of penetrating Moscow's nascent Anti-Ballistic Missile defences commenced in 1962. This was fully seven years before the first Polaris deterrent patrol and twenty before the resulting Chevaline-modified Polaris was deployed by the UK. Chevaline reduced the number of Polaris warheads from three to two, providing room for the carriage of decoys and other penetration aids. The overall aim was to increase the probability of breaching the Moscow Anti-Ballistic Missile defence system and, with it, meeting the Moscow Criterion.

From the late 1960s the Royal Navy (RN) vociferously opposed Chevaline. It favoured to upgrade from Polaris to the newer American Poseidon missile, which would meet the Moscow Criterion, maintain

31 Polaris Sales Agreement Article 11 Section 1-B. See The Nassau Connection: The Organisation and Management of the British Polaris Project, Peter Nailor, Ministry of Defence, HMSO, London, 1988, p. 112.

32 In that with the GRAPPLE 1 / Short Granite test on 15 May 1957, Britain had a thermonuclear weapon, albeit an inefficient one. Had the 1958 MDAP not been agreed, it must be assumed that Britain would have developed and deployed the 1.8 megaton Round C device used in the GRAPPLE X on 8 Nov 1957 see RAF Nuclear Deterrent Forces, p. 236.

33 Strategic Defence Review 1998, '*Modern forces for a modern world*', Ministry of Defence CM 3999, July 1998, Paragraph 62. Hereinafter 'Strategic Defence Review 1998'.

commonality with the US Navy and result in lower support costs.[34] Professional RN advice was ignored, however, and Chevaline proceeded in 1975. Kept secret from cabinet and parliament under successive Labour and Conservative governments, Chevaline was beleaguered by technical problems. It went more than £1bn over its secret budget by 1979 – £3.8bn today – without any parliamentary oversight. The 1981-82 Public Accounts Committee Report was suitably blistering, noting that "the failure to inform parliament or this committee until 1980 that a major programme on this scale was being undertaken, or that its cost was turning out to be so far in excess of that originally expected, is quite unacceptable."[35] One beneficial result of the Chevaline debacle was the initiation of the National Audit Office's Major Projects Report into Ministry of Defence procurement.

Trident I, Trident II

Though the Chevaline-improved Polaris was not yet in service, and would not be until 1982, in December 1979 Margaret Thatcher's new Conservative Government selected Trident I C4 as Chevaline's replacement from the early 1990s.[36] Trident I C4 was a development of Poseidon, designed to fit in the existing Poseidon launch tubes to provide the same accuracy over a 4000 nautical mile range as Poseidon at half that range. Apart from making the deterrent much more survivable by significantly increasing the area in which the submarines were able to operate whilst remaining within range of their targets, Trident also provided much greater accuracy and the ability to target its warheads separately.[37] These latter two developments would make Trident a quantum improvement in the UK's nuclear capability.

Subsequently, the Reagan Administration decided to proceed with the more capable Trident II D5 missile, a substantial redesign of increased diameter and length to provide improved accuracy over a range of more than 6000 nautical miles. Hence, though the US Navy would deploy Trident I from 1979, it was clear that in time the United States would standardise on Trident II D5. The problems

34 When the US Navy completed the replacement of Polaris with Poseidon in 1979, the UK began to bear the support costs for the Polaris alone, which the RN correctly understood would be ruinously expensive.

35 See Ministry of Defence: 'Chevaline improvement to the Polaris missile system', Ninth Report of the Committee of Public Accounts, Session 1981-82.

36 M Thatcher, 'The Downing Street Years', 1993.

37 Trident I C4 had a design range of 4000nm versus Poseidon C3 at 2000nm. See www.fas.org/nuke/guide/usa/slbm/c-4.htm. For comparison, Chevaline-Polaris A3TK had a range of 1950nm, a reduction of 550nm from the Polaris A3T range of 2500nm.

of operating an expensive deterrent independent of the United States became apparent in the early 1980s, leading the Thatcher Government to purchase Trident II in February 1982.[38] In the deal the 5 per cent levy was replaced with a fixed fee, protecting the UK from any increases in development costs and making Trident II comparatively inexpensive to any competing method of providing such capability.[39]

Similar to the earlier *Resolution*-class, Britain's Trident II *Vanguard*-class submarines incorporate a Common Missile Compartment (CMC) which (other than providing 16 launch tubes instead of 24) mirrors that of the US Navy's *Ohio*-class ballistic missile submarines.[40] Trident II's selection ensured that Britain's nuclear force was – arguably for the first time since the late 1950s – unambiguously able to meet the Moscow Criterion from 1995, precisely at the point at which deterrence of the Soviet threat to Western Europe had become irrelevant.

Post cold war developments

Since the retirement of the WE.177, Trident II D5 has represented the UK's only nuclear capability. Although each Trident II missile is capable of carrying up to 12 independently targeted warheads more than 6000 nautical miles, the initial UK deployment plan in November 1993 called for a maximum of 96 warheads per *Vanguard*-class submarine, rather than the maximum load of 192 warheads.[41] Concurrently, the British warhead stockpile would be capped at 300, approximately 40 per cent of the destructive power of the UK nuclear arsenal in the early 1970s.[42]

Further reductions came in the SDR 98, which explicitly called for the use of Trident in the "sub-strategic role" to replace WE.177 whilst retaining continuous at-sea deterrence. Additionally, the missiles would be de-targeted, increasing the notice period to fire from a

38 The Downing Street Years, pp. 247 – 8.
39 The Downing Street Years, p. 248.
40 Ministry of Defence Major Projects Report 2008, National Audit Office, HC 64-2009, paragraph 2.9, p. 18. Hereinafter MPR 2008. The Common Missile Compartment for the *Vanguard* and *Ohio*-classes is constructed in sections, each containing eight missile tubes. The UK military requirement was met by two CMC sections (16 missile tubes), resulting in a smaller, less costly design than the larger 3-section (24 missile tube) design of the *Ohio*-class. The future CMC will have 12 missile tubes, but in line with current UK policy from the 2010 Strategic Defence and Security Review, a replacement UK Trident submarine would only have eight tubes operational. See www.defenseindustrydaily.com/CMC-contract-to-Define-Future-SSBN-Launchers-for-UK-USA-05221/ .
41 'Jane's Fighting Ships 1995-96', 1995, p. 758.
42 Strategic Defence Review 1998. Percentages approximated from chart to accompany SDR paragraph 64.

"few minutes" to "days". This was accompanied by a reduction in the number of warheads per submarine from 96 to 48, representing a warload one-third less destructive per submarine than in the late 1980s. The number of "operationally available" warheads consequently dipped below 200. SDR 98 also announced that the total procurement of Trident missiles would be capped at 58.[43]

SDSR 10 announced further important changes. First, there would be a further reduction of deployed warheads to no more than 120, and the total warhead stockpile would be capped at 180. Second, UK warhead numbers per submarine would fall again from 48 to 40, and the number of missiles carried by each submarine would be reduced to no more than eight.[44] Third, for the first time, Britain guaranteed that it "will not use or threaten to use nuclear weapons against non-nuclear weapon states parties to the [Nuclear Non-Proliferation Treaty]", which mirrored the line taken by the Obama Administration on negative nuclear security assurances to NPT signatories in April 2010.[45]

Thus, midway through their 30-year life, the *Vanguard*-class submarines now carry approximately only about 20 per cent of the warheads that they are capable of, and these appear not to be targeted against any particular state. Again SDSR 10 is clear as to why: "No state currently has both the intent and the capability to threaten the independence or integrity of the UK."[46]

Replacing Trident

'Replacing Trident' is a catch-all term for three quite separate issues: the replacement of the existing *Vanguard*-class submarines; the life-extension or replacement of the Trident II D5 missile; and the life-extension or replacement of the warhead. All three elements move to different timescales, and it is unhelpful to conflate them.

Neither the warhead nor the Trident II D5 missiles are currently of concern. SDSR 10 confirmed that "a replacement warhead is not required until at least the late 2030s", negating any requirement to design a new warhead for the next decade.[47] In 2002, the US Navy awarded Trident's manufacturer Lockheed-Martin a Trident

43 Strategic Defence Review 1998.
44 SDSR 10 paragraph 3.11, pp. 38 – 39. Interestingly, this suggests that the UK Trident missiles will be carrying five RVs apiece – probably more than were carried in the last decade.
45 SDSR 10 paragraph 3.7, pp. 37 – 38; See Arms Control Association http://www.armscontrol.org/factsheets/negsec accessed 29 Dec 11 @ 21.57.
46 SDSR 10 paragraph 3.2, p. 37.
47 SDSR 10 paragraph 3.12, p. 39.

life-extension contract to extend the missile's operational life to at least 2042, with the improved missile known as Trident II D5 LEP.[48] As was made clear in the 2006 White Paper, the Trident II D5 LEP missile is central to any UK Trident replacement, and the UK has already invested some £250m in the programme.[49]

However, even with a five-year life-extension, the *Vanguard*-class submarines will need to be replaced from 2028 in order to ensure that there are sufficient submarines to maintain continuous at-sea deterrence.[50] As the NAO noted in 2008, it is unlikely that the replacement ballistic missile submarines could be constructed in less than 17 years from a decision to commence work.[51] However, the abysmal performance of the *Astute*-class attack submarine programme - where the seven submarines are on average more than two years late - suggests that the 17–year procurement timescale is at the optimistic end of the range of possible outcomes.[52] The ballistic missile submarines are also more complex to construct than the *Astute*-class.

Consequently, though a replacement Trident submarine was announced by former Prime Minister Tony Blair as long ago as December 2006, SDSR 10 suggested that only limited progress had been made. The Review allowed for design to continue along with the procurement of long-lead items through this parliament, with the final investment decision – the so-called "Main Gate" investment decision – to be made "around 2016".[53] Involved in the design phase are key long-lead items, notably the Rolls-Royce Third Generation Pressurised Water Reactor (PWR-3) nuclear propulsion system and the new Common Missile Compartment[54], at a reported cost in this Parliament of between £3bn – £5bn.

SDSR 10 estimated the cost of a new generation of submarines at up to £23bn[55], subsequently revised by the Ministry of Defence

48 www.lockheedmartin.com/news/press_releases/2002/NavyAwardsLockheedMartin248MillionC.html
49 'The Future of the United Kingdom's nuclear deterrent', paragraph 5.10, p. 26.
50 MPR 2008, paragraph 1.8, p. 13; SDSR 10 paragraph 3.12, p. 39.
51 'The United Kingdom's future nuclear deterrent capability', National Audit Office, November 2008.
52 Average delay is currently 28 months per submarine. See Ministry of Defence 'Major Projects Report 2011', National Audit Office. Hereinafter MPR 2011; MPR 2011, paragraph 12, p. 8.
53 SDSR 10 paragraph 3.10, p. 38.
54 www.defenseindustrydaily.com/CMC-contract-to-Define-Future-SSBN-Launchers-for-UK-USA-05221/
55 SDSR 10 quotes a cost of £20bn in 2006 prices at paragraph 3.10, p. 38, which corresponds to £22.608bn in 2011 prices using HM Treasury GDP deflators.

to £25bn in 2011.[56] Optimism bias, based on recent UK submarine procurement performance, increases the capital costs to £33bn. This is in-line with a 2009 Greenpeace report,[57] which estimated the capital costs up to £34bn,[58] with total through-life costs of at least £97bn.[59]

As costs for a replacement missile from 2042 and the possibility of a new warhead being required in the late 2030s cannot be estimated with any precision now, this paper ignores them. However, it should be understood that the additional capital costs of maintaining a submarine-based nuclear-armed ballistic missile system through to the end of the life of the replacement submarines could include some very substantial capital costs from the late 2030s onwards, and that the financial risks are all on the upside.

With a Main Gate decision deferred to 2016, the UK now has a window in which to consider whether the UK needs nuclear weapons at all and, if so, whether replacing Trident will be the correct answer to Britain's foreign policy needs over the next 30 years.

56 Looking into the Black Hole, p. 12.

57 'In the firing line: an investigation into the hidden cost of the supercarrier project and replacing Trident', Greenpeace, September 2009, available from www.greenpeace.org.uk/blog/peace/trident-costs-are-running-out-control-20090917

58 'In the firing line', p. 23 quotes a cost of £29bn in 2006 prices, which corresponds to £32.782bn in 2011 prices using HM Treasury GDP deflators.

59 'In the firing line', p. 11. It is not clear from the Greenpeace document what NPV basis this £97bn figure is, so it is included as stated. If the £97bn represented a 2009 value, then it would rise to £107bn in 2011 prices using HM Treasury GDP deflators.

2 - Strategic context

In 1992 Francis Fukuyama famously described the conclusion of the Cold War and the victory of western liberal democracy as "the end of history". Despite the subsequent criticism, at one level Fukuyama was right: for the first time since the Second World War, there was no immediate threat to Western Europe or the UK. Both SDR 98 and SDSR 10 noted the removal of this threat, and correctly noted that with the removal of the cold war's certainties, the prevalence of conventional conflict has increased. Underlining this, since 1991 Britain's forces have undertaken major operations in the Former Yugoslavia, Sierra Leone, Afghanistan, Iraq and Libya. In none of these campaigns have UK nuclear weapons had a role to play in either successfully deterring conflict or achieving victory.

Arms control: reducing the state-based nuclear threat

By the late 1950s it was clear to both the United States and the Soviet Union that their interests would be served by controls on nuclear weapons. It has been a long road, but the tentative steps of the 1963 Partial Test Ban Treaty banning atmospheric, outer space and underwater nuclear tests culminated in the 2010 Prague Treaty known as "New START". By September 2011 arms control agreements had reduced the total number of active[60] American and Russian nuclear warheads to approximately 6,650 from the Cold War high of over 70,000 in 1986,[61] with further falls in tactical warheads likely before 2020.[62] Of these 6,650 warheads, strategic weapons were limited to 1550 under "New START".[63]

60 As opposed to warheads in reserve or awaiting dismantling.

61 United States nuclear arsenal estimated at 2,150 warheads, See US nuclear forces, 2011, Hans M. Kristensen and Robert S. Norris, Nuclear Notebook, Bulletin of the Atomic Scientists, p. 74, 67(2) 66–76, March/April 2011, bos.sagepub.com/content/67/2.toc Russian Federation nuclear arsenal estimated at 4,500 warheads, H M Kristensen and R S Norris 'Russian nuclear forces, 2011', Nuclear Notebook, Bulletin of the Atomic Scientists, May/June 2011, bos.sagepub.com/content/67/3.toc.

62 Estimated warhead maximum of 70,481 occurred in 1986. See H M Kristensen and R S Norris, 'Global nuclear stockpiles, 1945–2006', Nuclear Notebook, Bulletin of the Atomic Scientists, July 2006. bos.sagepub.com/content/62/4/64.

63 New START Treaty Aggregate Numbers of Strategic Offensive Arms, Fact Sheet, Department of State Bureau of Arms Control, Verification and Compliance, October 25, 2011, www.state.gov/t/avc/rls/176096.htm Note: New START counts each manned bomber a single warhead despite the fact that all of the manned bombers are capable of carrying more than a single warhead.

It is in framing this new world that American President Barack Obama made his "Prague Speech" of 5 April 2009, in which he detailed that it was long-term American policy to "seek the peace and security of a world without nuclear weapons." This, Obama made clear, was not a simple case of unilateral nuclear disarmament, but a multi-stage plan beginning with "New START", American ratification of the Comprehensive Test Ban Treaty (CTBT), and a verifiable Fissile Material Cut-Off Treaty (FMCT). This three-pronged approach would take time, and in the meanwhile, "As long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense (sic) to our allies."[64]

The United States, then, aims to reduce, verify, and then eliminate nuclear weapons. However, the size of its nuclear arsenal and its status as the fulcrum and ultimate guarantor of security in Europe, North East and South East Asia, and the Middle East, almost ensures that it will be last to eliminate their nuclear weapons; a possible scenario being simultaneous disarmament with Russia and potentially China. Speaking in Paris in 2010, Under Secretary for Arms Control and International Security Ellen Tauscher indicated that this is unlikely to occur in the next 20 years, but the direction of travel is clear.[65]

None of these constraints apply to the UK. Indeed, the UK is an explicit beneficiary of the American nuclear security guarantees to NATO re-emphasised by President Obama in Prague. As the President made clear, all NATO members have an explicit American nuclear security guarantee under Article V of the 1949 North Atlantic Treaty.[66] "An attack on one is an attack on all," he said. "That is a promise for our time, and for all time."

Cold war deterrence

During the cold war, the Warsaw Pact conventional forces in Central and Eastern Europe enjoyed a significant numerical advantage over NATO's conventional forces. As a result, and as early as 1958, NATO war-planning envisaged the early first-use of tactical nuclear weapons to offset this numerical inferiority.[67] Unfortunately, no scenario was discovered in which this use of tactical nuclear

64 Text available from www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/

65 Remarks to the Global Zero Summit, by Under Secretary of State for Arms Control and International Security Ellen Tauscher (T), delivered in Paris, France, 3 Feb 2010. Available from www.state.gov/t/us/136425.htm, accessed 10 Feb 12 at 00.36.

66 The North Atlantic Treaty, Article V available from www.nato.int/cps/en/natolive/official_texts_17120.htm?selectedLocale=en.

67 Nuclear Diplomacy and the Special Relationship, p. 161.

weapons did not lead to an escalation to an increasingly strategic nuclear exchange between the superpowers. Put simply, the concept of nuclear war limited to Europe did not exist.

As a result, the North Atlantic Treaty's Article V guarantee was open to question: ultimately, would the United States risk an all-out nuclear exchange in which both the Soviet Union and the United States would be destroyed in response to a Soviet occupation of Berlin, Paris or London? Deterrence required the Soviet leadership to believe that the United States would – or at least to have sufficient fear that the United States *may* - risk an all-out nuclear exchange in order to be deterred from attacking West Germany. If Moscow did not believe this, deterrence could fail. The existence of American tactical nuclear weapons held under dual-key arrangements after the installation of permissive action links (PALS) in 1962 did not change this calculus, as the permissive action links meant that use of American nuclear weapons in West Germany, Belgium, the Netherlands and Turkey remained subject to an American veto.[68]

It was into this breach that the operationally independent British and indigenous French nuclear programmes played a potentially critical deterrent role – gifting London and Paris what Roger Ruston piquantly described as "a say in the end of the world".[69] Simplistically, if Britain and/or France could cause sufficient damage to the Soviet Union without recourse to the aid of the United States, then additional certainty that a conventional Soviet attack on West Germany would result in nuclear war would deter the Soviet Union from such an attack. This British position was crystallised as the "independent centre of nuclear decision making".[70] Indeed, Britain's ballistic missile submarines are capable of firing their missiles independently in the case that the Prime Minister and the Prime Minister's alternate have been destroyed in a successful surprise attack, using the Prime Minister's instructions in the so-called 'Letter of Last Resort'.[71]

68 On Permissive Action Links (PALs), see generally The JCAE and the Development of the Permissive Action Link, available from www.brookings.edu/projects/archive/nucweapons/box9_2.aspx.

69 Britain's ability to independently launch Polaris, and subsequently, Trident, has been consistently underscored by the British Government. See, e.g. FOI response of 19 Jul 05 questions 3 and 4, p. 2. Available from www.mod.uk/linked_files/publications/foi/rr/nuclear190705.pdf via web.archive.org/web/20051229080220/http://www.mod.uk/linked_files/publications/foi/rr/nuclear190705.pdf

70 The Future of the United Kingdom's Nuclear Deterrent, p. 18.

71 See e.g. 'HMAS Apocalypse: Deep in the Atlantic, a submarine waits on alert with nuclear missiles that would end the world...', Peter Hennessy / Richard Knight, Daily Mail 30 Nov 08, available from www.dailymail.co.uk/news/article-1090400/HMS-Apocalypse-Deep-Atlantic-submarine-waits-alert-nuclear-missiles-end-world--.html. Error in the article's title at the time of retrieval.

Thus, it was this *operational* independence together with the near-certainty of response that set the British and French nuclear forces apart from other non-US NATO members. However, the operational independence of the UK nuclear force was only valuable because the size and capability of the Soviet nuclear arsenal made a devastating nuclear attack on the United States possible, making fears of strategic decoupling realistic.

Post-cold war deterrence

In the post-cold war world, deterrence theory remains constant. In order for nuclear deterrence to work, an adversary must be:

i. rational;

ii. a state, with clearly defined territory; and

iii. capable of launching a nuclear attack on the UK.

To demonstrate that a UK nuclear system is the only source of deterrence, two further criteria would have to be met:

iv. without nuclear deterrence, the adversary would launch a nuclear attack on the UK; and

v. the adversary would have to be convinced that the United States would not respond to a nuclear attack on the UK (i.e. that the United States and / or NATO would not honour their commitments under Article V of the North Atlantic Treaty).

The requirements for the adversary to be a rational state are simple: if the adversary is irrational, then deterrence cannot be relied upon, and if the adversary has no clearly defined territory, there are no targets to retaliate against. Hence, it is impossible to use Trident to deter an ideologically-driven non-state actor willing to die to achieve their aims from using a stolen nuclear weapon. Indeed, even if you were to determine – presumably from intelligence and/or isotropic analysis of the fallout – which of the nuclear states' arsenals the weapon had come from, it is hard to see how the UK could retaliate against that state short of an admission of responsibility. And in any event, that would be *ex post facto*, demonstrating that deterrence had failed.

UK nuclear doctrine

SDSR 10 made significant steps in clarifying Britain's nuclear doctrine as well as the number and readiness of its warheads. Whilst retaining a level of deliberate ambiguity over the UK's intentions,

SDSR 10 states that the UK would "only consider using our nuclear weapons in extreme circumstances of self defence, including the defence of our NATO Allies".[72] Accepting the UK's continued ambiguity around first use in extreme circumstances, SDSR 10 does provide guarantees that the UK will not use its nuclear weapons against non-nuclear weapons states that are parties to the Nuclear Non-Proliferation Treaty (NPT) and that are meeting their NPT obligations. These are known as "negative security assurances"[73], the earliest iterations of which can be found in UN Security Resolution 255 of June 1968.[74] It is important to note that the UK negative security assurance language mirrors that of the United States in the 2010 US Nuclear Posture Review.[75]

Although the United States first issued a Negative Security Assurance in 1978, the 2010 US Nuclear Posture Review represents a major change in the American position by removing the Warsaw Pact exception, and foreswearing a nuclear response to a chemical or biological attack.[76] Given that the achievement of a legal basis for negative security assurances is a key demand[77] of the non-Nuclear Weapons States[78] either within the NPT framework – the preference of most – or through the regional Nuclear Weapons Free Zone treaties (e.g. Treaties of Tlatelolco[79] and Raratonga[80]), the increased clarity in SDSR 10 is welcome.

The formal incorporation of negative security assurances without an exception for biological and chemical weapons into public UK nuclear doctrine has profound effects on how and where the UK could

72 SDSR 10 paragraph 3.5, p. 37.
73 See the Arms Control Association, http://www.armscontrol.org/factsheets/negsec
74 UNSCR 255 (1968), adopted 19 June 1968 10-0-5 (Algeria, Brazil, France, India, Pakistan abstaining). Available from http://www.un.org/documents/sc/res/1968/scres68.htm accessed 01 Jan 12 @ 12.36.
75 2010 Nuclear Posture Review, p. 15 available at www.defense.gov/npr/docs/2010 per cent20Nuclear per cent20Posture per cent20Review per cent20Report.pdf
76 As recently as 2007 the United States was the sole vote in the UN General Assembly against a Pakistani-sponsored resolution on negative security assurances.
77 See e.g., the Nuclear Threat Initiative, http://www.nti.org/treaties-and-regimes/proposed-internationally-legally-binding-negative-security-assurances/
78 i.e., all NPT members except PR China, France, Russian Federation, United Kingdom and the United States of America.
79 Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean, signed 14 February 67, entered into force 22 April 68, covering 33 States. http://www.opanal.org/opanal/Tlatelolco/Tlatelolco-i.htm
80 Treaty of Raratonga states are Australia, Cook Islands, Fiji, Kiribati, Nauru, New Zealand, Niue, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa, and China, France, Russian Federation and the United Kingdom have all ratified the non-use and non-testing criteria in the zone; the US has signed but not ratified the Treaty. See www.fas.org/nuke/control/spnfz/text/spnfz.htm.

use its nuclear arsenal.[81] Most importantly, it reduces the number of countries that are potentially targetable to China, France, India, Israel, Pakistan, North Korea, Russia and the United States – and Iran and Syria only for as long they are adjudged to be non-compliant with their NPT obligations. It is interesting to note that the 2010 Defence Review is silent on who is to judge NPT non-compliance; it is assumed that, as the United States makes clear, the UK would make its own judgement informed by the work of the International Atomic Energy Agency (IAEA). However, in light of the intelligence failures and allegations of political interference in intelligence analysis made to Sir John Chilcott's enquiry into the 2003 Iraq War, it must remain open to question whether the UK would be better served by relying on independent, expert IAEA assessment of a country's non-compliance with their NPT obligations.[82]

States of concern

Unless the UK were to abandon the negative security assurances introduced in 2010, then at the risk of a truism it is important to restate which states are subject to UK nuclear deterrence today. There are nine: China, France, India, Israel, Pakistan, North Korea, the United States and Russia as states operating nuclear weapons; and due to their non-compliance with their NPT obligations, Iran and Syria.[83]

None of these states present a conventional military threat to the UK or its overseas territories. With the withdrawal of the Red Army from Central and Eastern Europe, and the return of Hong Kong to China in 1997, it is inconceivable that the UK would end up at war with either Russia or China where the United States was not itself a central participant.

Three states of this group, however, are of particular concern: Iran, Pakistan, and North Korea. It is axiomatic that a military threat is composed of capability, intent and opportunity; one without the other two cannot produce a military effect. It must be stressed that

81 Importantly, the caveat to the removal of the caveat for the UK's willingness to respond to a biological or chemical attack in SDSR 10 was that it could be reversed if the proliferation of chemical and biological, or the risk posed by these weapons, increased to such an extent that the UK government felt that a nuclear response was warranted. See SDSR 10 paragraph 3.7 pp. 37 – 38.

82 Notably that Iraq had no weapons of mass destruction in 2003. See The Art of Betrayal: Life and Death in the British Secret Service, Gordon Corera, Chapter 10 pp. 353 – 401; www.iraqinquiry.org.uk.

83 Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran: Report by the Director General "Section G. Possible Military Dimensions", pp. 7 – 8, GOV/2011/65, 8 November 2011, http://www.iaea.org/newscenter/focus/iaeairan/index.shtml

there is no evidence for this, and indeed the WMD programmes in all three states appear to be defensive deterrence to ensure the survival of the state (Pakistan) or the regime (Iran) or both (North Korea). Again, though, for completeness, we will accept that it is theoretically possible that such a government could come to power in these – or indeed any other country – in order to assess whether given this intent, they have the capability to attack the UK and the United States and therefore could provide the circumstances under which an operationally independent UK nuclear force could provide a deterrent effect.

Iran

Iran's nuclear programme is of concern because of both the technology in use, and the long record of incomplete and falsified declarations to the IAEA. This culminated in the IAEA's Board of Governors releasing a report in November 2011 in which the IAEA outlined its "increasing concern" about the "possible existence in Iran of undisclosed nuclear related activities involving military related organizations, including activities related to the development of a nuclear payload for a missile".[84]

This has included a previously covert uranium enrichment programme, which has produced uranium enriched to at least 20 per cent U_{235}, – 80 per cent of the journey to weapon grade uranium – and more than four times the level normally associated with commercial power reactors.[85] Though shy of the 90 per cent U_{235} preferred for warhead construction, this level of enrichment combined with a continued lack of transparency and their extensive missile development efforts, suggests that Iran is conducting a covert programme to produce nuclear weapon capability, or potentially a nuclear weapon in defiance of its NPT obligations.

According to a US State Department cable of 24 February 2010 published by Wikileaks, Iran had by then acquired 19 BM-25 *Musudan* Intermediate Range Ballistic Missiles from North Korea. [86] BM-25 *Musudan* is a development of the 1960s Soviet R-27 liquid-fuelled submarine launched ballistic missile, reportedly carrying a

84 Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran, p. 7.

85 Initial U_{235} enrichment for power reactors raises the proportion of the U_{235} isotope from 0.7 per cent to just 5 per cent. See www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html,

86 Iran Fortifies Its Arsenal With the Aid of North Korea, William J. Broad, James Glanz, David E. Sanger, New York Times, 28 Oct 10, www.nytimes.com/2010/11/29/world/middleeast/29missiles.html?_r=1

1,000kg warhead with ranges of between 3,000 and 3,200km, with the upper bound at 4,000km. [87] London lies approximately 3,865km from Tabriz in far north-western Iran[88], so at the upper limit of range estimates an Iranian BM-25 could hit London.[89] Iran is certainly capable of hitting British bases in Cyprus, and, assuming a 4,000km range for BM-25 *Musudan*, Diego Garcia would be in range from far south-eastern Iran.[90]

Iran has also built a two-stage liquid fuelled space launch vehicle named *Safir* (Messenger), and has conducted three launches. The first in August 2008 was unsuccessful, but the second in February 2009 and third in June 2011[91] successfully placed small research satellites into low earth orbit. Given the technical commonalities of space launch vehicles and long-range missiles, there is concern that *Safir* is the progenitor of an Iranian Intercontinental Ballistic Missile (ICBM) with a design range of 10,000km, sufficient to hit the East Coast of the United States. However, though the US Missile Defense Agency claimed in November 2008 that such an ICBM "could be ready by 2015", independent analysis questions both the timescale and the reported payload.[92] Six points are made:

First, the estimated payload at a range of 10,000km for a *Safir*–derived ballistic missile is in the order of 120kg, too small for all but the most advanced nuclear warhead designs.[93]

Second, Iranian guidance systems are primitive, suggesting that at 10,000km range, less than 50 per cent of the missiles would fall within 6.8 miles of the intended target.[94] Indeed, without a separating

87 Range estimates for BM-25 Musudan vary from 3,000 – 4,000km. The lower end, see Bulletin of Atomic Scientists (http://www.thebulletin.org/web-edition/features/north-korea-30000-feet, accessed 08 Jan 12 @ 21.57); the 4,000km range estimate comes from Wikipedia. MissileThreat use a US estimate of 3,200km www.missilethreat.com/missilesoftheworld/id.185/missile_detail.asp.

88 Distance from Tabriz to London (City Airport) is 3,865km (via www.gcmap.com).

89 Tabriz International Airport is at an altitude of 4,459ft (http://www.gcmap.com/airport/TBZ), and ballistic missiles launched from altitude will have a greater range than the same missile launched from sea-level as it will not have to climb through the thickest section of the atmosphere.

90 CentreForum analysis via www.gcmap.com.

91 See www.globalsecurity.org/space/world/iran/irans-second-satellite-launch.htm

92 Foreign Ballistic Missile Capability, US Missile Defense Agency November 2008, p. 7, available from www.marshall.org/pdf/materials/725.pdf; Geoffrey Forden, 25 Nov 08, available from http://forden.armscontrolwonk.com/archive/2110/designing-irans-icbm-from-the-ground-up accessed 8 Jan 12 @ 12.56..

93 See footnote 128.

94 With a separating warhead from Iran's Ghadr-1 or Seji short-range missiles, the CEP at 10,000km range estimated at 11km. See Jochen Schischka, 1 Dec 08, available from http://forden.armscontrolwonk.com/archive/2110/designing-irans-icbm-from-the-ground-up

warhead, this error would rise three-fold to over 20 miles.[95]

Third, *Safir* represents the apogee of SS-1 SCUD series missiles' development potential. This means that without major technical assistance including new engines, fuels with a higher energy potential than the existing kerosene and liquid oxygen, and more advanced missile airframes, *Safir* development is extremely unlikely to provide the step-change in payload performance to deliver a first or second generation nuclear warhead weighing at least 750kg over intercontinental ranges.[96]

Fourth, the stresses of spaceflight that intercontinental ballistic missile warheads are subjected to on re-entry requires a much more advanced re-entry vehicle than are required for medium range systems. There is no evidence that Iran has developed – or has the capacity indigenously to develop – such advanced re-entry vehicles.[97]

Fifth, *Safir* would produce a grossly inaccurate intercontinental ballistic missile – in common with early American and Soviet designs – meaning that to have a meaningful military role, it would need to mount a high-yield thermonuclear weapon in order to compensate for the missile's inaccuracy.[98] Not only has Iran not detonated a fission weapon (an A–Bomb) – a prerequisite for a thermonuclear weapon (an H-Bomb) – but there is no publicly available evidence that Iran has the technical capacity to produce a thermonuclear device, rendering *Safir* effectively militarily useless.

Sixth, as a liquid fuelled missile, a *Safir*-derived design would be highly vulnerable to a first strike, given the problems of keeping a fuelled missile on alert unless it were housed in a reinforced missile bunker. There is no evidence that Iran have designed – much less built – such complex underground launch facilities.

95 Non-separating warhead CEP at 10,000km range estimated at 33km. See Jochen Schischka, footnote 130.

96 See Geoffrey Forden, footnote 128.

97 See Jochen Schischka, footnote 130.

98 For example US LGM-30A/B Minuteman I had CEP of 0.5 – 1.0 km and compensated for this inaccuracy by carrying a W56 1.2 megaton warhead (see http://www.missilethreat.com/missilesoftheworld/id.77/missile_detail.asp accessed 8 Jan 12 @ 13.12). In context, the pressure wave from a one-megaton surface detonation – some 80 times the destructive power of the Hiroshima bomb – would destroy all but the most strongly reinforced buildings within a 2.7 mile radius of ground zero, and would cause significant damage out to 4.7 miles (see http://www.pbs.org/wgbh/amex/bomb/sfeature/1mtblast.html accessed 8 Jan 12 @ 14.04). Thus to ensure destruction of a single target with an inaccurate ICBM, the best route would be to fire a salvo of several missiles to bracket the target area, such that their accuracy errors overlap, ensuring that the subsequent blast damage achieves the military objective, albeit at the cost of several missiles, and if the target was in or adjacent to a metropolitan area, likely very high levels of civilian casualties.

The conclusion is that though Iran appears to possess a limited ballistic missile capability capable of hitting the UK, and that it may be – though publicly, there is no incontrovertible evidence to prove that it is – developing atomic weapons, Iran does not possess the same capability to blackmail the United States as possessed by the Soviet Union in the Cold War. Therefore the fear of strategic decoupling requiring the UK to have an operationally independent nuclear force to provide a "second decision making pole" does not arise.

The practical limitations of Iran's ballistic and technical capabilities are such that it is highly unlikely that Iran could produce and deploy a nuclear force comparable with the former Soviet Union or China in the absence of massive covert support from a superpower partner. As such, an operationally independent UK Trident force offers no additional deterrence effect against Iran, nor will it do so in the foreseeable future.

Pakistan

Definitive confirmation of Pakistan's status as a nuclear state came with the tit-for-tat nuclear tests with India in May 1998.[99] Pakistan was estimated to hold between 90 – 110 warheads at the beginning of 2011, and is producing sufficient highly enriched uranium and plutonium to build 10 – 21 warheads annually. Pakistan's nuclear weapons programme is assessed to have benefitted from significant Chinese technical assistance, reportedly including early Chinese bomb design blueprints and possibly including China conducting a 1990 test of a Pakistani nuclear weapon.[100]

Pakistan's nuclear arsenal comprises air-dropped free-fall bombs delivered from Pakistan Air Force aircraft, and both ballistic and cruise missiles. Pakistan's ballistic missiles have design ranges from 60[101] to 2,000km[102], and the cruise missiles operate over ranges of 350[103] to 600km.[104] Additionally, Pakistan is also developing the liquid fuelled Ghauri-II ballistic missile, and has proposed a Ghauri-III variant with design ranges of 2,300 and 4,000km respectively. If Ghauri-III achieved this design range, it would bring British bases at Diego Garcia and Akrotiri within range.

99 See news.bbc.co.uk/onthisday/hi/dates/stories/may/28/newsid_2495000/2495045.stm
100 Pakistan's Nuclear Forces, 2011, Hans M. Kristensen and Robert S. Norris, Bulletin of the Atomic Scientists 2011, Volume 67(4), p. 91; ibid., 2011, p. 93; ibid., p. 92. It is important to note that though this Chinese proliferation was destabilizing, it was not illegal as China did not become an NPT member until 9 March 1992. See http://www.un.org/disarmament/WMD/Nuclear/NPT.shtml; Pakistan's Nuclear Forces, p. 92.
101 Nasr (Hatf-9). Pakistan's Nuclear Forces, 2011, p. 93.
102 Shaeen-2 (Hatf-6). Pakistan's Nuclear Forces, 2011, p. 93.
103 Ra'ad (Hatf-8). Pakistan's Nuclear Forces, 2011, p. 93.
104 Babur (Hatf-7). Pakistan's Nuclear Forces, 2011, p. 93.

Attacking the UK mainland would require the successful development and deployment of the proposed 7,000km range Tamiur intercontinental ballistic missile. However, there is no evidence that Pakistan has the technical capability to design, test and deploy such a weapon, and even if it did so – and successfully integrated a nuclear warhead – Tamiur would still be incapable of hitting the United States. Consequently, in the unlikely event that Tamiur is successfully deployed, it poses no threat to the US, and therefore the threat of strategic decoupling – and with it, the need for an operationally independent UK nuclear system – ceases to exist.

North Korea

Neither of North Korea's publicly identified intermediate-range and long-range missile programmes – Taepongdong-2[105] or BM-25 Musudan[106] – have sufficient range to hit the UK or the UK's overseas bases from North Korea. Moreover, there is no public evidence that these missiles have either been successfully deployed, or fitted with nuclear warheads. Finally, whilst North Korea may harbour ambitions to produce a truly inter-continental range ballistic missile with an atomic or thermonuclear warhead, it has not come close to successfully testing (much less deploying) such a missile system and/or its accompanying warhead.

Consequently, any current UK deterrent role against a putative North Korean attack on our allies would be only as part of an American or NATO counter-strike to a nuclear attack on a friendly country that is within range, e.g. South Korea, Japan, Singapore, Philippines, the United States (Alaska) and Northern Australia.[107] Consequently, the value in the UK's retaliatory capability is measured by bearing our share of the costs of collective deterrence, making this a cost-benefit decision against other UK defence budgetary priorities.

Conclusions

The theoretical threat posed by Iran, Pakistan or North Korea with their current and future ballistic missile programme does not pose a threat of strategic decoupling of the UK from the United States. Thus,

105 Great circle distance from Pyongyang to London Heathrow is 5,394 miles (www.gcmap.com) and Taepo-Dong 2 has a quoted range of 3,730 miles (http://www.atomicarchive.com/Reports/Northkorea/TaepoDong.shtml). This range also precludes TD-2 from hitting Diego Garcia, BIOT, which is 4,673 miles from Pyongyang.

106 Great circle distance from Pyongyang to London Heathrow is 5,394 miles (www.gcmap.com) and as above at footnote 96, the upper bound of BM-25 / Musudan range is 4,000km / 2,485 miles.

107 Darwin is 3,568 miles from Pyongyang, and is the only major Australian city within Taepongdong-2 range.

in purely strategic terms, it would take a permanent deterioration in relations with China or Russia of the scale of a new cold war for an operationally independent UK nuclear force to provide any incremental deterrent effect over and above that provided by the United States' nuclear arsenal, even after current reductions under New START.

Given the extremely long lead time needed to bring a new generation nuclear deterrent into service, and the even longer period throughout which a future deterrent force might be expected to continue in service, it is of course conceivable that some unanticipated rogue regime well beyond the NATO area *might* in 20-30 years time develop a nuclear capability. Whether this would present a threat to the UK depends on the extent of British foreign policy interests in whichever part of Asia or Africa this regime occupied. To spend a major part of the defence budget to protect against the distant possibility that a threat might arise on the outer edges of the UK's strategic interests, however, seems irrational, and especially at the expense of conventional real-world capabilities.

3 - UK nuclear choices

The Alternatives paper

Under the 2010 coalition agreement, the Liberal Democrats are allowed to develop alternatives to a like-for-like Trident replacement. This study is now underway, and is scheduled to report to the Prime Minister and Deputy Prime Minister by Christmas 2012. An unclassified version is expected to appear sometime in the first half of 2013.

Without access to the classified analysis underpinning the study, this paper does not take a position on the Alternatives Paper *per se*. However, within the current enunciated strategic doctrine centred on the "Moscow Criterion" it is hard to see how technically or operationally there is an alternative to a submarine-launched ballistic missile system. In the wake of the Value for Money Study it is assumed that Trident remains the most cost-effective method of providing a submarine-launched ballistic missile capability as the United States has provided the preponderant cost of designing and deploying the Trident system.[108]

Some have argued that the UK should move to a cruise missile based nuclear force on the grounds that it will be cheaper and more flexible than the existing Trident system. It has also been suggested that this could lead to the development of multi-role submarines that combine the currently distinct roles of Trident ballistic missile submarines with the broader range of roles fulfilled by the UK's attack submarines. Putting to one side the fact that the UK does not currently have a warhead design suitable for cruise-missiles and that the United States Navy is retiring its nuclear cruise missile the Block II Tomahawk Land Attack Missile – Nuclear (TLAM-N) and its associated W-80 nuclear warhead because it is not "militarily cost-effective", we should consider whether or not the UK should move to a cruise missile-based nuclear system.

108 See SDSR 10 paragraph 3.10, p. 38.

It should be noted now that it is hard to see how it would be cheaper for the UK to design, produce and support in-service a bespoke warhead for cruise missiles rather than Trident. It would be deeply ironic if the Liberal Democrats found themselves supporting a policy that was substantially more expensive than Trident whilst being less effective – and, as we shall see, considerably more destabilising.

What type of nuclear force? – the signalling problem

The 2006 Defence White Paper "The Future of the United Kingdom's Nuclear Deterrent" provided an overview of a number of different types of nuclear force, encompassing submarine-based ballistic missiles and air-launched cruise missiles from a new, large aircraft platform. The 2006 White Paper goes on to make the case for a submarine ballistic missile based nuclear force on the grounds of invulnerability and cost. If the UK decides to replace the existing Trident system with another nuclear weapons system, both of these are sound rationales to select Trident again.

However, there is a more important reason that if the UK is to continue to deploy nuclear weapons, then they should be delivered by a ballistic missile: making clear to an adversary whether or not they are being attacked with nuclear weapons, a problem known as "nuclear signalling".

You are the President

Place yourself in the command centre of a hypothetical UK adversary which has a small nuclear arsenal based around land based liquid fuelled ballistic missiles and a large air force with free-fall bombs. This, for illustration, was approximately the UK's position in the 1962 Cuban Missile Crisis[109], and more sophisticated than either North Korea or Iran are likely to achieve in the next twenty years. You know your weapons are vulnerable to a first strike, and your air defence commander informs you that British aircraft have just launched cruise missiles 200 miles from your nuclear sites. She knows that they are cruise missiles as their radar returns indicate an aircraft-like, rather than ballistic, trajectory. Due to the missiles' speed, you have less than 20 minutes to decide what to do.

109 During the Cuban Missile Crisis of October 1962, the RAF fielded 17 V-bomber squadrons (7 Vulcan squadrons, 5 Victor squadrons, 5 Valiant squadrons plus 2 Valiant tanker squadrons), and 59 (of 60) Thor Intermediate Range Ballistic Missiles under US/UK dual key arrangements. At least some of the Valiant bomber squadrons were assigned to NATO with US nuclear weapons under dual key. See H Wynn, 'RAF Nuclear Deterrent Forces'.

> Currently, because Britain's nuclear weapons are only carried by ballistic missiles, you would be able to deduce that because the incoming missiles were cruise rather than ballistic, that they could not be nuclear. Hence, the nature of the incoming attack is knowable, and would be factored into the decision over whether or not pre-emptively to launch the vulnerable nuclear weapons.

Consequently, it is important for as long as the UK retains conventionally-armed cruise missiles that any nuclear delivery system is ballistic, and thus distinguishable to adversary decision-makers in a crisis. As the recent Libyan conflict demonstrated[110], the UK's complementary conventional submarine[111] and air launched[112] cruise missile systems are key elements of the UK's ability to project power, and will only become more so as the austerity cuts take effect. Hence, as their utility could be seriously undermined by UK nuclear-armed cruise missiles, the latter should be rejected.

Why not land basing? Lessons from BLUE STREAK

A potential alternative to submarine based missile would be to land-base the missiles in the UK, which raised considerations of where the bases should be built. This was last explored in the UK's BLUE STREAK ballistic missile programme in the late-1950s, which itself built upon the experience of RAF-operated American-owned SM-75 Thor intermediate-range ballistic missiles under dual-key arrangements from 1958-63.[2] Unlike Thor, which was stored but launched from ground level with an 8 – 13 minute countdown[3] (during which time it was extremely vulnerable to a first-strike), BLUE STREAK would be launched from hardened silos[4] that were designed to survive a near-miss[5] by a one-megaton warhead.

The problem was stark: the 100-missile BLUE STREAK force indicatively required 70-paired[6] silos, with at least six miles between each pair.[7] Worse, much of the eastern half of

110 See, e.g. www.haaretz.com/news/international/u-s-britain-fire-more-than-100-cruise-missiles-as-libya-action-begins-1.350286, http://www.telegraph.co.uk/news/worldnews/africaandindianocean/libya/8400079/Libya-Navy-running-short-of-Tomahawk-missiles.html, and http://www.aviationweek.com/aw/blogs/defense/index.jsp?plckController=Blog&plckScript=blogScript&plckElementId=blogDest&plckBlogPage=BlogViewPost&plckPostId=Blog per cent3A27ec4a53-dcc8-42d0-bd3a-01329aef79a7Post per cent3Ac9874eff-f7a9-4a14-8098-746a7449cfaf

111 Raytheon / McDonnell-Douglas BGM-109 Tomahawk Block IV, see: http://www.royalnavy.mod.uk/sitecore/content/home/the-fleet/ships/weapons-system/tomahawk-cruise-missile

112 MBDA Storm Shadow, see www.raf.mod.uk/equipment/stormshadow.cfm

England was deemed geologically unsuitable,[8] and the Home Office was understandably reluctant to place prime nuclear targets down-wind from major conurbations, ruling out the geologically favourable North Downs.[9] Fundamentally, Great Britain is too crowded, making UK land-based silos deeply unattractive.

It would of course be possible to select and acquire appropriate sites under compulsory purchase orders, but the social and political cost of, for example, basing nuclear missiles in the North Downs or in Kielder Forest would be prohibitive in all but the most extreme contingencies. Indeed, it is notable that at no point since the cold war has the MoD publicly suggested – let alone advocated – the land-basing of ballistic missiles in the UK, and this paper similarly discards the notion.

What operational posture – and therefore how many submarines?

A cornerstone of the UK nuclear posture since the Royal Navy assumed deterrent patrols in 1969 has been that one ballistic missile submarine will always be on patrol, and ready to fire; this is known as "Continuous At-Sea Deterrence" (CASD), and utilises submarines' inherently stealthy nature to maximise survivability against a surprise attack. The operational analysis for Polaris[113] indicated that continuous at-sea deterrence required five submarines. This figure was based around ensuring that two submarines were always on patrol, so that if one suffered damage or equipment failure, there would always be a spare already at sea – undetected, and invulnerable from a surprise attack.[114] Only building four submarines would at some point likely result in gaps in CASD coverage.[115] But, due to a combination of good husbandry and good luck, there has been no break in coverage with four submarines since 1969.[116]

It was therefore surprising that the 2006 White Paper outlined an investigation of reducing procurement to three submarines[117], a

113 In fact, a fifth Resolution-class SSBN (putatively named HMS RAMILLIES) was optioned in 1963, and cancelled in 1965 by the Wilson administration by what was presented as a cost-saving measure. Cancelled early, the total cost of cancelation was put at "less than £1m" (£16m in 2012). See The Nassau Connection, pp. 50-54.

114 The Nassau Connection, p. 30.

115 Submarines in British Defence Policy: Making the Case, Dr. Lee Willett, Head, Maritime Studies Programme, Royal United Services Institute (RUSI), 15 January 2008, p. 3. Available from www.rusi.org/downloads/assets/Willett_paper.pdf .

116 The United Kingdom's Future Nuclear Deterrent Capability, p. 8.

117 The Future of the United Kingdom's Nuclear Deterrent, paragraph 5.9, p. 26.

position reiterated by then-Secretary of State for Defence Dr. Liam Fox in July 2010.[118] Whilst the number of submarines required to deliver CASD should be subject to rigorous operational analysis, the key to CASD's deterrent effect is the continuous nature of it. Reducing the number of replacement submarines is frequently tied to another, superficially beguiling notion of delivering cost savings through a "part-time deterrent" that would sail at a time of tension.

Such a part-time deterrent is dangerously escalatory. First, the act of sailing a ballistic missile submarine in a crisis would be a major escalation just at the time when governments are attempting to de-escalate. Second, as the UK's only nuclear weapons system, a part-time deterrent in port provides a major incentive for an adversary to mount a pre-emptive strike to disable or destroy the Trident submarines in port or to ambush them on sailing, again increasing the incentives for an adversary to escalate a crisis more rapidly. A part-time deterrent is dangerously escalatory in a crisis, and must be rejected.

Thus, if the UK decides to procure on a Trident replacement, CASD is an essential precondition to deterrence, and sufficient submarines – heretofore four – must be built in order to maintain this posture. Moreover, any decision to purchase fewer than four submarines would need to pass muster not just in the UK but in the mind of any potential adversary in order to have the desired deterrent effect.

A multilateral nuclear force?

An alternative that could provide substantial cost savings would be to move to an integrated European nuclear force with France. Theoretically, there are several options running from cost-sharing for common elements of the nuclear capability, potentially including missiles and submarine development, training and support organisations, through to joint warhead design and manufacture and shared deterrent patrols, possibly with mixed crews.

Such cooperation is not a new idea; it was first proposed in the mid-1960s under the abortive NATO Multilateral Nuclear Force (MNF) proposals. Instructively, these proposals went nowhere, mired in a range of operational and political disputes over costs and command and control arrangements. Similarly, a modern variant of MNF would require either nationally crewed submarines under separate national control – offering only small savings – or a dual-key arrangement between the cooperating states.

118 Reported by the BBC on 13 July 2010. See http://www.bbc.co.uk/news/10623343

Dual-key arrangements were rejected in the 1960s precisely because they did not offer the UK the ability to act independently *in extremis*. Whilst areas of commonality leading to welcome cost-savings with France and the United States should – and are – being pursued, the opportunities for real savings made possible by jointly-crewed bi-national submarines under dual-key arrangements cannot be realised without fundamentally changing UK declaratory nuclear policy.

4 - Economic and budgetary issues

In budgetary terms, the end of the cold war led to the so-called 'peace dividend', which saw substantial cuts in military spending. During this period UK defence spending fell from an average of 4.3 per cent of GDP[119] in the decade from 1982, to 2.8 per cent of GDP[120] over the ten years from 1992, and then to 2.1 per cent of GDP in the decade since 2001.[121] In real terms, Britain spent 14 per cent less on average in the decade to 2011 than in 1992.[122]

Unfortunately, British governments neither scaled down their policy nor defence-industrial ambitions to match their reduced means, resulting in an unfunded budgetary "black hole" from 2011 – 2021 of £51bn.[123] Combined with the subsequent cuts to reduce the budget deficit, this "black hole" has increased to £74bn over the decade to 2021; if this were straight-lined across a decade, £7.4bn would represent 22.8 per cent of the MoD's £32.8bn 2011-12 budget.

Despite the future capability promised in SDSR 10 known as "Future Force 2020", these immediate cost pressures led directly to significant cuts, especially in personnel: military personnel is projected to fall by 20 per cent by 2020, and MoD civilian staff by almost 40 per cent over the same period. Equipment cuts included the withdrawal of maritime patrol aircraft, the RN's aircraft carrier capability and reductions in the number of ships, flying squadrons and army units. There are also ambitious targets for efficiency savings, though realizing these has proved difficult historically.

These cuts proved insufficient to close the MoD's budget gap, which forced further cuts in the 2011 Planning Round (PR11), the results

119 CentreForum analysis of HM Treasury data via http://www.ukpublicspending.co.uk .
120 CentreForum analysis of HM Treasury data via http://www.ukpublicspending.co.uk .
121 And therefore barely meeting the NATO target for defence spending of 2 per cent of GDP. CentreForum analysis of HM Treasury data via www.ukpublicspending.co.uk
122 1992 defence spending was £31.37bn in 2005 prices versus an average of £26.94bn in 2005 prices between 2001 and 2011. CentreForum analysis of HM Treasury data via http://www.ukpublicspending.co.uk.
123 Looking into the Black Hole, p. 3.

of which were announced in July 2011's 'Three Month Review'.[124] What should have followed in the autumn of 2011 was publication of the MoD Equipment Plan that would demonstrate that the budget is in balance, together with an audit of the Equipment Plan's assumptions by the National Audit Office. However, both documents have been delayed and remain unpublished. The shortfall facing the MoD, *after* SDSR 10 was supposed to have eliminated the deficit, was estimated at £25bn.[125] Analysts consequently concluded that the MoD would need 3 per cent real terms increase per annum to meet the targets outlined for Future Force 2020,[126] but this was deemed unaffordable. Instead a 1 per cent real-terms increase for the Equipment Programme from 2015-16 was agreed.[127]

The period from 2015 to 2030 will see three major military procurements in addition to Trident replacement: Type 26 frigate, F-35C Joint Strike Fighter (JSF), and future armoured vehicles.[128] These three procurements will be critical to the UK's conventional force capability in maritime, air and land environments: for example the JSF programme will replace both the RAF's Tornado strike aircraft and the aircraft for the RN's new aircraft carriers. The suspicion remains that these programmes are being deferred beyond the 10-year planning horizon to "demonstrate" affordability over that period. Such deferrals rarely constitute value-for-money.

As the Commons' Public Accounts Committee reported in November 2011 on the aircraft carrier programme, "The Department believes that the SDSR decision will save £3.4 billion, but only £600 million of this is cash savings while the remainder is simply deferring expenditure beyond the Department's 10 year planning horizon."[129] The net result of such manipulation is not to balance the books but to delay capability – in the case of the aircraft carriers, full capability will not be delivered until 2030, a full 20 years after the retirement of its predecessors – and, because of the delaying of the procurement programmes, much higher costs.[130]

124 Looking into the Black Hole, p. 2.
125 Nick Hopkins, The Guardian, 18 July 2011. See http://www.guardian.co.uk/politics/2011/jul/18/defence-spending-25bn-cameron-osborne accessed 10 Jan 12 @ 22.56.
126 See footnote 177.
127 R Norton-Taylor, The Guardian, 18 July 2011. See www.guardian.co.uk/uk/2011/jul/18/mod-spending-increase-armed-forces accessed 10 Jan 12 @ 23.18.
128 The programme that was previously known as the Future Rapid Effects System (FRES).
129 Providing the UK's Carrier Strike Capability, House of Commons Committee of Public Accounts, Fifty-sixth Report of Session 2010-12, HC 1427, 29 Nov 2011, p. 3. Available from www.publications.parliament.uk/pa/cm201012/cmselect/cmpubacc/1427/1427.pdf accessed 5 Feb 12 at 18.46.
130 See NAO Major Projects Reports passim.

Trident and the UK's international status

It is frequently asserted that the UK's international status would be undermined, and that specifically the UK's Permanent Membership of the UN Security Council would be threatened, if Trident were not replaced.[131] These issues are separate and should not be conflated.

When the United Nations Security Council convened for the first time in 1946, the United Kingdom did not possess nuclear weapons; only the United States did. That the permanent members all eventually acquired nuclear weapons is an unfortunate coincidence that has fostered serious misunderstandings about the linkage of nuclear weapons and status in the international community.

Under the terms of the United Nations' Charter, the only method of removing the UK from the Security Council is through a change to the UN Charter.[132] In turn, a Charter change requires the approval of the current members of the Security Council. This means that the UK would have to acquiesce in its removal by not vetoing the draft resolution containing the Charter change when it is presented to the Security Council. Consequently, the UK's Security Council position is entirely separate to the decision to replace Trident. Linking possession of nuclear weapons as a *sine qua non* of holding Security Council permanent membership is both historically inaccurate, and deeply unhelpful in the fight against nuclear proliferation.[133] Indeed, it is telling that the possession of nuclear weapons has had no discernible impact on the Security Council membership aspirations of India or Pakistan. In fact, it would be an important signal of the declining relevance of nuclear weapons for one of the permanent members to relinquish its nuclear-weapons capability.

The broader conception is that the UK is a "world power", and that this status demands nuclear weapons. Such status-driven thinking has a long history in UK defence doctrine, most famously exemplified by Foreign Secretary Ernest Bevin. At the pivotal Cabinet Committee meeting in January 1947 approving the UK's

131 See, for instance www.dailymail.co.uk/news/article-1299101/Trident-vital-UK-arms-race-Fox-Osborne-clash-defence-funding.html, accessed 11 Jan 12 @ 14.55.

132 Art 23(1) UN Charter details the permanent members of the Security Council. The Permanent Members' veto right is detailed in Art 27(3) UN Charter. See www.un.org/en/documents/charter/chapter5.shtml.

133 From 1945 to 1949, the United States was the only nuclear-capable Permanent Member, when it was joined by the Soviet Union. Britain joined the nuclear club in 1952, and France in 1960. The Republic of China (Taiwan) held China's UN membership (and with it, the Chinese permanent membership of the UN Security Council) from 1945 to 24 November 1971, and did not have indigenous nuclear capability during its membership of the Security Council. When the People's Republic of China took over the UN seat in November 1974, it was already a nuclear weapons state.

nuclear programme, Bevin famously opined: "We've got to have this thing over here, whatever it costs. We've got to have the bloody Union Jack on top of it."[134] In a similar vein, when approving the development of thermonuclear weapons in 1954, Churchill noted, "We must do it. It's the price we pay to sit at the top table."[135]

In 1954, however, perceptions of Britain's global role arguably reflected reality: though the Indian Empire and Palestine were no longer colonial possessions, the humiliation at Suez lay two years in the future, and Ghanaian independence – the first realised by a British African colony – would wait until 1957. In the meantime, Britain still governed colonies worldwide, and had played the leading non-American role in the Korean War that had ended a year earlier. Conscription provided a large – and in direct costs, inexpensive – body of men for the forces, making conventional forces affordable on a scale that would be inconceivable by the mid-1960s.[136]

Such practical considerations were already history when Tony Blair decided to push Trident replacement through the House of Commons on a three-line whip in March 2007. Surviving a Labour backbench rebellion of 95 MPs only with the votes of Conservatives,[137] the Blair Government was continuously insistent that "We maintain our nuclear forces as a means of deterring acts of aggression ... and not for reasons of status."[138] Yet as Blair's memoirs demonstrate, this was simply untrue; in fact, perceptions of status were the deciding factor in the decision to replace Trident, with Blair noting that, "in the final analysis, I thought giving it up too big a downgrading of our status as a nation".[139]

For a decision with implications for the UK throughout the first half of the 21st century, such a status-based argument needs to be made explicitly, so that it can be weighed against the costs and benefits of other policy choices. This does not mean that arguments about the UK's status are irrelevant. On the contrary, arguments about the UK's international role – and with it, status – are deeply relevant. However, the question should be where is the marginal pound best invested to maximize the UK's international clout?

134 The Secret State, p. 48.
135 The Secret State, p. 52.
136 Clearly there were broader economic costs to having a large number of young men in HM Forces who would otherwise be in employment, education or training.
137 At the 2005 election, Labour held 355 seats, Conservatives 198 and Liberal Democrats 62. A majority was 324, so the Labour rebellion of 95 left Labour 64 short of a majority in its own right. See Hansard, www.publications.parliament.uk/pa/cm200607/cmhansrd/cm070314/debtext/70314-0021.htm, accessed 19 Feb 12 @ 21.50.
138 The Future of the United Kingdom's Nuclear Deterrent, Box 3-1 tiret 5, p. 20.
139 T Blair A Journey, Hutchinson, London, 2010, p. 636.

Force 2020

The centrepiece of SDSR 10 was a bargain of "pain today for jam tomorrow". The jam in question is branded Future Force 2020, and provides a blueprint for a flexible force capable of the full-spectrum of conflict, ranging from a series of enduring stabilisation operations of varying complexity through to a divisional level[140] operation on the scale of the UK's contribution to the 2003 Iraq invasion for a limited period.[141] This involves some interesting assumptions about expensive commitments. For instance, the maritime contribution is centred around an aircraft carrier routinely operating 12 F-35C Joint Strike Fighters; yet the carrier is not now slated for full operational capability before 2030, and the plan to mothball HMS QUEEN ELIZABETH from 2019[142] means that the UK will not have an aircraft carrier continuously available.[143] Moreover, with the Joint Strike Fighter currently costing £117m per aircraft the unit costs will seriously constrain overall procurement numbers, reducing the flexibility of the resultant force.[144]

It is axiomatic that military procurement is constrained by budget, time, and capability; to some extent any of these criteria can be traded against a combination of the other two. The MoD has not explained how the Future Force 2020 vision can be delivered by 2020 (or indeed 2025) within the current or likely future MoD budget. Barring a significant – and commensurately unlikely – increase in the defence budget, the future of Future Force 2020 and the Trident replacement are inextricably linked, as each pound spent on Trident replacement is one less spent on the conventional forces.

Is Trident affordable?

With large conventional force cuts being taken, questions of the priority of Trident replacement arise. These questions combine two separate, but related, issues. First, is the Trident replacement

140 SDSR 10 describes this as three brigades. See Fact Sheet Five: Future Force 2020 – Summary of size, shape and structure, p. 1. See www.cabinetoffice.gov.uk/sites/default/files/resources/Factsheet5-Future-Force-2020.pdf,.

141 Fact Sheet Five: Future Force 2020, p. 1.

142 See SDSR 10; see www.telegraph.co.uk/news/uknews/defence/8072041/Navy-aircraft-carrier-will-be-sold-after-three-years-and-never-carry-jets.html

143 Providing the UK's Carrier Strike Capability, House of Commons Committee of Public Accounts, Fifty-sixth Report of Session 2010-12, HC 1427, 29 Nov 2011, p. 3. Available from www.publications.parliament.uk/pa/cm201012/cmselect/cmpubacc/1427/1427.pdf

144 Figure is based on the all-in-costs of the F-35C from Low Rate Initial Production Batch 5 (LRIP-5) of $182.2m per aircraft. In practice, the figure should fall as production ramps up, but this is the best figure at the time of writing. See www.defense-aerospace.com/article-view/release/131154/f_35-unit-cost-nears-$160m-as-lockheed-wins-$4bn-for-lrip-5-lot.html

programme affordable in absolute terms from the MoD's future budget? Second, given the trade-offs demanded to fund it, would the impact on Future Force 2020 be worth it?

To answer these questions, the first requirement is to understand the MoD's future budgets. This is challenging as the current agreed budgets run until 2014-15, with funding beyond that date subject to future elections and Defence Reviews. The current position is that the Equipment Programme will grow at 1 per cent real per annum "from 2015". For the sake of this analysis, it is assumed that this real growth will be sustained throughout the next Parliament, with the remainder of the MoD budget flat in real terms. Tables 1a and 1b detail the outturn figures in nominal and constant 2011 pounds, with the Equipment Programme growing at 1 per cent in real terms from 2015–16 to 2019–20, and then reverting to no real growth from 2020–21.[145]

The MoD have not published a detailed budget or the spending profile – how much will be spent in each year – for the *Vanguard* replacement programme. As a result, this analysis entails a number of assumptions. Given the similarities and the publicly available information, the best comparator is the US Navy's Trident submarine replacement programme, codenamed SSBN(X), for which a detailed spending profile is available in the Congressional Budget Office's occasional papers.[146]

Answering the first question, after applying the *Vanguard*-class spending profile and Trident-replacement costs to the probable MoD capital budget in the years from 2015 to 2032, Trident replacement is probably affordable in absolute terms. By this, we mean that if Trident replacement comes in approximately in line with the spending profile and the budget, then there is enough capital in the budget to pay for the replacement Trident submarines.

However, this is only part of the answer, as the opportunity costs of that spending also need to be considered. Our analysis shows that on average Trident replacement consumes an average of 22 per

145 This paper's recommendation that the UK continues to meet the NATO target of spending 2 per cent of GDP on defence would mean that defence spending is likely to rise in real terms after 2015. This is because the target is currently being "met" by counting the cost of operations (notably in Afghanistan), and with the withdrawal from Afghanistan in 2014, it is likely that the UK's defence spending will fall below 2 per cent of GDP. This putative additional spending will provide some budgetary headroom for the MoD, but it will not be enough to allow for Future Force 2020 and the likely costs of Trident replacement.

146 Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan, 23 June 2011, Congressional Budget Office, Washington DC.

Table 1: Ministry of Defence Departmental Expenditure Limits 2010/11 – 2031/32 (Nominal £m)

	10-11	11-12	12-13	13-14	14-15	15-16*	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32
Resource‡	24,320	24,890	25,225	24,916	24,705	25,323	25,956	26,605	27,270	27,951	28,650	29,366	30,101	30,853	31,624	32,415	33,225	34,056	34,908	35,780	36,675	37,592
Capital	8,613	8,861	9,136	9,191	8,749	9,051	9,363	9,686	10,020	10,366	10,625	10,891	11,163	11,442	11,728	12,021	12,322	12,630	12,946	13,269	13,601	13,941
*o/w EP*ø	*7,500*	*7,688*	*7,903*	*8,100*	*8,303*	*8,593*	*8,894*	*9,205*	*9,528*	*9,861*	*10,108*	*10,360*	*10,619*	*10,885*	*11,157*	*11,436*	*11,722*	*12,015*	*12,315*	*12,623*	*12,939*	*13,262*
Total	**32,933**	**33,751**	**34,361**	**34,107**	**33,454**	**34,373**	**35,319**	**36,291**	**37,290**	**38,317**	**39,275**	**40,257**	**41,264**	**42,295**	**43,353**	**44,436**	**45,547**	**46,686**	**47,853**	**49,050**	**50,276**	**51,533**

Source: CentreForum Analysis of CSR 10, www.mod.uk/DefenceInternet/AboutDefence/Organisation/KeyFactsAboutDefence/DefenceSpending.htm

*Flat Real Resource from end of CSR 10 period. Capital incorporates 1% per annum equipment programme real growth from 2015-16 to 2019-20, then Flat Real to 2031-32.

‡Excluding depreciation

ø Equipment programme as % of capital spend per 2010-11 MoD Annual Report and Accounts, Section 2 Paragraph 8.9, p. 54

Inflation assumption beyond 2015 assumed to be 2.5%

Table 2: Ministry of Defence Departmental Expenditure Limits 2010/11 – 2031/32 (Constant 2011 £m)

	10-11	11-12	12-13	13-14	14-15	15-16*	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32
Resource‡	25,007	24,890	24,538	23,646	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874	22,874
Capital	8,856	8,861	8,887	8,723	8,101	8,176	8,251	8,328	8,405	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483	8,483
o/w EPø	*7,712*	*7,688*	*7,688*	*7,688*	*7,688*	*7,763*	*7,838*	*7,915*	*7,992*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*	*8,070*
Total	**33,863**	**33,751**	**33,425**	**32,369**	**30,975**	**31,050**	**31,125**	**31,202**	**31,279**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**	**31,357**

Source: CentreForum Analysis of CSR 10, www.mod.uk/DefenceInternet/AboutDefence/Organisation/KeyFactsAboutDefence/DefenceSpending.htm, and using HM Treasury GDP deflators available from www.hm-treasury.gov.uk/data_gdp_fig.htm

*Flat Real Resource from end of CSR 10 period. Capital incorporates 1% per annum equipment programme real growth from 2015-16 to 2019-20, then Flat Real to 2031-32.

‡Excluding depreciation

ø Equipment programme as % of capital spend per 2010-11 MoD Annual Report and Accounts, Section 2 Paragraph 8.9, p. 54

Inflation assumption beyond 2015 assumed to be 2.5%

cent (+/- 5 per cent) of the MoD's capital budget in the years 2015 – 32.[147] Worse, in the programmes peak spending years of 2019-20 to 2027-28 this rises to 26 per cent (+/- 5.7 per cent) crowding out conventional force procurement in support of the Future Force 2020 goals.[148]

This alarming picture is based on the "best case" of the project running on time and to budget – any slippage to time or cost will directly impact on the budget for the conventional force procurement. Moreover, with no slack in the timetable for the introduction of *Vanguard*-class replacement, the usual route of accepting delays to future procurement as a method of overcoming short-term cost pressures is also unavailable, increasing the risk of overspends. In the absence of additional funding, cost overruns on Trident will lead to further cuts and postponements in procurement for Future Force 2020.

Two views of the future: "Full-Spectrum Conventional Forces" vs. "Switzerland with Trident"

In light of the above, the UK faces a stark choice between conventional forces and nuclear forces. Worse, with all of the cost risk of Trident replacement on the upside, any overspends will lead to further cuts in conventional force capability. Thus, the question confronting the UK is whether the national interest is better served by proceeding with Trident replacement with its attendant costs in conventional capability, or by scrapping the Trident replacement and reinvesting the savings in the UK's conventional forces.

Though it is unlikely to be fundable along with Trident replacement, events since SDSR 10 have shown that Future Force 2020 is also unlikely to be sufficient to meet the challenges of global instability in the 21st century. For example, it is asserted that had the aircraft carrier at the heart of Future Force 2020 been available for operations over Libya in March 2011 in support of UNSCR 1973, then there would have been no need for the large RAF land-based contingent, reducing costs and increasing operational flexibility.

147 CentreForum analysis of MoD and CBO data. CBO published spending profile for SSBN(X) applied across the £20bn - £29.591bn cost estimates for Trident replacement spending after 2015-16. £20bn is the £25bn present value of the programme cost assuming that £5bn had been spent on long-lead items by 2015; £29.591bn is the £32.591bn figure (£25bn with 30.4 per cent allowance for optimism bias) less the £3bn estimate of pre-2015 spending on long-lead items. For SSBN(X), see footnote 80.

148 This problem is not unique to the UK; the US Navy is facing the same crowding out concerns with its procurement of replacements for the *Ohio*-class Trident missile submarines. See Navy SSBN(X) Ballistic Missile Submarine Program: Background and Issues for Congress, Congressional Research Service, Washington DC, July 2010, pp. 15 – 16.

In reality what this actually shows is that as well as being unaffordable Future Force 2020 is too small: had Libya occurred during the 41 to 55 per cent of the time that a single UK aircraft carrier was available, it would have been able to generate a mere 20 missions per day.[149] Moreover, lacking its own airborne early warning and refuelling aircraft, it would have been reliant on significant land-based support, whether from the UK or our allies. Finally, it would have required more sea-going tanker support than the UK currently has available.[150]

As seen in this illustration, Future Force 2020 falls between two stools: it was scaled back so that it is theoretically deliverable (making it too small to be operationally useful) but it remains unaffordable (making it unachievable). This is not to suggest that Future Force 2020 is a bad notion; doctrinally speaking, it is a well-balanced force that, though small, has the capability to engage in the full spectrum of conventional conflict. It also contains a number of key force multipliers that are prized by our allies, including the United States. In this sense, Future Force 2020 provides an effective, scalable vision of what the UK could achieve given sufficient investment. Moreover, it is a vision that allows the UK to make a more concrete contribution in the range of likely scenarios than would be possible if the UK were to divert £25bn to £33bn to a Trident replacement.

Filling Future Force 2020's conventional strike gap – *Vanguard*-class SSGN conversions

The *Queen Elizabeth*-class aircraft carriers are a centrepiece of the 'Future Force 2020', providing a deployable conventional strike capability worldwide limited only by deployment time. However, as the Public Accounts Committee reported in November 2011, the carrier's full operational capability will not be available before 2030.[151] To fill this gap, it is proposed to convert the existing *Vanguard*-class submarines during their life-extension overhaul along the same lines as four US Navy *Ohio*-class Trident submarines a decade ago: to carry conventional BGM-109 Tomahawk cruise missiles a decade ago.[152] Based on the cost of these conversions, it is estimated to cost £826.8m per submarine for 15 years' operational life.[153]

149 CentreForum analysis derived from the data provided in Providing the UK's Carrier Strike Capability.
150 Providing the UK's Carrier Strike Capability, Question 45.
151 Providing the UK's Carrier Strike Capability.
152 See Navy Trident Submarine Conversion (SSGN) Program: Background and Issues for Congress, Roland O'Rourke, Congressional Research Service, Washington DC, May 2008.
153 Navy Trident Submarine Conversion (SSGN) Program, p. 6.

Converting the *Vanguard*-class to carry conventional cruise missiles confers several advantages. First, each could carry more than 90 cruise missiles compared with a maximum of 38 torpedoes and cruise missiles on *Astute*-class submarines. Second, they would provide enhanced facilities for hosting and covertly infiltrating special forces.[154] Used operationally in Kosovo, Afghanistan, Iraq, and Libya,[155] the RN's Tomahawk capability has become an essential part of UK and coalition operations by combining long range and great accuracy with limited risk to UK service personnel and, unlike land-based aircraft, no need to secure basing rights in operational theatres or overflight rights.

These were precisely the capabilities that the *Queen Elizabeth*-class will provide Future Force 2020 from 2030. Though the converted *Vanguards* will be less flexible than the *Queen Elizabeth*-class aircraft carriers with their full air wing, timely conversion of *Vanguard*-class submarines will allow the *Vanguards* to make a significant contribution to the UK's power-projection capabilities until the *Queen Elizabeth*-class achieve full operational capability.

154 www.royalnavy.mod.uk/News-and-Events/Latest-News/2011/November/14/111114-Astute-Tomahawk

155 www.royalnavy.mod.uk/sitecore/content/home/the-fleet/ships/weapons-system/tomahawk-cruise-missile

What could Trident cancellation fund?

The sheer scale of the Trident procurement provides significant opportunities for rebalancing the UK's conventional capabilities. It is worth sketching out what this funding could provide, in this case focused on air and littoral capabilities that took a disproportionate share of the cuts with the land forces largely spared given their continuing combat role in Afghanistan.

These are capital costs, and do not include operational costs; as such notions of affordability would need careful analysis. For this reason, and due to the uncertainty in the costs, this example caps spending at 80 per cent of the projected savings. Additionally, the opportunity exists to use the savings to reprieve some capabilities scheduled for premature retirement in 2015, such as the Sentinel reconnaissance aircraft.

		£20bn scenario		£33bn scenario	
Item	Unit Cost (£m)*	Number	£m	Number	£m
Convert *Vanguard* -class to SSGN role[i]	804.3	4	3217.1	4	3217.1
Tomahawk cruise missiles[ii]	0.5	200	99.2	400	198.4
Astute attack submarines[iii]	747.7	3	2243.1	5	3738.5
F-35C Joint Strike Fighter[iv]	114.4	40	4575.9	75	8579.8
Type 26 frigate[v]	400.0	7	2800.0	13	5200.0
E-2D Hawkeye early warning aircraft[vi]	111.8	4	447.1	5	558.9
C-2 Greyhound carrier cargo aircraft[vii]	Lease	0	0.0	2	0.0
P-8 Poseidon maritime patrol aircraft[viii]	155.0	8	1239.7	12	1859.5
Convert HMS QUEEN ELIZABETH to operate conventional take-off aircraft[ix]	1200.0	1	1200.0	1	1200.0
Total		15823.5			24544.7

*2011 Pounds. Where required, converted from USD at a rate £1 = $1.55

i Navy Trident Submarine Conversion (SSGN) Program, Table 1 p. 5 converted to 2012 dollars from www.measuringworth.com/uscompare/relativevalue.php gives a value of $4.66bn for the four conversions including refuelling. Converted to sterling at £1 = $1.55 and allowing a 10 per cent increase in cost gives a cost of £826.8m per submarine, scaled back to 2011 pounds gives a unit cost of £804.3m.

ii Tomahawk Block IV priced at £496k per round; this is derived from the US Navy's NAVAIR command estimate of $609k (Fiscal 1999 Dollars) (www.navair.navy.mil/index.cfm?fuseaction=home.display&key=F4E98B0F-33F5-413B-9FAE-8B8F7C5F0766) inflated to $789k 2012 dollars via www.measuringworth.com/uscompare/relativevalue.php.

iii Unit cost based on the unit cost of Astute boats 4-6 as reported in the MPR 2011 Figure 2, p. 11 of £747.7m (2011 pounds). In reality, these costs would be likely lower as the build rate would increase and the unit costs should fall.

iv Figure is based on the all-in-costs of the F-35C from Low Rate Initial Production Batch 5 (LRIP-5) of $182.2m per aircraft, which allowing a 10 per cent increase in cost gives a cost of £117.6m per aircraft, scaled back to 2011 pounds gives a unit cost of £114.4m. In practice, the figure should fall as production ramps up, but this is the best figure at the time of writing. See www.defense-aerospace.com/article-view/release/131154/f_35-unit-cost-nears-$160m-as-lockheed-wins-$4bn-for-lrip-5-lot.html,

v There is great uncertainty around the Type-26 costs, not least because the actual specification of Type-26 is yet to be defined. £400m is the RN's target cost, see www.defenseindustrydaily.com/Britains-Future-Frigates-06268/

vi P-1 Item 19 Page 1 of 5, Programme Unit Costs of E-2D Hawkeye from Justification of Estimates February 2011: Aircraft Procurement, Navy Volume I: Budget Activities 1-4, lists programme unit cost at $157.9m for E-2D Hawkeye. This translates to $178.0m in 2012 dollars including 10 per cent to cover export surcharges. $178.0m converts to £114.9m for unit costs, scaled back to a £111.8m in 2011 pounds. See www.finance.hq.navy.mil/FMB/12pres/APN_BA1-4_BOOK.pdf

vii C-2 Greyhound is a cargo variant of the E-2 Hawkeye to allow cargo and personnel to be flown to and from the aircraft carrier. Cost unknown as US Navy production concluded in 1990. C-2A is undergoing a service life extension package www.navy.mil/navydata/fact_display.asp?cid=1100&tid=100&ct=1, and the US Navy have reportedly leased 2 C-2s to the French Navy in 2011.

viii P-8A Poseidon is the new US Navy maritime patrol aircraft replacing the P-3 Orion series. P-8A is based on the Boeing 737 airliner. P-1 Item 17 Page 1 of 5, Programme Unit Costs of P-8A Poseidon from Justification of Estimates February 2011: Aircraft Procurement, Navy Volume I: Budget Activities 1-4, lists programme unit cost at $219.040m for P-8A Poseidon. This translates to $247.0m in 2012 dollars including 10 per cent to cover export surcharges. $247.0m converts to £159.3m for unit cost, scaled back to a £155.0m in 2011 pounds. See www.finance.hq.navy.mil/FMB/12pres/APN_BA1-4_BOOK.pdf

ix Conversion of HMS QUEEN ELIZABETH from short-take off vertical-landing ("ski-jump") configuration to conventional take-off and landing configuration ("cats and traps") to operate the F-35C. Figures from Providing the UK's Carrier Strike Capability, paragraph 12, p. 9.

5 - Legal issues

The 1968 Nuclear Non-Proliferation Treaty (NPT) is the cornerstone of the international nuclear weapons control regime, with 189 member states[156] and an independent guardian in the form of the IAEA.[157] Only India, Israel and Pakistan have never signed, and in 2003, North Korea became the only state to have withdrawn from it. The NPT takes the form of a complex bargain: in return for foregoing the right to acquire nuclear weapons and recognising the right of those states that had previously detonated a nuclear device as 'Nuclear Weapons States', the treaty gave non-nuclear powers access to nuclear technology for civilian purposes. Further, under NPT Article VI, the Nuclear Weapon States committed themselves to nuclear disarmament, with the clear goal of a nuclear free world.

At the periodic Review Conferences, non-nuclear weapon states have consistently claimed that the Nuclear Weapons States were violating their NPT obligations by failing to disarm. This was an especially powerful argument in the late cold war when the 38,974 warheads extant in 1968 had nearly doubled to 70,481, with 95 per cent in the arsenals of the two superpowers.[158] Indeed, at the 1995 Review Conference when the signatories were discussing making the NPT permanent rather than extending it for a decade, this failure to disarm came close to bringing the NPT Review Conference to breaking point.

In their advisory opinion on the legality of Nuclear Weapons in 1996, the International Court of Justice held that NPT Article VI places the Nuclear Weapon States under an obligation "to achieve a precise result - nuclear disarmament in all its aspects" - and to achieve this

156 Only India, Israel, Pakistan, and North Korea remain outside the NPT. See "Status of the Treaty" on www.un.org/disarmament/WMD/Nuclear/NPT.shtml

157 IAEA Safeguards Overview: Comprehensive Safeguards Agreements and Additional Protocols. See www.iaea.org/Publications/Factsheets/English/sg_overview.html

158 Global nuclear stockpiles, 1945–2006, Hans M. Kristensen and Robert S. Norris, Nuclear Notebook, Bulletin of the Atomic Scientists, 62(4), July 2006, p. 66. bos.sagepub.com/content/62/4/64

"the pursuit of negotiations on the matter in good faith".[159] Since the end of the Cold War, the number of active warheads has fallen dramatically, with Russia and the United States now holding less than 6,650 warheads combined – a number expected to fall further over the next decade as obsolete tactical warheads are retired. Moreover, President Obama's 2009 Prague Speech has established an American commitment to work toward 'nuclear zero', albeit achieved over time. In the absence of such general negotiations how does the UK demonstrate the required good faith?

In their 2005 Opinion, Professor Christine Chinkin and Rabinder Singh QC concluded that replacing Trident would be a violation of this good faith test, and illegal in light of Britain's international treaty obligations.[160] Writing in 2009, Professor Philippe Sands QC and Helen Law agreed. Simply put, it is hard to demonstrate that the UK is working to achieve nuclear disarmament by spending upwards of £25bn on replacing Trident.

Moreover, given the *de minimus* nature of the UK's nuclear force, the logical step for the UK to demonstrate its good faith to nuclear disarmament is to withdraw Trident from service immediately.

Such a step would rightly be seen as a significant step towards nuclear disarmament, but needs to be properly understood. In removing the UK's fielded nuclear weapons, Britain would adopt a "nuclear threshold" status, in that until global nuclear disarmament occurs, the UK would retain the capacity to field a free-fall thermonuclear capability at 12-18 months notice by retaining the weapons-grade fissile material and the requisite weapon fabrication capacity. This nuclear threshold status is entirely consistent with the UK's international obligations under the NPT.

Meeting the verification challenge

Perhaps counterintuitively, nuclear disarmament gets harder as the number of warheads declines, as the benefits from cheating – and therefore the incentive to cheat – rise rapidly. Thus, research into verification of nuclear disarmament is a key precondition for further nuclear disarmament by Russia and the United States.

Britain can help. For the past two and a half years, the Verification Research, Training and Information Centre (VERTIC), a British

159 Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion of 8 July 1996, paragraph 99.

160 R Singh QC and C Chinkin, 'UK Trident replacement: a material breech of the NPT', 2005 www.acronym.org.uk/docs/0512/06.htm

NGO, has been conducting research into verifiable nuclear warhead dismantlement, in cooperation with the Atomic Weapons Establishment, Aldermaston (AWE) and Norwegian laboratories. The program was created in order to counter scepticism amongst non-nuclear-weapons states over the UK's nuclear disarmament bona fides.[161] As a nuclear weapons state, the United Kingdom is able to provide unique technical expertise that non-nuclear weapons states have foresworn. The alliance between VERTIC and AWE has been able to prove that technical methods can accurately and efficiently track fissile materials and nuclear weapons components, without having to expose classified information about the nuclear warheads themselves.

The research collaboration between AWE and VERTIC has facilitated a better understanding of each other's work and there is value for both sides in expanding this collaboration. It has contributed to the positive increase in public awareness of the nuclear programme of the British government. [162] It has also established the UK as the most forward-leaning of the nuclear-weapon states in research into verifiable nuclear disarmament.[163]

Verification is a key confidence building measure in disarmament, and under the policy proposals in this paper, this partnership should continue and be deepened by demonstrating publicly the verification techniques pioneered by AWE and VERTIC when applied to the dismantling of the UK's existing Trident warheads. Not only will this verifiably demonstrate that the UK is meeting its NPT Article VI obligations, it will provide a large evidence base for verification techniques for other states with nuclear weapons. In this way, the UK can put AWE's expertise at the disposal of global and regional bodies seeking technical verification support. These could include, but are not limited to, the United Nations, the IAEA and Six-Party Talks over the North Korean nuclear programme.

161 Verifying Warhead Dismantlement, Vertic Research Reports No 9, Persbo, Andreas. Cliff, David. Elbahtimy, Hassan. September 2010, p. 14. Available from www.vertic.org/media/assets/Publications/VM9.pdf,.

162 Renewing Trident: Can the UK's Atomic Weapons Establishment Cope?, Henrietta Wilson, Disarmament Diplomacy, Summer 2008. www.acronym.org.uk/dd/dd88/88hw.htm#en55,

163 *Verifying Warhead Dismantlement*, p. 14.

6 - Addressing other perspectives

SDSR envisages the UK retaining a world role, either operating with allies or alone to protect the UK's national interest. A key element of long-range power projection and intelligence gathering continues to be provided by the Royal Navy's nuclear-powered attack submarines and, for as long as the UK continues to have a global role, nuclear-powered attack submarines will have a critical part to play. Given this, changes to submarine procurement resulting from the cancellation of the replacement Trident submarines requires careful analysis to ensure that in cancelling the replacement Trident submarines, the UK retains the ability to design, build, operate and decommission nuclear-powered attack submarines in the late-2020s.

Submarine Industrial Issues

The cost-overruns and delays in the *Astute*-class attack submarine programme are usually ascribed to a protracted ordering process, which meant that the requisite design and engineering skills at BAE Systems Submarine Solutions' and through the supply chain[164] were lost, and so had to be regained at vast cost. Consequently, a premium is placed on the continuity of the industrial base, and *Astute* production has been slowed both to meet in-year cash pressures in 2010[165], and to ensure that there is a continuity of work in the nuclear submarine supply chain until the replacement Trident submarines are slated for construction.[166] Given the 25-year design life of HMS ASTUTE, *Astute's* successor submarines will be designed from the mid-2020s for an entry into service in the 2030 timeframe.

Against this backdrop, does the RN need nuclear powered

164 Notably including Rolls-Royce Marine Power Operations limited, based at Raynesway, Derby. See www.rolls-royce.com/marine/products/submarine_equipment/nuclear/
165 MPR 2011, p. 29.
166 MPR 2011, p. 28.

submarines? Perhaps more than any other conventional weapon procurement, the choice between nuclear and diesel-electric submarines is indicative of a nation's level of international ambition, as only nuclear powered submarines have the speed and endurance to operate globally. In no other area of conventional weaponry is the capability choice between two apparently similar systems so stark. Given the UK's reliance on its submarine fleet to provide timely covert strike capability outside the European-Mediterranean theatre, if the UK wishes to retain such a global capability then it will need to retain nuclear powered submarines for the foreseeable future.

To achieve this beyond the end of the *Astute*-class, three conceptual routes exist. First, the UK could decide to outsource provision of this capability *in toto* to an ally – in reality, the United States; second, the UK could decide to work collaboratively with allies to produce nuclear powered submarines – in effect, with France; third, the UK could retain sovereign capability to design and build nuclear powered submarines.

The United States has never exported a nuclear submarine, and the supply of reactor equipment to the UK for the UK's first nuclear submarine HMS DREADNOUGHT should be seen as the exception rather than the rule.[167] In 2011, after media discussion proposing an Australian lease or purchase of American *Virginia*-class submarines, it was made clear that such a sale was extremely unlikely, even to the United States' closest allies.[168] It would be unrealistic to expect different treatment for the UK, and therefore predicating future UK nuclear submarine capability on supply from the United States would be a high-risk strategy.

Much the same analysis goes for collaboration with France, though with higher risks. Unlike the United States, France is not building two nuclear attack submarines per annum.[169] Furthermore, French submarines' weapon systems offer reduced capability in comparison to their British or American counterparts, as France does not have access to the Tomahawk cruise missile system, relying instead on the shorter ranged, and consequently less flexible, SCALP cruise

167 The Nassau Connection, pp. 15 – 22.

168 Brendan Nicholson, The Australian, 9 Feb 11, http://www.theaustralian.com.au/news/features/nuclear-or-not-well-need-prefab-subs/story-e6frg6z6-1226002430804.

169 Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress, Ronald O'Rourke, September 2010 Congressional Research Service, see assets.opencrs.com/rpts/RL32418_20100928.pdf

missiles.[170] Therefore neither outsourcing option offers the certainty or capability that the RN requires.

This leaves a version of the status quo, in which Britain retains the domestic capability to design and build nuclear submarines after the *Astute*-class. Currently, the seventh and final *Astute*[171] is scheduled for delivery in 2024.[172] However, if Trident replacement were cancelled, some of the savings could be recycled into an extended *Astute* production run, expanding the RN's attack submarine fleet to meet the RN's attack submarine requirement which will not currently be met for periods in the next decade.[173] On the current production schedule of one submarine every 22 – 28 months, a 10-boat *Astute* build would keep the submarine supply chain's skills current through to 2030.

Moreover, the production line can be extended through exports to the UK's closest allies with the requirement for nuclear powered submarines. In practice, this means Australia and Canada.[174] Both countries operate diesel-electric submarines, and in both cases, the submarines have had serious operational shortcomings.[175] Given the lack of American appetite for *Virginia*-class exports, an opportunity may exist to export 10 or more *Astute*-class submarines, extending the production line and reducing unit costs for all three countries.[176]

What happens if there is a new cold war?

Implausibly, there could be a revival of the cold war. Such a scenario could see a newly aggressive Russia abrogating the existing arms control treaties, threatening our European partners in Central and Eastern Europe, and using hydrocarbon supply as a weapon. In response to UK and EU protests, Russia attempts nuclear blackmail, and the United States is deterred by the Russian nuclear build-up.

It must be stressed that this is deeply implausible, not least because

170 SCALP Naval / MdCN (Missile de Croisière Naval) is a variant of the RAF's STORM SHADOW cruise missile, and was first successfully test-fired from a submarine on 8 Jun 11. See www.defencetalk.com/mbda-announces-first-submarine-launch-of-scalp-naval-35190/.

171 HMS AJAX

172 MPR 2011, p. 30.

173 MPR 2011, p. 8.

174 www.cbc.ca/news/politics/story/2011/10/27/submarines-british-nuclear.html.

175 For the Canadian Victoria-class diesel-electric subamarines, see www.defenseindustrydaily.com/sub-support-contract-creating-canadian-controversy-04563/ For the Australian Collins-class diesel-electric subamarines, see www.defenseindustrydaily.com/Australias-Submarine-Program-In-the-Dock-06127/

176 Australia's requirement is estimated between 8 and 12 nuclear-propelled but conventionally armed submarines, with Canada estimated to require between 4 and 6.

it is massively contrary to Russian interests. It is included only to demonstrate that there are several clear stages – arms control abrogation, nuclear build-up, attempts to divide the United States from Europe – when the UK has the opportunity to invest in a new ballistic missile force from the United States to match this emergent threat. The agreements governing missile supply would still be in force, and the fissile material and warhead assembly expertise would still be available in the UK. In this case, a Russian build up would be offset by an independent British build-up.

The sheer improbability of this course of events would make the replacement of Trident to counter it an irrational act in a period of budgetary plenty; to do so when the likely budgets preclude the implementation of Future Force 2020 *and* Trident would be the height of strategic myopia.

7 - Conclusions and recommendations

Should the UK replace Trident?

As Tony Blair's memoirs set out, since the end of the cold war removed the intellectual case for NATO's second decision-making pole, notions of national status have governed UK nuclear weapons policy. This is strategically myopic, is probably a contravention of the UK's obligations under Article VI of the Nuclear Non-Proliferation Treaty and, due to contracting budgets, is forcing unacceptable – and unnecessary – cuts on the UK's conventional forces. In particular, the flexible forces outlined in Future Force 2020 cannot be delivered in the desired timescale, leaving the UK increasingly reliant on her allies out to 2030.

If the UK wishes to continue to play a significant international role, then the military capability to deliver the full spectrum of conventional capability worldwide needs to be maintained at the level of soft power delivered through DfID and conflict avoidance through the FCO and the Stabilisation Unit. SDSR 10 did not achieve this within the available budget, and a balanced budget is yet to appear from the MoD.

Against this backdrop, spending more than £25bn in capital costs alone to replace Trident when it has no additional deterrent role to play in current or likely future UK security scenarios is inexplicable. Consequently, the UK should withdraw Trident from service immediately, and plough the savings into the UK's conventional forces to make the Future Force 2020 vision reality. Separately, the UK should ensure that the UK continues to meet the NATO target of assigning at least 2 per cent of GDP to defence activities, honour the 1 per cent real increase in the Equipment Budget from 2015-20, and continue to meet our obligations to the United States under existing agreements for the Common Missile Compartment and the Trident D5 Life-Extension Programme.

In pursuing these aims, the UK would revert to a being a threshold

nuclear state, with the capability to deploy nuclear weapons after a notice period if the international situation demanded it. The UK's weapons grade fissile material would be retained, and released to IAEA safeguards only in the context of final nuclear disarmament. Any return to a fielded nuclear capability would require governmental decision and parliamentary oversight, with delivery initially provided by the RAF's all-weather strike aircraft, supplemented in due course by the air wing of the *Queen Elizabeth*-class aircraft carriers.[177]

Moving the UK's nuclear posture to that of a threshold state would also represent a major step forward in arms control. Making the UK's experts available to aid international efforts to produce a viable nuclear disarmament verification regime provides tangible evidence of working with international partners towards President Obama's 2009 Prague vision of a nuclear weapon-free world.

This leads to the package of eight recommendations grouped into three categories:

- Focusing Resources on UK Conventional Forces;
- Building Verification Capability to push to worldwide nuclear disarmament; and
- Moving the UK to Nuclear Threshold Status.

It should be stressed that these recommendations are an interconnected package and need to be implemented in full.

Focus resources on UK conventional forces

Recommendation one: Retire the existing Trident system immediately without replacement and convert the current Trident submarines to a conventional role from 2014 through to life-expiry in 2029 – 32, recycling 100 per cent of the savings into the UK's conventional forces.

Such a conversion replicates the US Navy's so-called "Tactical Trident" programme, which has converted four *Ohio*-class submarines to carry up to 154 cruise missiles as well as Special

177 In the near-term delivery would be by Tornado GR4, replaced by Typhoon FGR4 when Tornado is retired, supplemented by the Joint Strike Fighter (JSF) after 2025. A study would need to be conducted to understand what wiring modifications would be required to reinstate Tornado's nuclear capability and to install it on Typhoon (and in future, JSF) which are currently exclusively conventional platforms in UK service. Given that the weapon would be based on WE.177, a survey of the extant tactical nuclear infrastructure left over from the 1990s would be required to see what could be reused and what new-build would be required in the case the option to field a tactical nuclear force was required.

Forces. In UK service, this would see the converted *Vanguard*-class submarines carrying up to 98 cruise missiles (depending on configuration), providing a survivable, flexible and covert platform capable of striking targets at more than 1200nm range. These converted *Vanguard*-class submarines will provide long-range conventional strike capability when the *Queen Elizabeth*-class carriers and their associated air-wing become fully operational in 2030.

Recommendation two: Commit to continue to meet the NATO 2 per cent of GDP on defence budget benchmark, and honour the one per cent real growth in the equipment budget from 2015.

The UK is only meeting the NATO 2 per cent of GDP target through counting the supplemental costs of the war in Afghanistan, and may fail to meet the target by the end of this parliament. The 2010 Strategic Defence and Security Review (SDSR 10) detailed the blueprint for a balanced conventional force with global deployment capability, known as Future Force 2020. Britain faces a direct financial choice between Future Force 2020 and Trident replacement, as procuring the Trident replacement will render the conventional elements of Future Force 2020 unaffordable under any foreseeable budget through to 2028. This is a true even with the government's commitment to a one per cent increase in the Equipment Programme from 2015-20.

Recommendation three: Retain the UK's ability to design and produce nuclear-powered attack submarines to support the UK's global responsibilities.

Nuclear-powered submarines are likely to remain the covert power projection tools of choice over global ranges for as long as the UK intends to play a military role on a global scale. As there is no certainty of supply from overseas, the UK will need to retain sovereign capability to design, build, operate and decommission nuclear-powered submarines for the foreseeable future. We should also make these nuclear-powered but conventionally-armed submarines available to meet the emerging requirements of Australia and Canada.

Building verification capability to push to worldwide nuclear disarmament

Recommendation four*:* Build on the existing work of AWE Aldermaston with VERTIC and international partners to create the verification mechanisms necessary to achieve and sustain a world

without nuclear weapons (nuclear zero) in line with the aspiration of President Obama in his 2009 Prague speech.

The challenge of verifying deep nuclear reductions is significant, but it is essential to achieving and sustaining worldwide nuclear disarmament. Former Foreign Secretary Margaret Beckett expressed a vision of using the expertise of AWE Aldemaston as a laboratory of disarmament in a 2007 speech to the Carnegie Endowment for International Peace. The UK should continue to play a major role in developing the technologies to meet the verification challenge, and the expertise of the staff at AWE Aldermaston will be essential.

Move the UK to nuclear threshold status

In proposing the immediate retirement of the current Trident system, this paper is reflecting the international, fiscal and legal environment. But whilst I seek a nuclear-free world, I understand that the UK may in future require an independent nuclear capability. In moving to nuclear threshold status, the UK retains the ability to regenerate its nuclear capability in the unlikely event that the international situation demands it.

***Recommendation five**:* Renew the US-UK Mutual Defence Agreement for another decade in 2014.

***Recommendation six**:* Retain the Trident Sales Agreement as amended, fully complying with our obligations to the United States Government and to the US Navy.

Britain is committed to co-developing the Common Missile Compartment for future UK/US nuclear powered ballistic missile submarines, and contributing towards the funding of Trident II (D5) SLBM life extension (D5 LEP). The UK will honour its international contractual obligations to the United States, and continue its deep collaboration in submarine technology with the US Navy and American defence suppliers. This ensures that the UK retains the option to design, build and operate a new generation of Trident armed submarines.

***Recommendation seven**:* Retain the UK's existing weapons-grade Uranium and Plutonium subject to the existing safeguards regime.

In 2010[178] the UK was estimated to hold 21.2 tons of Highly Enriched Uranium (HEU) and 3.2 tons of weapons-grade Plutonium. This is

178 Global Fissile Material Report 2010, International Panel on Fissile Materials, pp. 72 – 76, available from ipfmlibrary.org/gfmr10.pdf

assessed to be sufficient to support the current warhead stockpile and the requirements for submarine nuclear reactors for the next 75 years.[179] Retaining these military stocks provides the basis for a future nuclear weapons programme if required by changes in the international climate.

Recommendation eight: Retain the capability to produce and deploy a nuclear weapon[180] at short (12 months') notice in the event that a credible nuclear threat to the UK emerges.

Such an air-dropped weapon would provide a short-term deterrence and, whilst this reconstitution capability will be indigenous, there are obvious benefits in continuing the UK's nuclear partnership with the United States.

179 Global Fissile Material Report 2010, p. 71.

180 A weapon based on the WE.177 design from the mid-1960s that remained in service until 1998. In the near-term delivery would be by Tornado GR4, replaced by Typhoon FGR4 when Tornado GR4 is retired, supplemented by the Joint Strike Fighter (JSF) after 2025. A study would need to be conducted to understand what wiring modifications would be required to reinstate Tornado's nuclear capability and to install it on Typhoon (and in future, the F-35 Joint Strike Fighter) which are currently exclusively conventional platforms in UK service. Given that the weapon would be based on WE.177, a survey of the extant tactical nuclear infrastructure left over from the 1990s would be required to see what could be reused and what new-build would be required in the case the option to field a tactical nuclear force was required.