



British American Security
Information Council

Feeding the ‘monster’

Escalating Capital Costs for the Trident Successor Programme

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April 2016

Preface

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In October 2015 Jon Thomson, Permanent Under Secretary at the Ministry of Defence, described the Trident Successor programme as a “monster” that kept him up at night, “the biggest project the Ministry of Defence will ever take on” and “an incredibly complicated area in which to try to estimate future costs.”¹

Trident and its replacement are a high salience, politically symbolic issue. When it comes to a vote in Parliament later in 2016, the debate will involve familiar positions and arguments around national security, status, cost and jobs as well as tactical electoral assessments. Meanwhile, the

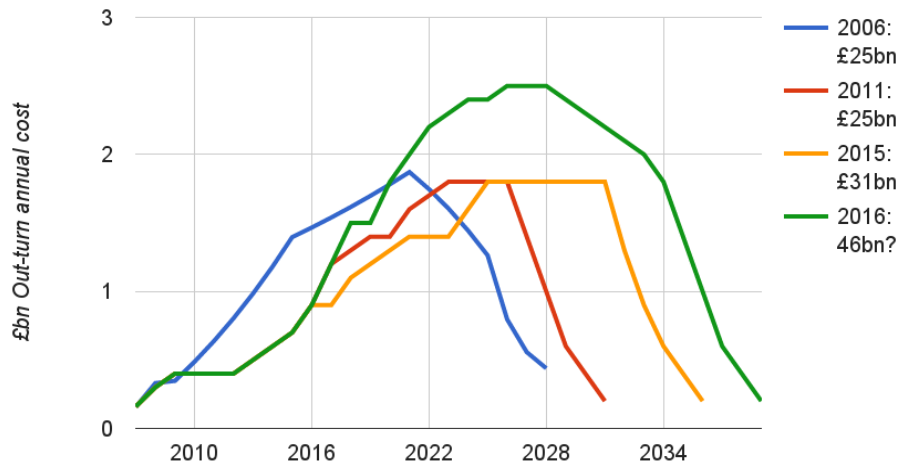
project to construct the Successor class submarines goes on, although its progress is far from smooth. Delayed partly for political reasons in 2010, it is now becoming clear that further slippage in the programme has been down to poor management, significant cost escalation, delays in the construction of the Astute attack submarines at Barrow, and other uncertainties. More recently, questions have arisen over the choice of submarines as an effective platform for the UK’s nuclear weapons, as they could be far more vulnerable to detection than first thought.

The Successor submarine project has been plagued by delay and confusing, out-dated or over-optimistic cost assessments, made worse by conflicting bases of reporting. This briefing from Nick Ritchie pulls into one place the evolution of the main official statements in relation to costs associated with the UK Trident renewal project from 2006 to the present. The graph on the next page is an illustrative cost function over time for the Successor project, showing the cost shifts based upon declared past estimates and a possible cost hike in the near future.

What of the future? We were assured in November 2015 that the updated cost assessments presented in the SDSR were based upon rigorous assessments. But they are already under pressure internally, and could soon be increased by up to another 50% over the coming months, more than wiping out the £10bn contingency even before the vote in Parliament expected in late 2016 and the contracts for production are laid with BAE Systems and other major suppliers. The change in procurement structure away from a single Main Gate and towards greater flexibility is highly understandable in the circumstances, but must present a major worry that costs will not be contained. This danger is recognised by officials, but there is as yet no indication that MoD will be able to produce the incentive packages to prevent further budget-busting price hikes.

This has already been a story of serial under-estimation of costs, shifting bases for cost announcements and a deep lack of confidence in the management of the project. A recent Ministerial correction to a Parliamentary Written Answer from last year is revealing in this regard that even

Illustrative Cost Functions for Successor Programme ¹



officials were confused by their own figures.² The 2006 White Paper estimated the Successor submarines would cost £11-14bn in 2006 prices. The 2011 Initial Gate claimed costs were maintained within this envelope, but estimated this to equal £25bn in outturn prices. Subsequent Ministerial statements, including the 2014 update to Parliament, reverted to the £11-14bn figure as an assurance that costs had not risen. This all suggests that the 2006 figure was arrived at by adding general inflation to the cost of the original Vanguard programme from the 1980s and 90s, and no serious attempt was made to relate the figures to actual future estimates, until the November 2015 review estimated £31bn outturn figures.

This all begs the question - can we be confident of Parliamentary accountability for the biggest capital project ever undertaken by MoD when the costs are reported in such opaque ways?

It would be heroic indeed to expect the project to stay roughly within the current public estimates released in November 2015, even with the addition of the £10bn contingency. This leaves parliament and the public with the question of 'how much is enough?' At what point does the cost of the 'monster' project become too much, particularly when there's little guarantee that emerging technologies will not render it a liability before the first submarine even comes into service? Will parliament only find out when it is too late and billions more have been committed?

Summary

- In 2006 the capital cost for the 'Successor' submarine programme was estimated at £11-14 billion in 2006 prices (the whole renewal project estimated at £15-20 billion included other elements). In 2011 this was translated as a figure of £25 billion at outturn prices (accounting for inflation) and was based on a newly extended timeline.
- In the SDSR, November 2015, this was increased to £31 billion plus a £10 billion contingency allocation. Some of this cost is now to be met through a new Treasury Fund that will effectively subsidise the Successor programme – the Joint Security Fund unveiled in the July 2015 Summer Budget with further details announced in the November Spending Review and Autumn Statement. This figure may rise substantially in the near future.
- £905 million was spent on the Concept Phase approved by a Parliamentary vote in 2007 up to the Initial Gate decision in 2011. A further £3 billion was approved for the Assessment Phase through Initial Gate authorisation in 2011. This was increased to £3.9 billion by the November 2015 SDSR. Total spending on the Concept and Assessment Phase up to Autumn 2016 is now a projected £4.8 billion.
- Other costs for the Trident renewal programme announced in the 2006 White Paper include additional capital costs of £2-3 billion for infrastructure, and £2-3 billion for a new warhead (both at 2006-7 prices). Further investment in the Vanguard Life Optimisation Programme for the existing submarines was estimated at £1.3 billion in 2010, and the nuclear reactor Core Production Capability programme at Rolls Royce at £1.1 billion in 2015.
- Operating costs for the nuclear enterprise are cited at 6% of the defence budget, amounting to over £2 billion per year from a 2015-16 DEL of £34.3 billion.
- Further delay cannot be ruled out given MoD and BAE Systems' experience with the Astute nuclear-powered attack submarine programme currently in production. The first-of-class was 3.5 years late and 47.5% over budget. The fourth Astute submarine scheduled for delivery in August 2015 is now due in January 2018.³
- The current Vanguard submarines have had their service lives extended in 2006 from 25 to 30 years, in 2010 to 34 years, and in 2015 to 36-38 years, as the in-service date for the first Successor boat has been pushed back from 2019, to 2024, to 2028 to 'the early 2030s'. Further life extension is unlikely and with the government committed to a continuous at-sea deterrence (CASD) posture, the first new submarine is planned for when the second Vanguard retires to ensure CASD continuity (though this could be delayed until the third submarine retires). Limited elasticity in the production schedule could constrain options for accommodating manufacturing problems and risks an increase in cost to find timely solutions.

History

2007: Concept and design phase authorisation

In 2006 the government estimated the capital cost of replacing the current Trident system at £15-20 billion at 2006-07 prices. This comprised £11-14 billion for four new submarines, £2-3 billion for the possible future refurbishment or replacement of the warhead, and £2-3 billion for infrastructure modernisation at Faslane and Coulport, and command and control of the nuclear firing chain over the life of the submarines.⁴ An additional £1.5 billion was a speculative estimate of the cost of replacing the Trident II (D5) missile, and £250 million to participate in the US Trident missile life extension programme.⁵ The total project cost therefore ranged from £16,750 million to £21,750 million, although in November 2008 MoD's Permanent Undersecretary Sir Bill Jeffrey warned that these were only "ballpark estimates".⁶ The National Audit Office also reported in 2008 that "the White Paper cost estimates are not sufficiently robust to provide an accurate baseline against which progress can be measured and budgetary control exercised. There remain a number of major areas of uncertainty in the budget, including the provision for contingency, inflation and Value Added Tax".⁷

2007: Comprehensive Spending Review

In 2006 Prime Minister Tony Blair promised that Trident replacement would "not be at the expense of the conventional capabilities that our armed forces need".⁸ The cost of initial development work on the Successor programme for the period 2007-08 to 2010-11 was reflected in the 2007 Comprehensive Spending Review budget settlement, but came from the MoD budget. The CSR stated that it was increasing the MoD budget by "1.5 per cent average annual real growth over the three years to 2010-11." This increase in funding, plus further value for money savings of £2.7 billion by 2010-11, would enable MoD to procure new conventional capabilities, new and refurbished accommodation,

and "fund the renewal of Britain's nuclear deterrent while ensuring that this does not come at the expense of the conventional capability our Armed Forces need".⁹

Lord Boyce, former Chief of the Defence Staff (2003-06), described the 2007 CSR settlement for defence as "derisory" and "a cynical observance of the promise made by the then Prime Minister that the cost of the Trident replacement would, 'not be at the expense of the conventional capabilities that our armed forces need'. I said in this House at the time of the debate on the nuclear deterrent replacement that: 'We will have to examine the outcome of the Comprehensive Spending Review with great care to see whether the Prime Minister has kept his word'. I leave your Lordships to draw your own conclusions."¹⁰

2010: Trident renewal costs from MoD budget

In July 2010 Chancellor George Osborne announced that MoD would have to fund the capital costs of the Trident replacement programme from its own core budget not the Treasury reserve. Defence Secretary Liam Fox argued that MoD should not have to pay and insisted that "the Treasury must stick to a commitment made by the last Labour government that the nuclear deterrent is of special strategic significance – and that the cost of renewing it must, therefore, be ring-fenced from spending on conventional defence equipment".¹¹ Osborne insisted that "All budgets have pressure. I don't think there's anything particularly unique about the Ministry of Defence. I have made it very clear that Trident renewal costs must be taken as part of the defence budget".¹²

The capital costs of the original Vanguard class programme came from inside the MoD budget. In July 1980 Defence Secretary Francis Pym made a statement to the House on the replacement of Polaris with Trident stating: "We estimate the capital cost of a four-boat force, at today's prices, as up to £5 billion, spread over 15 years. We expect rather

over half of the expenditure to fall in the 1980s. We intend to accommodate this within the defence budget in the normal way, alongside our other major force improvements... 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. Within the defence budget this can and will be accommodated in the same way as Polaris was accommodated 10 to 20 years ago".¹³ In 1982 Defence Secretary John Nott stated that he had not been given any extra money for Trident but had negotiated a 3% real growth up until 1985-86 that would cover some of the cost.¹⁴

Successor funding is held within MoD's Core Equipment Procurement Programme. According to the 2015 MoD Equipment Plan, approximately one quarter (£43 billion) of total committed MoD spending on equipment over the next ten years will be on nuclear-powered submarines and associated nuclear weapon systems. These costs cover the entire submarine enterprise, including support to all in-service submarines, the delivery of the Astute class SSN, the Successor programme (covering build activities at Barrow; the common missile compartment arrangements with the US; command and control and naval base infrastructure upgrades), and the costs associated with the Atomic Weapons Establishment's (AWE) nuclear warhead capability sustainment programme (including the operation, maintenance and upgrade of AWE, the Trident missile system with the US; the UK/French collaborative Teutates project, and the provision of other services and activities across the Strategic Weapons System). It does not take into account the savings that are expected to be achieved under the Submarine Enterprise Performance Programme.¹⁵

2010: VfM Review and SDSR

The coalition government initiated a value-for-money review of the Trident replacement programme and reported its results in the October 2010 Strategic Defence and Security Review.

SDSR10 stated that "The overall impact of the changes identified by the value for money review will be to reduce costs by £3.2 billion, saving approximately £1.2 billion and deferring spending of up to £2 billion from the next 10 years".¹⁶ This included deferment of £500 million of spending on the warhead programme for the next 10 years, savings of £250 million in the joint UK-US Common Missile Compartment programme, £900 million efficiency savings with industry through the Submarine Enterprise Performance Programme, and deferment and possible elimination of £1 billion spending on infrastructure. With these in mind the SDSR reported that the projected cost of the programme remained within the estimates set out in the 2006 White Paper based on actual and potential savings reported. This implied that programme costs had inflated and could only be maintained at 2006-07 levels through the savings found via the value-for-money review.

The SDSR also announced that a decision on whether or not to procure a new warhead could be delayed until the next parliament, the Main Gate submarine procurement decision would be delayed until 2016, and that the service life of the current submarines would be extended by a further four years delaying entry into service of the first Successor submarine from 2024 to 2028.

2011: Initial gate report to Parliament

In May 2011 the Government published *The United Kingdom's Future Nuclear Deterrent: The Submarine Initial Gate Parliamentary Report* outlining the decision to take the Successor procurement programme through 'Initial Gate' authorisation and move from the Concept Phase to the Assessment Phase of the procurement process. The Concept Phase cost £905 million based on:

- Boat and propulsion concept work - £309 million
- Common Missile Compartment - £283 million
- US high steam generators and technology - £59 million

- Extension to the concept phase - £254 million¹⁷

The report said that the 2006 cost estimates still held but added that the £11-14 billion (2006 prices) estimate would mean spending £25 billion at outturn prices taking inflation into account.¹⁸

The report also stated that “the Assessment Phase will culminate in the Main Gate investment point in 2016, where we will sign the main construction contracts and also decide whether continuous at sea deterrence can be delivered by three or four boats.”¹⁹ The report said that spending on long lead items had been minimised with expected spend of:

- £380M for the first boat split between the propulsion, main boat systems and steel
- £145M for the second boat for propulsion systems; and,
- £6M for the third boat also for propulsion systems.

The report said that no long lead parts would be procured for the fourth boat as a decision was not required for this boat until Main Gate in 2016.²⁰ It said work to prepare for submarine production would be needed during the Assessment phase through investment in the Barrow shipyard’s workforce, facilities and equipment.

MoD expected to spend a further £3 billion at outturn prices on the concept phase up to Main Gate, totalling £3.9 billion when including the Assessment phase, or 15% of the outturn cost of a four-boat submarine fleet. MoD said 15% budget expenditure ahead of Main Gate investment decision reflected normal practice.

2012: Update to Parliament

The 2012 update to Parliament reported on the framework contracts with BAE Systems and Babcock, and an amendment to an existing Rolls-Royce contract announced on 22 May 2012.²¹ The framework contracts cover the period up to Main

Gate and consist of an overarching framework structure with rolling waves of work packages. The first set of work packages announced in May 2012 covered the first 18 months of the Assessment Phase and were valued at £350 million: £328 million to BAE Systems Maritime Submarines; £15 million to Babcock; and £4 million to Rolls-Royce. The second set of work packages with BAE Systems and Babcock announced on 29 October 2012 cover the subsequent 18 months and were valued at £350 million: £315 million for BAE Systems and £38 million for Babcock.²² MoD said it intended to negotiate further packages in the same manner until the Assessment phase concluded.²³

MoD also announced on 18 June 2012 a separate Core Production Capability contract with Rolls-Royce Power Engineering worth £1.1 billion for an 11-year programme of work at its nuclear reactor core facility in Raynesway, Derby. £500 million was for site regeneration and £600 million to “sustain reactor core production at the facility until March 2023. This will include production of reactor cores for the Astute class and the next generation nuclear deterrent Successor SSBN submarines if approved”.²⁴ The decision was precipitated by a 2002 Periodic Review of Safety that identified shortcomings with the current facilities constructed in the late 1950s against current nuclear and environmental standards. The continuation of nuclear operations to support the submarine programme after 2012 was deemed to require capital investment to meet the latest standards.²⁵

The Core Production Capability is a separate programme that went through Initial Gate in September 2007 and Main Gate on May 2012.²⁶ This would allow construction of Core H12 for the next Astute submarine and Core J1 for the first Successor submarine. The CPC project was subsequently delayed by over four years following the revelation by MoD in March 2014 of a breach in the fuel cladding of the PWR2 prototype test reactor at Dounreay that allowed low-level radiation to leak

into its sealed cooling circuit. The PWR2 reactor powers the current Vanguard-class ballistic missile submarines and Astute-class attack submarines. A decision was taken to replace the core in HMS Vanguard again during its next planned maintenance visit to HMNB Devonport in 2015 and keep open the option to refuel HMS Victorious.²⁷ The CPC project's Assessment phase cost £107 million. The Demonstration and Manufacture phase is projected to cost £1,148 million.²⁸ The delay caused by the decision to refuel HMS Vanguard will cost an additional £196 million.²⁹

In November 2012 MoD provided updated figures on the year-on-year Assessment phase spending profile out to the Main Gate investment decision in 2016, these were:

- 2012-13: £431 million
- 2013-14: £486 million
- 2013-14: £595 million
- 2015-16: £695 million
- 2016-17: £608 million³⁰

2013: Update to Parliament

The 2013 update to Parliament confirmed the submarine cost at £11-14 billion at 2006-07 prices and spending for the Assessment phase forecast to remain with £3 billion envelope approved in April 2011.³¹ The report said that a number of spending commitments had been made from the £533 million approved for long lead items at Initial Gate. These included:

- £52 million on elements of nuclear propulsion
- £31 million on missile tube long lead items, through the US;
- £79 million on long lead contracts with BAE Systems for items including castings and forgings, structural fittings, electrical equipment and secondary propulsion equipment.³²

In December 2013 two further contracts were awarded to BAE Systems worth £47 million and £32

million to begin work on some initial items, such as structural fittings, electrical equipment, castings and forgings.³³ MoD confirmed that “no new significant infrastructure will be required to support the Successor submarines” and that any investment is “forecast to be limited to the modification of existing infrastructure to accommodate the differences between the Vanguard and Successor designs”.³⁴

In February 2013 MoD awarded Rolls Royce an £800M foundation contract to facilitate the company's transformation of its operations as part of the Submarine Enterprise Performance Programme.³⁵ MoD said “The foundation contract covers the overhead, running and business costs at Rolls-Royce Submarines' sites. Historically, these costs were included in each individual contract placed with the company. This new foundation contract, however, will consolidate these costs, focus on efficiency, and will secure key terms and conditions for future contracts between the MoD and Rolls-Royce Submarines”.³⁶

2014: Update to Parliament

The 2014 update reported that functional designs had reached the required level of maturity to enable some sections of the submarine to move into Stage 2 (spatial) design.³⁷ Spending on the Assessment phase was increased when the Treasury approved bringing forward £261 million of funding. £206 million was to support new facilities at the Barrow shipyard to improve outfitting, finishing and logistics as well as early implementation steel work in Barrow's New Assembly Shop.³⁸ £55 million was for platform and secondary propulsion system long lead items. Expenditure on long lead items was increased from £533 million approved at Initial Gate to £588 million ahead of Main Gate. The total Assessment Phase approval was increased from £3.1 billion to £3.3 billion.³⁹

It was reported that in October 2014 General Dynamics Electric Boat was awarded an \$83 million contract modification by the US Department of

Defense to continue development of the joint US-UK Common Missile Compartment (CMC) as part of the Assessment phase. The contract provides funding for 17 missile tubes, of which, approximately \$59 million is for the first 12 missile tubes for the UK Successor programme. Costs beyond the first 17 tubes have yet to be agreed.⁴⁰ Total CMC spend from 2011-12 to 2015-16 is an estimated £103 million, plus payment of 12.5% of all non-recurring expenditure on design activities.⁴¹

The report said procurement costs for the Successor submarine remained within initial estimates of £11-14 billion at 2006-07 prices taking into account currently planned and future Submarine Enterprise Performance Programme efficiencies.

In December 2014 MoD reported that total programme spend at the end of financial year 2013-14 was £2,068 million of which £230 million had been committed for long lead items. This now included:

- £11.8 million for Weapon Handling and Launch System
- £6.6 million for Gearbox and associated equipment
- £58.8 million for Pressurised Water Reactor 3 reactor plant and associated main propulsion systems
- \$27.4 million to the US Department of Defense for material to support the manufacture of missile tube components
- \$52.8 million for Missile Tube Long Lead Materials, and
- \$7.6 million for material to support the manufacture of integrated tube and hull fixtures.⁴²

2015: Summer Budget and Joint Security Fund

In his July 2015 Summer Budget George Osborne announced an “additional £1.5 billion a year by the end of the Parliament to fund increased spending on the military and intelligence agencies by an average of 1% a year in real terms” on top of the the annual

increase in the defence budget. The purpose was to facilitate more “coordinated responses from the armed forces, security and counter terrorism agencies” to address the diverse threats the country faced.⁴³ Further details of this new ‘Joint Security Fund’ were announced in the Spending Review and Autumn Statement that said £2.1 billion from the Joint Security Fund would be used to “fund and deliver the MOD’s SDR commitments in full, maintaining the current levels of the Armed Forces and building 4 new submarines to renew the nuclear deterrent”.⁴⁴ This is additional to the increase in the defence budget “by 0.5% above inflation every year of this decade”, according to Defence Secretary Michael Fallon. It is being used in part to subsidise the Successor programme.⁴⁵

2015: SDR

The Strategic Defence and Security Review announced a series of changes to the Successor programme reflecting greater understanding of the scale and complexity of the programme. These were:

- Delay in the entry into service of the first submarine from 2028 in SDR10 to “the early 2030s”. This will require the Vanguard class submarines to continue to operate a CASD posture well beyond their expected life. MoD has not given any clear indication as to why previous official claims that the Vanguards’ life expectancy was inflexible and could not possibly be extended beyond 2028 should now be relaxed.
- Plans to move away from a single Main Gate investment decision to a series of decisions, or a “staged investment programme”, based on new industrial and commercial arrangements between government and industry because of the scale and complexity of the Successor programme.⁴⁶ MoD later clarified that “Options for the subsequent investment stages and their scope, time and cost are currently under consideration and

will be subject to the formal approvals process."⁴⁷

- Increase in expenditure for the Assessment phase of £600 million from £3.3 to £3.9 billion to allow purchase of long-lead items for the fourth submarine, reversing the announcement in 2011 that no long lead items for a fourth submarine would be ordered before a Main Gate decision.⁴⁸
- Increase in the projected cost of the Successor programme from £25 to £31 billion with an additional £10 billion contingency. Defence Procurement Minister, Philip Dunne, said in December 2015 that earlier revisions of the 2006 £11-14 billion figure had only been for inflation but that the latest estimate of £31 billion plus £10 billion contingency was the "first really rigorous estimate of costs".⁴⁹ The fact that previous figures kept to the original 2006 'ballpark estimates', showed some unwillingness or inability to achieve greater clarity until this moment.
- The contingency was presented as a response to the criticism in Bernard Gray's 2010 report on MoD procurement of a behavioural bias towards cost estimate optimism.⁵⁰ MoD said in February 2016 that cost estimates for the Successor programme had taken this 'optimism bias' into account through the £10 billion contingency that represented around 35% of the submarine cost to completion. This was claimed to be "a prudent estimate based on past experience of large, complex civil projects, such as the 2012 Olympics."⁵¹ We may soon be in a position to judge the veracity of this claim.
- Plans to establish a new MoD team "headed by an experienced, commercial specialist to act as the single sponsor for all aspects of the defence nuclear enterprise, from procurement to disposal, with responsibility for submarines, nuclear warheads, skills, related infrastructure and day-to-day nuclear

policy." It also said the government would establish "a new delivery body with the authority and freedom to recruit and retain the best people to manage the submarine enterprise."⁵²

Earlier in October 2015 Defence Secretary Michael Fallon made it clear to the submarine-building industry: "Let's be in no doubt that our new conventional [Astute nuclear submarine] timetable may have slipped a little but our new ballistic missile submarines cannot be late. There cannot be any threat to the build times, overrunning costs or any other excuses".⁵³ This followed comments by Jon Thomson, Permanent Under Secretary at the Ministry of Defence, before the House of Commons Public Accounts Committee:

"The project that I worry about most in relation to future financial risk is the nuclear enterprise, which is a significant element of the overall equipment plan and is in the equipment plan review report that is to come in couple of weeks. That is the project that most keeps me awake at night. It is the biggest project the Ministry of Defence will ever take on. The annual cost of the annual nuclear enterprise is in excess of £3.5 billion. If the Government is to proceed with renewing the deterrent, in due course that would exceed £5 billion a year. That is a significant proportion of the defence budget and is an incredibly complicated area. There has been a significant change in the governance of the nuclear enterprise. I am now chairing the nuclear enterprise board, reporting directly to the Defence Secretary and other interested Ministers, including the Chancellor of the Exchequer. That is the single biggest future financial risk we face. I am content that I can manage this one. I think I can drive more in the supply chain on the equipment support plan, but that project is a monster and it is an incredibly

complicated area in which to try to estimate future costs. That is the one I worry about.”⁵⁴

The subsequent report by the Public Affairs Committee noted that expenditure of £5 billion was a “significant element of the Department’s £15 billion a year spending on equipment and support”.⁵⁵

On the latter it was reported in April 2015 that MoD had conducted a review of the whole UK nuclear enterprise prompted by challenges associated with the Successor programme and major projects at AWE Aldermaston. The *Times* reported that one option under consideration was the creation of a ‘nuclear command’ to oversee the entire nuclear enterprise. A ‘senior defence source’ said that “The whole nuclear side of things is in a complete mess”.⁵⁶ This appears to have triggered changes in the ‘nuclear enterprise board’. There is a longstanding Defence Nuclear Executive Board (DNEB) that manages the Defence Nuclear Programme and reports to Ministers via the Defence Board. The board comprises the MoD Permanent Secretary; Vice Chief of the Defence Staff; Director General Finance; Director General Security Policy; Deputy Chief of Defence Staff Military Capability; Chief Scientific Advisor; and the Fleet Commander. In March 2016 MoD reported that “The Terms of Reference for the Board are currently being reviewed.”⁵⁷

It remains unclear how the ‘new delivery body’ will be constituted. It was reported in November 2015 that the decision to establish a ‘new delivery body’ for the nuclear enterprise and Successor submarine programme was the outcome of persistent Treasury concern about the capacity of BAE Systems and MoD to manage costs: “The Chancellor is reported to have delivered an ‘ultimatum’ to Prime Minister David Cameron that he will support the funding of the boats to carry Britain’s Trident nuclear missiles only if the project is given to a new body reporting to the Treasury.”⁵⁸ However, SDSR15 stated that it will be a new team within MoD. MoD stated in

December 2015 that “Options for the composition of the new organisation will be developed and assessed for a decision in 2016. The Ministry of Defence will remain in control of the Successor submarine programme.”⁵⁹

Additional expenditure was also announced in 2015. This included the third set of work packages in March worth £285 million under the framework contracts: £257 million for BAE Systems; £22 million for Babcock; and £6 million for Rolls Royce.⁶⁰ On 31 August 2015 Chancellor George Osborne also announced a 10-year £500 million of infrastructure investment for HMNB Clyde. MoD said the investment was part of a planned programme of work needed to update the facilities at the naval base to support all Royal Navy submarines and therefore not part of the Successor programme, despite the fact that MoD said the project (now in its own Assessment phase) is to make the necessary adaptations to accommodate the Successor submarine programme.⁶¹

2016:

In March 2016 MoD announced a further increase in Assessment phase spending of £42 million taking the increase announced in SDSR15 from £600 to £642 million.⁶²

Additional costs

Conventional protection forces

The annual operating cost of conventional forces ‘committed’ to the protection of the Vanguard submarines as they enter and leave Gare Loch at Faslane was £25-30 million in 2007. ‘Committed’ forces are defined as “force elements committed to the military task as their primary role” and constitute a single mine warfare vessel and a single survey vessel. The annual operating costs of ‘contingent’ forces that are assigned to a number of tasks and are not planned routinely to deploy in support of the SSBN fleet is £250-300 million. This included two SSN attack submarines, a single destroyer or

frigate, three additional mine warfare vessels, a single Royal fleet auxiliary vessel, five Merlin anti-submarine warfare helicopters, and eight maritime reconnaissance aircraft.⁶³

PWR3 nuclear reactor development

The costs of developing the new PWR3 nuclear reactor are unlikely to be assigned to the Successor programme. MoD began considering nuclear reactor propulsion requirements for future submarines in 2005 and agreed a ten-year partnering contract worth up to £1 billion with Rolls Royce in May 2007.⁶⁴ This covers the period relating to development of a new reactor plant for the Successor fleet. The original Trident contract let to VSEL to build the Vanguard-class fleet included purchase of the PWR2 reactor from Rolls Royce (namely the Nuclear Steam Raising Plant and secondary Propulsion Machinery at a cost of £70 million in 1987-88 prices). None of the costs of developing the PWR2 that began in 1978 were attributed to the Trident programme since it was under development for all future classes of submarine (Vanguard and then Astute).⁶⁵

Vanguard submarine life extension

The service life of the current Vanguard submarine fleet was extended by five years from 25 to 30 years in 2006, by a further four years in SDSR10 with entry into service of the first Successor submarine pushed back from 2024 to 2028, and in SDSR15 by several more years with entry into service of the first of class now scheduled for “the early 2030s”. In evidence before the House of Commons Defence Committee in 2007 MoD’s Tom McKane, Director General of Strategic Requirements, stated that the cost of extending the life of the Vanguard submarines by around 5 years “will be generated as we get closer to the point where work actually has to be done on the boats, but the work that we have done shows that we are probably talking in round terms of hundreds of millions for the five years for the four boats”.⁶⁶ In October 2010 Defence Secretary Liam Fox provided an updated figure: “To achieve that five year extension will require three

additional Long Overhaul Periods (LOPs). Planning is at an early stage but initial estimates suggest this will cost around £1.3 billion between 2014 and 2024.”⁶⁷ The following month Fox said “There will be additional costs to maintaining the Vanguard class through to 2028. We expect those to be around £1.2 billion to £1.4 billion extra to maintain those submarines for longer”.⁶⁸

In December 2013 MoD reported planning to extend the life of the Vanguard class submarines to maintain continuous at sea deterrence until the Successor submarines enter service. This would require an additional deep maintenance period (DMP) at HMNB Devonport for each submarine in the class, starting with HMS Vanguard in 2015.⁶⁹ In December 2015 MoD said that “cost estimates for supporting the ballistic missile submarines during the transition from Vanguard to Successor are not materially affected by minor changes to scheduled dates”⁷⁰ and that “the marginal costs associated with maintaining the submarines can be contained within the existing running cost of the deterrent, which is around 6% of the defence budget per year.”⁷¹

Operating costs

MoD has said the operating costs for the nuclear enterprise are 6% of the defence budget. In October 2015 Chair of the House of Commons Foreign Affairs Committee, Crispin Blunt, asked MoD for its latest estimate of “(a) the whole life programme cost of the Successor programme, (b) capital costs associated with (i) submarine acquisition, (ii) Trident missile renewal and (iii) basing facilities, (c) the running and support costs of the Successor fleet and associated capability to protect and sustain it, (d) all future costs associated with the Atomic Weapons Establishment maintaining a capability to maintain an on-going nuclear warhead design capability and (e) decommissioning costs.” MoD answered “Once the new fleet of SSBNs come into service, we expect that the in-service costs of the UK’s nuclear deterrent, which include the costs of the Atomic Weapons Establishment, basing and disposals, will be similar to the current system, at

around six per cent of the defence budget".⁷² Based on the current defence budget of £34.3 billion for 2015-16 (total Defence Expenditure Limit [DEL]), that amounts to approximately £2.05 billion per year.

Full programme cost

The full cost of the Trident replacement programme has been subject to a number of estimates. Most recently in October 2015 Crispin Blunt said in response to MoD's answer to his parliamentary question above: "My office's calculation based on an in-service date of 2028 and a missile extension until 2060 ... the total cost is £167bn."⁷³ This was based on: a recapitalisation cost of £25 billion for the submarines; additional costs for infrastructure and a new warhead set out in the 2006 White Paper; in-service costs of 6% of the defence budget for 32 years from 2028 to 2060; a defence budget based on the Government's commitment to meet a NATO target of spending 2% of GDP on defence; and an assumption of annual GDP growth of 2.48% between 2020 and 2060.

Cost inflation: Astute and Project D154

History suggested that the 2006 procurement figure was likely to be too low based on the impact of defence inflation that has tended to escalate over time at a rate greater than inflation in the rest of the economy as measured by the GDP deflator,⁷⁴ and MoD's history of nuclear and submarine-related delay and cost escalation. This scepticism of the 2006 estimates has proved correct.

On the latter, the Astute-class attack submarine programme and Project D154 at the Devonport Naval Base are instructive. A contract to build three Astute submarines was placed with GEC-Marconi in March 1997 worth £1,961 million for full development and initial production of three boats.⁷⁵ The contract was restructured in December 2003 to £2.6 billion.⁷⁶ Costs increased further by 2006 to £3,492 million with £1,104 as research and development costs.⁷⁷ In 2008 the Astute programme was forecast to cost £3,806 million on completion of the initial tranche of three submarines.⁷⁸ The

National Audit Office estimated that the Astute programme was set to overrun its 'most likely' cost at approval by 48 per cent and was 47 months behind its 'most likely' in-service date at approval.⁷⁹ The first submarine was delivered to the Navy in November 2009, over four years after the original in-service date of June 2005.⁸⁰ The planned service lives of the older Swiftsure and Trafalgar-class SSN submarines had to be adjusted to take into account the delayed in-service dates of the Astute-class submarines.⁸¹ MoD had to look to the United States to get the programme back on track by employing General Dynamics Electric Boat to apply its proven expertise from the US Virginia-class attack submarine programme. The US Department of Defense facilitated this via a Government-to-Government Foreign Military Sale for up to \$98 million.⁸² As Greenpeace observed in 2009, "BAE Systems is well known for delivering projects late and over budget, with recent examples including the Astute Class submarines (three and a half years late, and around £1.3bn and 47.3 per cent over budget), the Type 45 Destroyer ships (two years late and £1.5bn and 29 per cent over) and the Nimrod reconnaissance aircraft rebuild (six years late and £700m and 25 per cent over)".⁸³ HMS Astute went on to suffer further problems during its sea trials after experiencing a major problem with its hydraulics in May 2011 and then running aground on a sandbank near the Isle of Skye three months later.⁸⁴ The lessons learnt from the problems with the Astute programme are reportedly being applied to the design and build phase of the Successor programme.⁸⁵

Project D154 adds a further note of caution on cost estimates for MoD's nuclear-related programmes. In 1993 it was confirmed that Devonport would be the single UK site for future deep maintenance, refitting and refuelling of the UK submarine fleet, including the Vanguard-class submarines. All the existing submarine support facilities within the dockyard would consequently be upgraded to meet modern stringent standards for nuclear safety. The contract for the facility redevelopment programme became

known as the D154 Project and it involved upgrading nuclear facilities at Devonport in three phases.⁸⁶ The Phase 1 concept and design contract ran from 1993 to 1996. It was originally envisaged that the construction work would begin in 1996, with completion in 1999. The Phase 2 contract was eventually awarded in March 1997 and construction work began in 1998. The estimated date for completion of the contract was April 2004. During 2001 it became clear that the approved maximum cost for Phase 2 would be exceeded and the Phase 2 contract was renegotiated and re-scoped.⁸⁷ In 1999 the government stated that “The contracted target price range for the provision of refitting and refuelling facilities for nuclear submarines at Devonport is £335 million-£359 million. The figures relate both to the refurbishment of existing facilities and the provision of new facilities for Trident submarines”. Three years later it was reported that the cost of upgrading the facilities at Devonport to

cope with the refits of the nuclear fleet was likely to be £638-£659 million.⁸⁸ The *Scotsman* reported that “Tougher safety standards and a lack of clarity at the time of the original decision about what the regulators – primarily the Nuclear Installations Inspectorate – would accept as a safe site are being blamed.”⁸⁹ The doubling of the cost of Project D154 came after significant cost escalation in nuclear infrastructure programmes under the original Trident programme and fuels concern about MoD’s ability to bring nuclear infrastructure and nuclear submarine projects in on budget and on time.

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