National Audit Office

Report
by the Comptroller
and Auditor General

Ministry of Defence

The Defence Nuclear Enterprise: a landscape review

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National Audit Office

Ministry of Defence

The Defence Nuclear Enterprise: a landscape review

Report by the Comptroller and Auditor General

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Sir Amyas Morse KCB
Comptroller and Auditor General
National Audit Office

18 May 2018

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This landscape report was prepared to help Parliament better understand one of government's most complex and costly programmes.

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Key facts

49

number of years the Royal Navy has operated the continuous at sea deterrent

£5.2bn

estimated expected spend on the Nuclear Enterprise (the Enterprise) in 2018-19, 14% of the defence budget

10

number of in-service nuclear submarines as at March 2018

£50.9 billion	expected spend on Enterprise equipment and support programmes in the 10 years, 2018 to 2028
£2.9 billion	gap between the expected spend on equipment and support and the available budget, 2018 to 2028
97%	percentage of Enterprise contracts, by value, held by four main contractors, 2017-18
30,000	estimated number of people involved in the Enterprise, March 2018
337	shortage of skilled military Royal Navy nuclear staff across seven areas, January 2018
20	number of submarines awaiting disposal, March 2018
£4.9 billion	initial forecast cost of 52 in-progress estate upgrade programmes over their lifetime

Summary

1 The Ministry of Defence (the Department) maintains a submarine-based nuclear deterrent to support the government's national security policy. It currently operates four nuclear-armed deterrent submarines: the Vanguard class. To do this, the Department relies on a network of programmes, equipment and people, often referred to as the Nuclear Enterprise (the Enterprise). Its work includes designing, producing and maintaining submarines and nuclear warheads, and providing the necessary estate, people and support.

2 In 2008, we reported on the future nuclear deterrent. We concluded that, despite early progress, value-for-money risks relating to costs, decision-making and governance needed to be managed. This landscape report looks at the Enterprise more broadly than our 2008 report. It aims to help Parliament better understand the complexities of the Enterprise by describing how the Department needs to bring together its programmes, including production of the new deterrent submarines, to provide a continuous at sea deterrent. In particular, we describe:

- the component parts of the Enterprise (Part One);
- its governance and accountability (Part Two); and
- the management of specific aspects of the Enterprise (Part Three).

We have not evaluated the value for money of the Enterprise or commented on the overarching policy.

Key findings

Components of the Enterprise

3 The government's policy is to maintain a nuclear deterrent as part of its national security strategy. Since April 1969 the Department has carried out this policy, which it assesses as one of its highest priorities, through having at least one nuclear-armed submarine on patrol at any given time. This is often termed the 'continuous at sea deterrent'. In 2006, the government announced its intention to maintain the deterrent. Parliament last endorsed this decision in July 2016 when it voted to start constructing new nuclear-armed submarines, the Dreadnought class (paragraphs 1.2 to 1.5).

4 **To maintain the deterrent, the Department coordinates a range of programmes and organisations, often termed the 'Enterprise'.** This includes submarines, the nuclear propulsion systems used to power the submarines, and the missiles and warheads that arm them. It also brings together the design, build, operation, maintenance and support of these elements, which involves numerous partners. The United Kingdom (UK) and the United States (US) cooperate closely including on elements of both the Trident and nuclear propulsion systems (paragraphs 1.7 to 1.19).

5 **In 2018-19, the Department forecasts to spend £5.2 billion across the Enterprise.** This sum represents 14% of its overall budget. It includes £1.8 billion on procuring and supporting submarines, £1.4 billion on the missiles and warheads, £790 million on the propulsion systems, and £220 million on managing the Enterprise (paragraph 1.6).

Governance and accountability of the Enterprise

6 **The Department is held to account for providing the Enterprise in a number of ways.** It is responsible for delivering the requirements set out by the Prime Minister's policy intent. On occasions, Parliament, the National Audit Office, and the Infrastructure and Projects Authority examine different aspects of the Enterprise. Regulators hold the Department to account for its safe management (paragraphs 2.2 to 2.7).

7 **In the last two years, the Department has reorganised how it manages the Enterprise.** The Strategic Defence and Security Review (SDSR) 2015 set out the Department's commitment to making governance and decision-making for the Enterprise clearer, as this had become fragmented under the Department's devolved model. The Department has implemented most of its commitments by establishing a single point of accountability for the Enterprise and creating two new organisations: the Defence Nuclear Organisation (DNO) and the Submarine Delivery Agency (SDA) (**Figure 1**) (paragraphs 2.8 to 2.13).

8 **After announcing revised arrangements in SDSR 2015, the Department introduced them over an 18-month period, during which time it also had to make key commercial decisions.** Both the DNO and the SDA are now recruiting to fill recognised skills gaps, including to some senior finance and commercial positions. As the Department established these new bodies, it also had to agree critical submarine production contracts. Having made these decisions, the Department has said it will now focus on building up the new organisations (paragraphs 2.14 to 2.16).

Figure 1

The Department's response to Strategic Defence and Security Review (SDSR) 2015 commitments, March 2018

The Department has implemented most of its commitments

Commitments	Departmental response
Establish a new Departmental team headed by an experienced commercial specialist to act as the single sponsor for all aspects of the Nuclear Enterprise.	Created the Defence Nuclear Organisation (DNO), a top-level departmental budget to set policy, assign budgets and make decisions. Appointed a Director General Nuclear in May 2017, who previously worked at HM Treasury and the UK Border Agency.
Strengthen arrangements for the procurement and in-service support of nuclear submarines. Establish a new delivery body with the authority and freedom to recruit and retain the best people to manage the submarine enterprise.	Created the Submarine Delivery Agency (SDA) from April 2018 to manage equipment and support programmes. SDA has the same freedoms to recruit as, and staff have transferred from, Defence Equipment & Support (DE&S).
Intensify efforts to improve contractors' performance, including through sustained investment in skills and infrastructure.	Introduced various initiatives to respond to poor contractor performance.
Put in place new industrial and commercial arrangements between government and industry.	Created SDA and industry agreement to work together to produce the Dreadnought-class submarine.

Source: National Audit Office

Managing the Enterprise

9 The Department has had to cut costs, identify efficiency savings and re-programme work to keep the Enterprise affordable. This includes committing to realising £3 billion of efficiency savings over the next 10 years and delaying by two years the development of an Astute-class submarine replacement. For 2018-19, the Department also agreed with HM Treasury it could access up to £600 million from the £10 billion Dreadnought programme contingency announced in SDSR 2015, to ensure it can deliver the programme within its 2015 cost forecast of £31 billion (paragraphs 3.4, 3.6 to 3.8).

10 The Department is under continuing cost pressure from the Enterprise. Looking beyond a £200 million gap in 2018-19, the Department still needs to manage a further £2.7 billion affordability gap across its equipment and support programmes. The Modernising Defence Programme will allow further consideration of programme options and how the £1.1 billion departmental contingency can be used. The Department will need to agree with HM Treasury under what conditions it can access the remaining £9.4 billion of Dreadnought-specific contingency that can be used across the programme lifetime. As we have previously reported, problems with the affordability of the Enterprise could destabilise the Department's overall Equipment Plan given that around a quarter of its planned spend on equipment relates to nuclear programmes (paragraphs 3.8 to 3.10).

11 The Department uses four main contractors for 97% of its Enterprise-related contracts. These contractors in turn use hundreds of sub-contractors, many of which are small and specialist. The SDA is now seeking to better understand these relationships. The Department must also meet its own contractual responsibilities for providing, for example, nuclear reactor components to its main submarine production contractor (paragraphs 3.14 to 3.15 and 3.17).

12 The Department has introduced new ways of working with its contractors to try to address past poor performance. The Department recognises that contractors' performance has been poor across its nuclear-related contracts. From 1 April 2018, BAE Systems, Rolls-Royce and the SDA will act together on the Dreadnought build to set joint costs and schedules. The Department hopes this will improve performance in delivering Dreadnought through a combination of improved project controls, stronger collaboration and information sharing, and more rigorous oversight (paragraphs 3.16, 3.18 to 3.20).

13 Delivering and operating programmes across the Enterprise requires a wide range of military and civilian skills that are in short supply nationally. The Department acknowledges that it does not have enough suitably qualified and experienced personnel, including across seven military nuclear specialisms. This has resulted from the intermittent nature of the nuclear build programme, which led to skills being lost. There is also growing demand for nuclear skills in other parts of the economy, including the civil nuclear industry. In response, the Department has developed skills programmes and is consolidating submarine-related training at its Naval Base in Scotland (paragraphs 3.21 to 3.28).

14 The complexity of the Enterprise means the Department must coordinate around 75 programmes, and manage knock-on effects between programmes. For example, the timeframe for bringing into service future submarines could be affected by delays with those currently in production. This will in turn influence the support and maintenance requirements for in-service submarines. Given the limited space available, the Department also needs to coordinate plans for its estate to ensure it has the facilities to maintain its submarines, and also to decommission and dismantle those submarines leaving service (paragraphs 3.29 to 3.35).

Concluding remarks

15 Our 2008 report on the nuclear deterrent recommended that the Department address significant risks, particularly around costs, skills, commercial relationships and delivery to schedule. Some of these risks remain 10 years later. In the last 18 months, the Department has made some positive changes to the way it manages the Enterprise and has agreed commercial arrangements designed to improve cost and performance. However, the coming years are crucial. As the Department invests heavily in the Dreadnought-class submarines and more widely across the Enterprise, it needs to ensure that the new structures, processes and its workforce operate effectively together to maintain the nuclear deterrent. We plan to review aspects of the Enterprise further as these arrangements evolve.

Part One

Background

1.1 For almost 50 years, the Ministry of Defence (the Department) has retained a submarine-based nuclear deterrent. This part outlines the importance and scale of the Department's nuclear-related programmes, together described as the Nuclear Enterprise (the Enterprise).

UK government policy

1.2 To support national security requirements, the government's policy is to retain an independent nuclear deterrent. The Treaty on the Non-Proliferation of Nuclear Weapons, signed every five years, recognises the United Kingdom (UK) as a nuclear weapons holding state alongside the United States (US), France, China and Russia. The government knows or suspects that other states also hold nuclear weapons. It recognises that states might use their weapons to threaten the UK, constrain the UK government's decision-making, or sponsor nuclear terrorism. The government has stated its commitment to maintaining the minimum amount of destructive power to deter any aggressor.

1.3 Since 1969, the Department has met the government's deterrence policy by having at least one nuclear-armed submarine on patrol at any given time. This is commonly known as the 'continuous at sea deterrent'. Maintaining the deterrent is one of the Department's highest military priorities, as set out in the Strategic Defence and Security Review (SDSR) 2015.

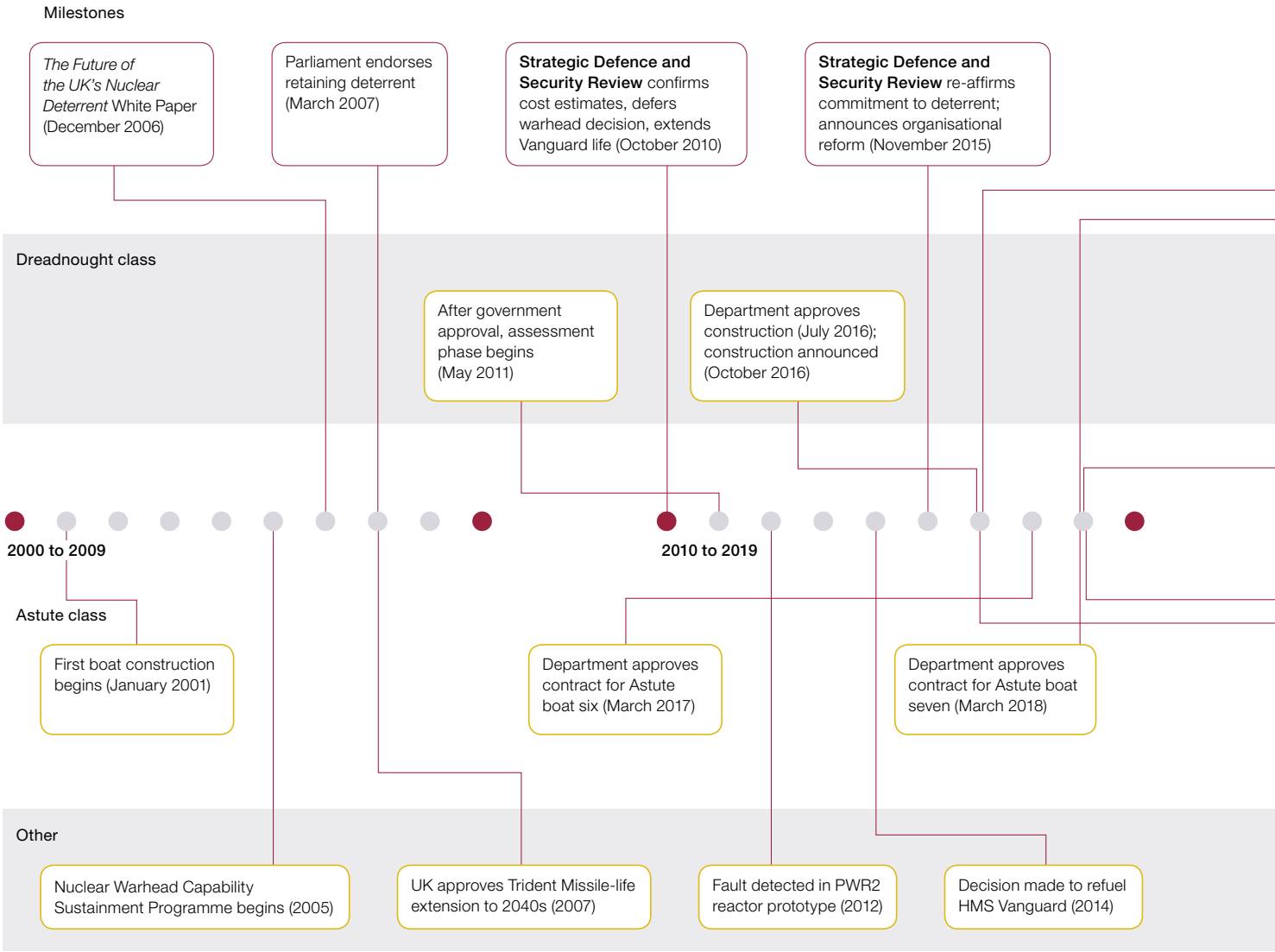
1.4 In 2006, the government stated its intention to renew the deterrent in a White Paper, which Parliament endorsed in 2007. This stated that:

- Steps must be taken to sustain a credible nuclear deterrent in the 2020s and beyond.
- This should be achieved by retaining a submarine-based system, with new submarines in service by 2024 to maintain continuous deterrent patrols. Although they would later be refined, procurement costs for the submarine, support infrastructure and warhead, if needed, were estimated to be £15–£20 billion (2006-07 prices).
- The UK needed to decide whether to participate in the US's Trident D5 missile life extension programme by 2007 if it wanted to continue using the Trident D5 missiles beyond 2020.
- The Trident warhead design was expected to last into the 2020s.

1.5 The new Dreadnought-class submarines will gradually replace the in-service Vanguard-class submarines from the early 2030s. SDSR 2015 restated these plans, which were endorsed by Parliament in July 2016. In October 2016, the Department announced the start of construction for the first Dreadnought-class submarine. **Figure 2** summarises the main developments between 2000 and 2040.

Figure 2
Timeline of programme decisions and milestones

The Department has made a number of long-term decisions



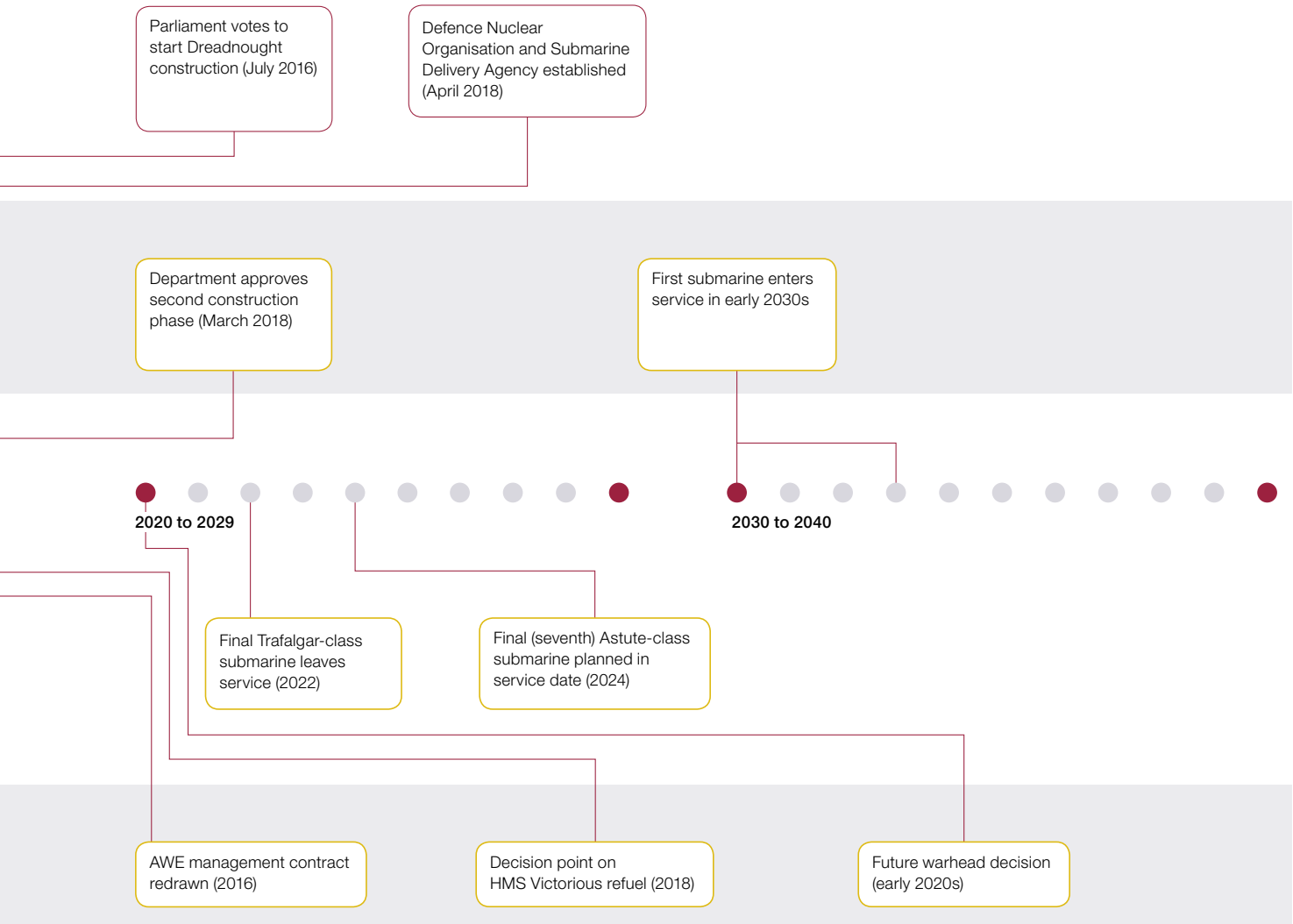
Notes

1 Does not include future submarines, such as the Maritime Underwater Future Capability programme, which will replace the Astute class.

2 AWE – Atomic Weapons Establishment.

3 Assesment phase involves the finalisation of designs and initial preparations for the build.

Source: National Audit Office


Parliament votes to start Dreadnought construction (July 2016)
Defence Nuclear Organisation and Submarine Delivery Agency established (April 2018)
Department approves second construction phase (March 2018)
First submarine enters service in early 2030s
2020 to 2029
2030 to 2040
Final Trafalgar-class submarine leaves service (2022)
Final (seventh) Astute-class submarine planned in service date (2024)
AWE management contract redrawn (2016)
Decision point on HMS Victorious refuel (2018)
Future warhead decision (early 2020s)

The Enterprise

1.6 In 2018-19, the Department plans to spend £5.2 billion on the Enterprise (**Figure 3**). This sum includes £4.9 billion on procurement and support programmes, and £220 million on running the Enterprise. This represents around 14% of the Department's £37 billion defence budget.

1.7 To maintain the deterrent, the Department coordinates programmes and organisations across the Enterprise (**Figure 4** on pages 14 and 15). The complexity, scale and inter-generational timescale of these programmes make it difficult to draw a boundary around them all, but understanding them is important for identifying and managing interdependencies and costs.

1.8 In bringing together the programmes, the Department works with organisations and teams inside and outside the Department, within the commercial sector and in allied countries (**Figure 5** on page 16). International relationships include those with the following:

- **The US**

  Since the 1950s, the US has played a major role in the UK's nuclear programmes. The 1958 Mutual Defence Agreement provides the basis for UK–US cooperation on nuclear weapon and reactor technologies. A 2014 amendment to the Agreement sets out how the US can provide nuclear propulsion plants and parts, including spare parts, replacement cores and fuel elements, alongside information necessary for the design, manufacture and operation of submarine nuclear propulsion plants. In addition, the 1963 Polaris Sales Agreement enables the UK to acquire and operate the US Trident missile system.

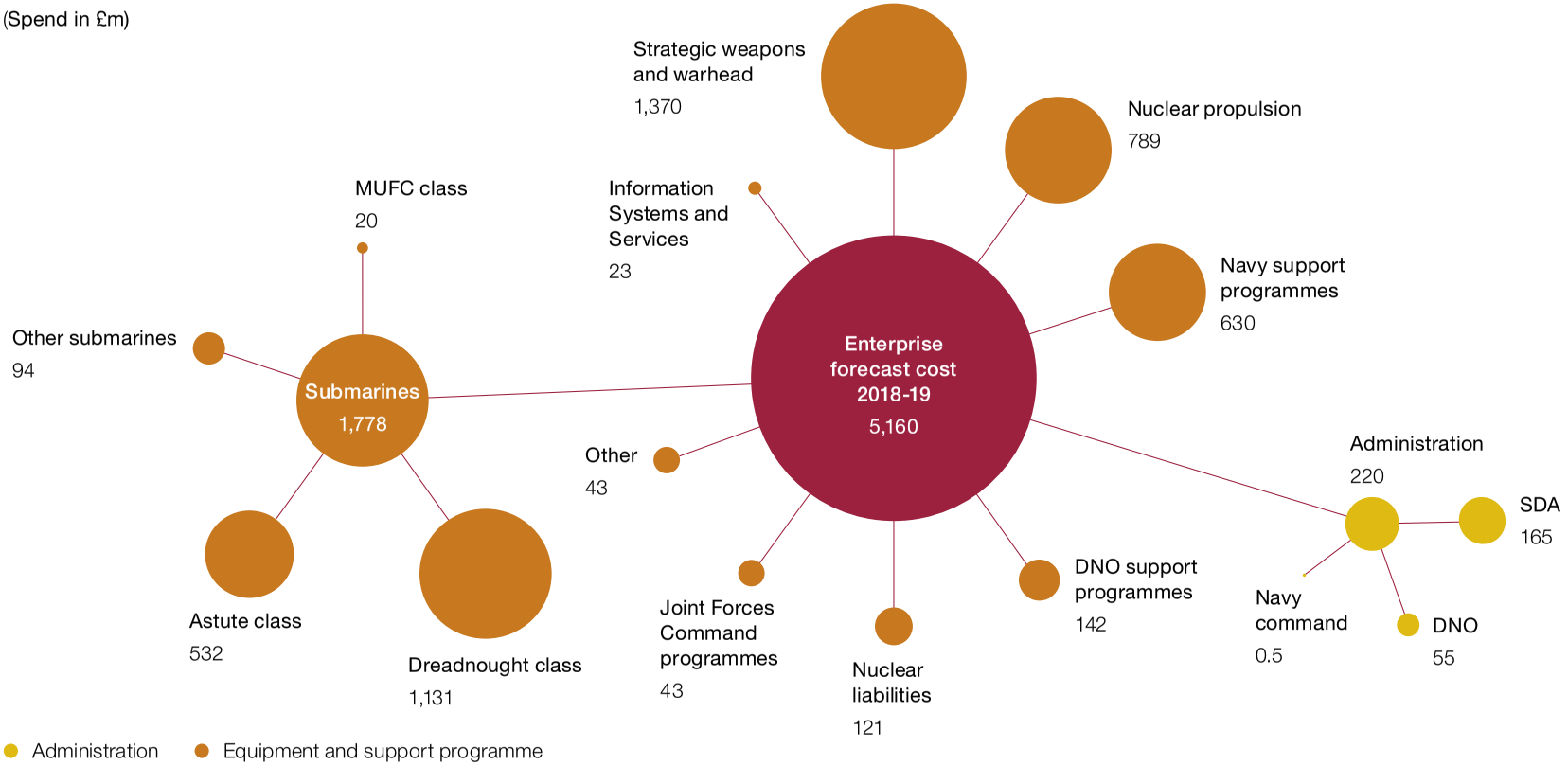
- **France**

  Cooperation includes a 2010 programme, known as 'Teutates', to develop testing facilities for new technologies designed to ensure that nuclear stockpiles are maintained safely and effectively. Since 2014, the UK has operated a UK development centre at Aldermaston. At the French facility in Valduc, UK personnel supervise the construction of test facilities and carry out preparatory work for experiments.

Figure 3

Breakdown of Enterprise agreed forecast spend, 2018-19

The Department forecasts to spend £5.2 billion across the Enterprise in 2018-19



Notes

1 Categorisation of costs does not necessarily reconcile with the Department's broader definition of some programmes, such as its description of Dreadnought-class in the Strategic Defence and Spending Review 2015.

2 Excludes Joint Forces Command administration spend and non-civilian Royal Navy staff spend.

3 MUFC, the Maritime Underwater Future Capability, will replace the Astute class.

4 SDA – Submarine Delivery Agency; DNO – Defence Nuclear Organisation.

5 Navy support covers in-service submarines, combat systems and spares.

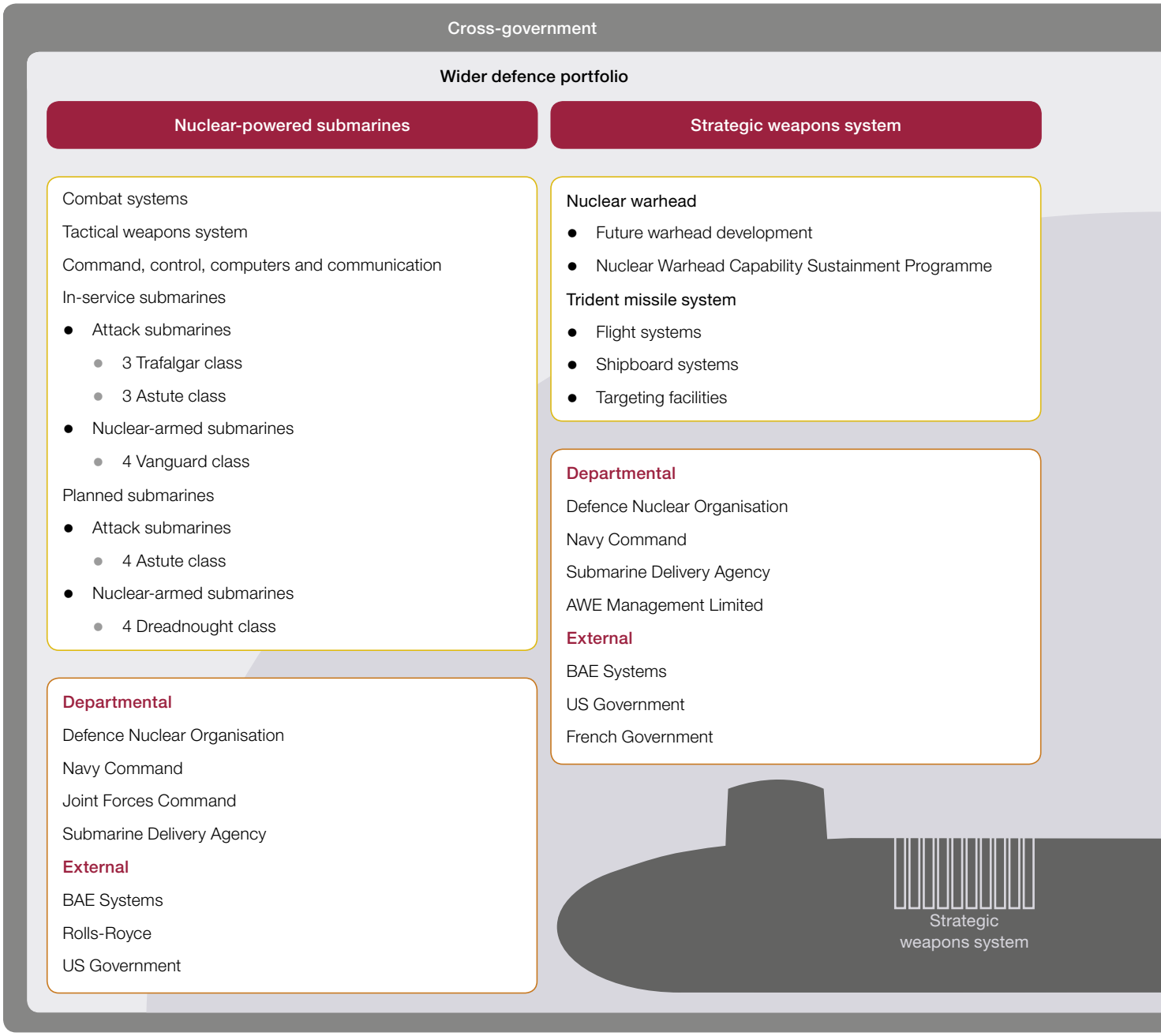
6 Other includes £45 million of efficiencies and an £88 million forecast spend.

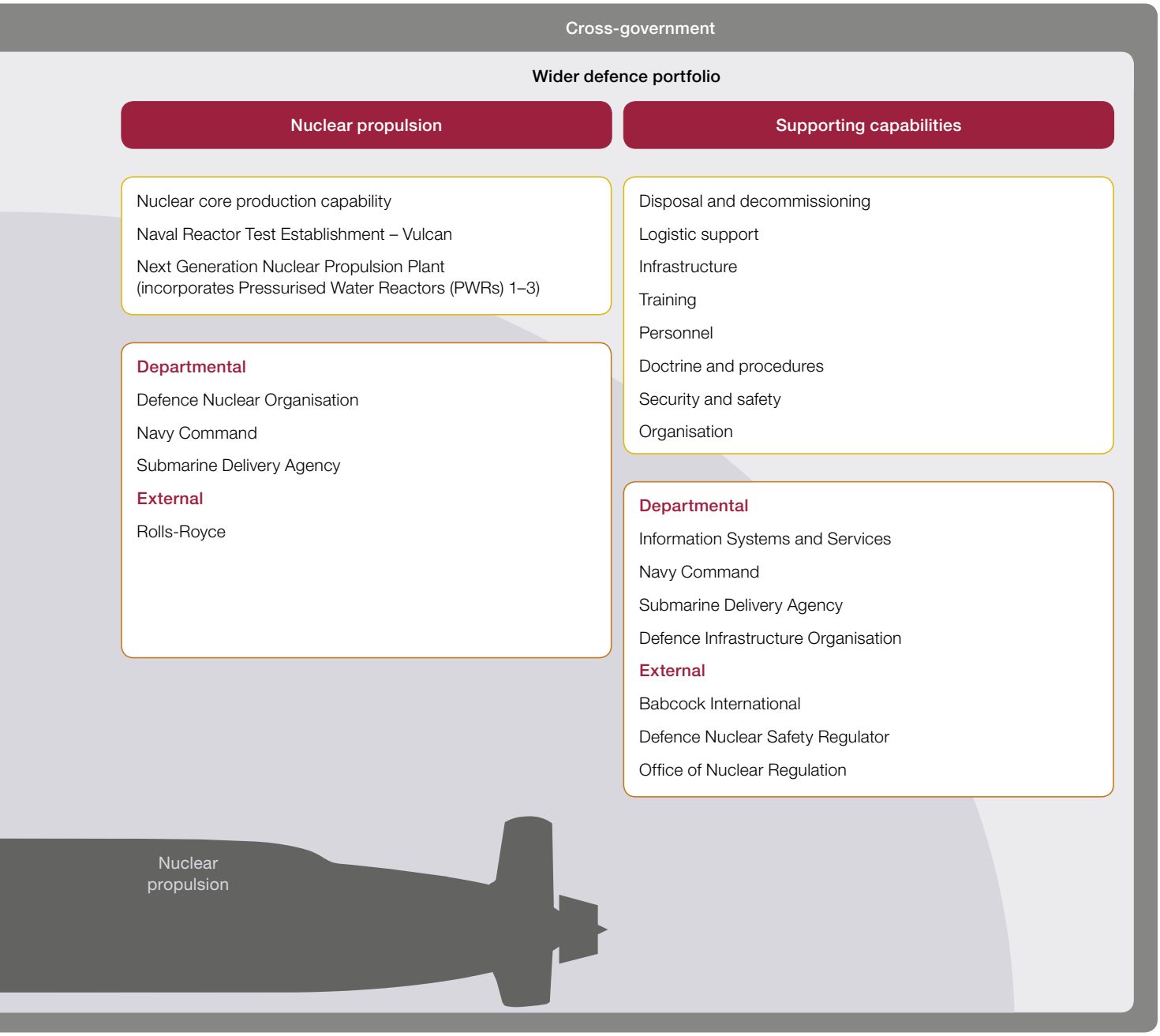
7 Figures do not sum due to rounding.

Source: National Audit Office analysis of departmental data

Figure 4
Summary of the Nuclear Enterprise

The Enterprise encompasses many components and organisations





Notes

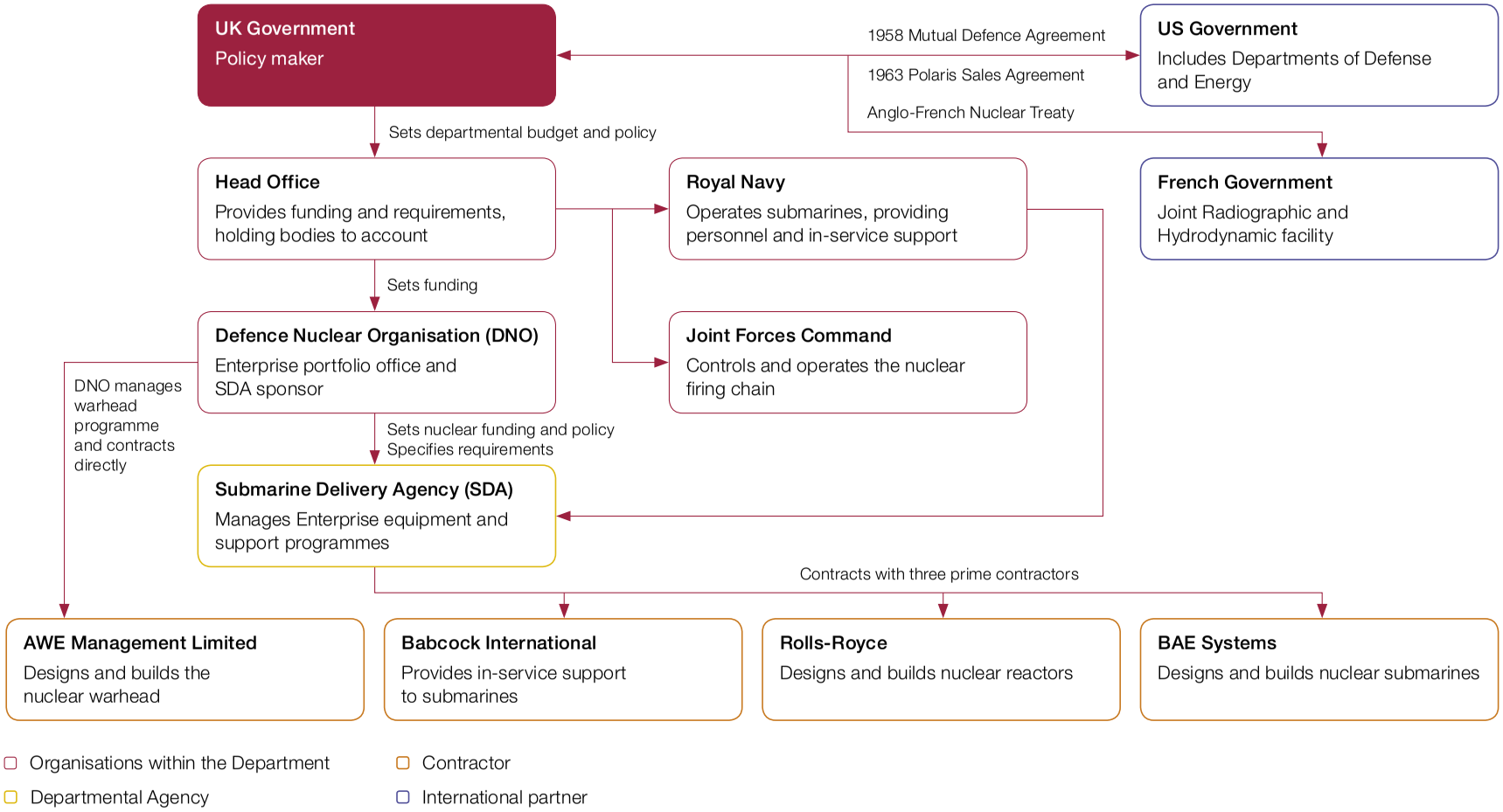
1 Additional capabilities, such as ships and commandos, are not shown.

2 Cross-government includes the Cabinet Office, HM Treasury, the Foreign & Commonwealth Office and the Department for Business, Energy & Industrial Strategy.

Source: National Audit Office

Figure 5
Organisations involved in the Enterprise, April 2018

A number of organisations contribute to the Enterprise



Notes

1 Shows Enterprise funding flows rather than working level engagements.

2 During 2017-18, SDA operated in shadow form alongside Defence Equipment & Support (DE&S). Until March 2018, AWE Management Limited was a DE&S supplier.

3 The three prime contractors contract with hundreds of sub-contractors not shown.

Source: National Audit Office

Nuclear-powered submarines

1.9 The submarine fleet currently includes four nuclear-armed submarines (the Vanguard class), which carry the nuclear warhead armed Trident missile. They came into service between 1993 and 1999, and are now expected to remain in service until the 2030s. There is at least one nuclear-armed submarine on patrol at any one time, typically for around three months.[1] The remaining nuclear-armed submarines could be undertaking training exercises or undergoing maintenance.

1.10 As the Vanguard-class submarines reach the end of their service lives, they will be replaced by the Dreadnought class from the early 2030s. The Department still expects that designing and building four Dreadnought-class submarines will cost £31 billion, in line with the forecast in SDSR 2015, with £10 billion of contingency funds available.[2] Following early work on the concept, in May 2011, the Department announced the start of a five-year assessment phase to refine the submarines' design and capture the associated costs. Following Parliament's endorsement of the programme in July 2016, the Department approved the costs and BAE Systems announced the start of construction at its Barrow shipyard on 1 October 2016.

1.11 Alongside the four nuclear-armed submarines, the Department currently operates six attack submarines (**Figure 6** overleaf). They are three Trafalgar-class submarines and three newer Astute-class submarines. At present, the Department expects to decommission the Trafalgar-class submarines in the early 2020s, as it brings into service four more Astute-class submarines. It will then operate a fleet of seven attack submarines. As at March 2018, the Department expects these submarines to be in service for 32 years, and is currently considering their replacement. There has been cost growth on all Astute-class submarines due to delays, the re-assessment of future requirements, changes to technical scope and contract discussions.

1 Ministry of Defence, *The United Kingdom's future nuclear deterrent: the submarine. Initial Gate Parliamentary Report*, May 2011.
2 Cost figures included in SDSR 2015 cannot be compared with those included in the 2006 White Paper.

Figure 6
Comparison of nuclear submarine types

The Department operates two types of submarine

	Nuclear-armed submarines	Attack submarines
Detail	Seeks to remain undetected by hostile forces while on patrol and ready to provide a nuclear response at short notice.	Seeks to detect and, where necessary, destroy enemy submarines and surface vessels; protect strategic assets such as aircraft carriers and nuclear-armed submarines; conduct reconnaissance and intelligence gathering; and transport special forces
Number in-service	4	6
Current submarines (in-service date)	Vanguard class 1 HMS Vanguard (1993) 2 HMS Victorious (1995) 3 HMS Vigilant (1996) 4 HMS Vengeance (1999)	Trafalgar class 1 HMS Trenchant (1989) 2 HMS Talent (1990) 3 HMS Triumph (1991) Astute class 4 HMS Astute (2010) 5 HMS Ambush (2013) 6 HMS Artful (2016)
Planned replacement	Dreadnought class in the early 2030s	Four Astute-class submarines to replace Trafalgar-class by 2024 Ongoing programme to consider Astute-class replacement
Design features	Vanguard class	Astute class
Length (metres)	150	97
Propulsion	Nuclear propulsion	Nuclear propulsion
Armament	16 tubes capable of firing ballistic missiles carrying nuclear warhead(s) and tubes capable of firing Spearfish torpedoes	Six tubes capable of firing Spearfish torpedoes and Tomahawk missiles
Crew size	150	97

Source: National Audit Office

Nuclear propulsion

1.12 The Department's 10 submarines are powered by two different types of nuclear reactor, containing different nuclear cores, called Pressurised Water Reactors (PWRs). The three in-service Trafalgar-class submarines use an earlier version (PWR1) to that used in the Vanguard and Astute-class submarines (PWR2). The UK designs and builds the nuclear reactors. Rolls-Royce is the only UK commercial contractor able to undertake this work.

1.13 When it approved the Dreadnought programme in 2011, the Department had to decide whether to use PWR2 or a new PWR. The Department recognised, as recommended by the regulators, that PWR2, or an updated version of PWR2 would not be acceptable going forward. As such, it decided to develop a new reactor, PWR3. This decision, and HM Treasury's challenge of it, delayed approval of the initial Dreadnought business case.

1.14 In 2012, during its on-shore testing, the Department identified a fault with a prototype of PWR2. It had been running the prototype at a nuclear reactor testing centre to identify any potential engineering issues. As a precautionary measure, the Department installed a new nuclear core in HMS Vanguard, at an estimated cost of £270 million.

1.15 In April 2012, the Department started a 16-year programme to regenerate and replace the nuclear core production facilities at the Rolls-Royce site in Raynesway, sustain the required capabilities, and develop and manufacture the nuclear reactor cores for Dreadnought. As a result of scope changes, including the decision to retain existing facilities to produce an additional reactor core for HMS Vanguard, in 2017 the Department forecast the programme would exceed the initial approved budget. The programme is currently being reviewed to reflect its revised scope, which includes new commercial arrangements. Following approval of an increase in programme spend, the Infrastructure and Projects Authority (IPA), which previously had concerns following the change in scope, expects the programme to deliver the new facilities on time.

Missiles and warhead

1.16 Decisions about the use of nuclear weapons remain entirely sovereign to the UK. Only the Prime Minister, and those to whom the Prime Minister has delegated responsibility, can authorise the launch of a nuclear weapon. The UK's nuclear weapons consist of the following:

- **Trident D5 missile**

  Manufactured by Lockheed Martin in the US, the missile carries warheads with an effective range of about 4,000 nautical miles when fully armed. Under agreement with the US, the UK can access a shared missile pool held at a US naval base. The UK contributes approximately £12 million a year to maintaining this facility. To minimise the risk of obsolescence, the US is undertaking a missile life extension programme, in which the UK participates, and which is expected to cost the Department £352 million over the project's lifetime. The UK also continues to participate in other US-led programmes to extend the service life of missile components and spares.

- **Mk4 warhead**

  The Department plans to reduce its warhead stockpile to around no more than 180 by the mid-2020s. The UK's nuclear warheads are designed, produced and maintained by the Atomic Weapons Establishment. It is currently refurbishing the UK's warheads in order to replace obsolescent non-nuclear parts, using some components provided by the US. In the early 2020s, the government will decide whether to obtain a new warhead model. The Department has funded a 20-year nuclear warhead capability programme, currently forecast to cost £20 billion. This programme will be delivered by the Atomic Weapons Establishment, and will both develop an appropriately skilled workforce and improve infrastructure by the mid-2020s.

Supporting capabilities

1.17 Maintaining a nuclear-armed submarine, its systems and its weapons requires a broad range of in-service support and capabilities. This includes having the right people and infrastructure to build, operate, maintain and dispose of the submarines, nuclear reactors and warheads. In 2018-19, the Department forecasts to spend £772 million across support programmes. It estimates that the in-year service cost for the Dreadnought submarines will be similar to operating the Vanguard-class submarines.

People

1.18 Organisations across the Enterprise need to recruit, train and retain a large, and often specialist, workforce. The Department has stated that maintaining and supporting the Enterprise results in over 30,000 UK jobs. These jobs are spread across the UK with around 7,000 at Her Majesty's Naval Base (HMNB) Clyde in Scotland and 7,000 in Barrow. The total includes:

- submariners, provided by the Royal Navy, some of whom are nuclear and naval engineers;

- non-military staff, provided by the Department and contractors, with commercial, programme management and financial management expertise; and
- technical staff, both departmental and contractors, ranging from nuclear-qualified welders to submarine designers.

Estate

1.19 The Enterprise is spread across 13 UK sites, with one in the US (**Figure 7** overleaf). The Department owns and manages nine sites, while its contractors manage four.[3] They include:

- **HMNB Clyde,** located in Faslane near Glasgow, the base for most of the Department's submarines and shortly the Department's Submarine Centre of Excellence;
- **Royal Navy Armaments Deport Coulport,** near Faslane, where nuclear weapons are loaded into, and unloaded from, submarines;
- **Devonport Royal Dockyard,** owned and operated by Babcock International, which is the UK's main site for deep maintenance, refuelling and overhaul of submarines. It houses 13 of the Department's 20 decommissioned submarines, with the remainder at Rosyth;
- **Barrow Shipyard,** owned by BAE Systems, which is currently the only UK shipyard licensed to build nuclear submarines; and
- **Atomic Weapons Establishment (AWE) sites at Aldermaston, Burghfield and Black Nest** – these Department-owned sites design, manufacture, maintain and support nuclear warheads.

1.20 The age and condition of the estate and facilities across the Enterprise vary. Some facilities, such as at Faslane, were significantly redeveloped in the 1980s and early 1990s and will be needed for at least 50 years to support the new Dreadnought submarines. Since 2014-15, the Defence Nuclear Safety Regulator has reported that facilities used to build and support the Vanguard class, and intended to support Dreadnought, will require upgrades so they can be used for longer. This includes the ship lift at HMNB Clyde that needs to be available at short notice.

1.21 The Department has identified 52 programmes (initially valued at £4.9 billion over their lifetime) currently under way to upgrade and renew the estate and facilities (**Figure 8** on page 23). It is considering a further 45 programmes, which include a £4 billion upgrade to facilities at HMNB Clyde. A number of these programmes have experienced delays or cost increases, which add to risks associated with using existing facilities. Delays include those to the upgrade to the AWE warhead assembly facility, which is six years late with costs increasing 146% from the £734 million 2011 approved cost to £1.8 billion, and to the nuclear core facilities in Raynesway.

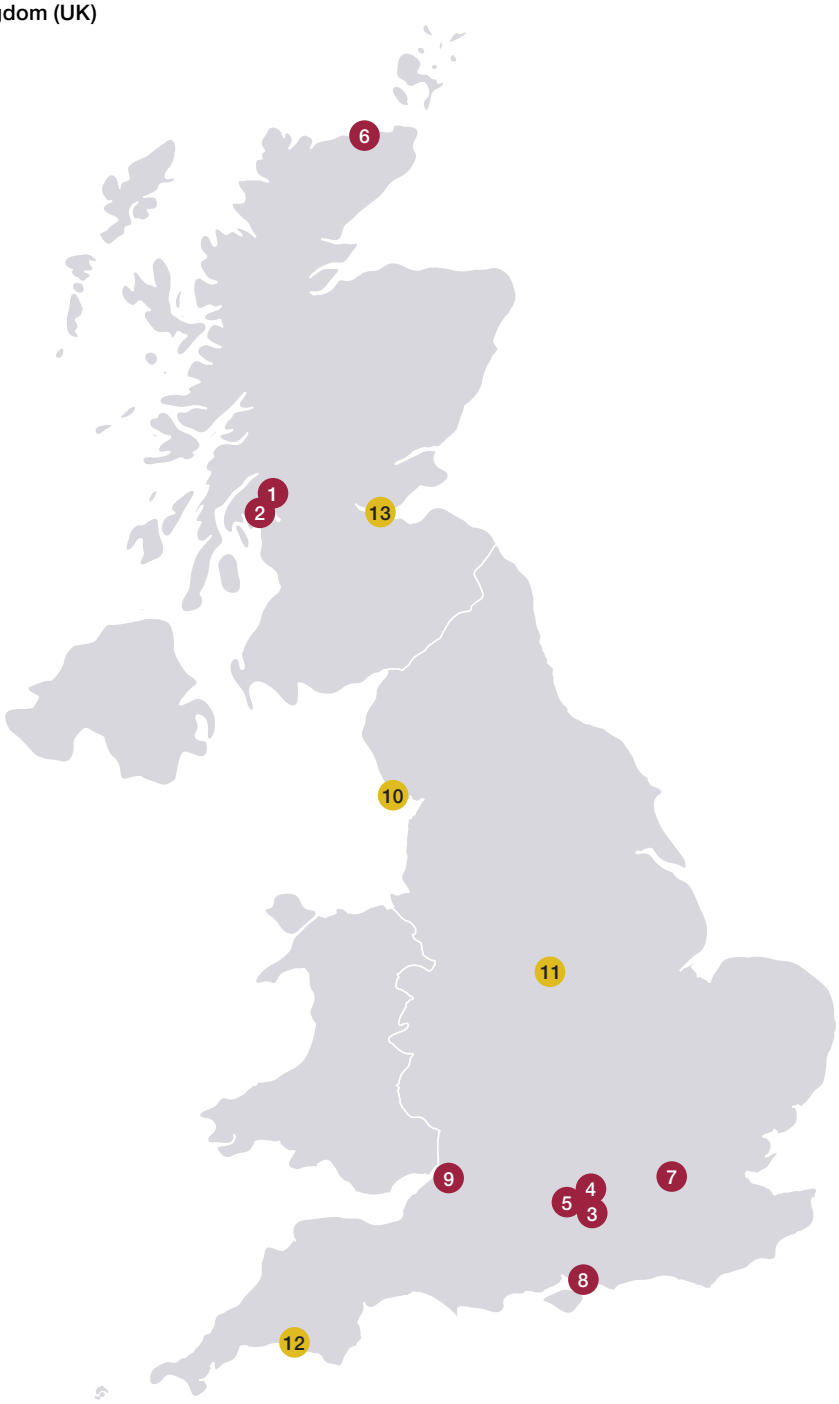
3 Devonport Royal Dockyard, which is part Crown-owned, has been shown as contractor-owned.

Figure 7
Enterprise site locations

The Enterprise is spread across the United Kingdom (UK)

- Ministry of Defence site
- Contractor site

1. **Her Majesty's Naval Base Clyde:** home for the Vanguard-class deterrent submarines.
2. **Royal Naval Armaments Depot Coulport:** processing and storage site for UK nuclear weapons and the loading/unloading facility for submarines.
3. **AWE Aldermaston:** researches, designs and manufactures UK nuclear weapons.
4. **AWE Burghfield:** assembles, maintains and decommissions nuclear weapons.
5. **AWE Black Nest:** undertakes seismic monitoring as part of the UK's nuclear counter-proliferation activities.
6. **Vulcan Nuclear Test Establishment:** a test facility for Pressurised Water Reactors.
7. **Ministry of Defence Head Office:** the Department's senior leadership and central functions, including the Defence Nuclear Organisation.
8. **Navy Command Headquarters:** coordinates the various non-equipment components of the Enterprise (eg training, personnel).
9. **Submarine Delivery Agency:** provides management of programmes.
10. **BAE Systems Barrow:** the only UK shipyard licensed to design and construct nuclear submarines.
11. **Rolls-Royce Marine Raynesway:** main site for the development and construction of cores for UK submarines.
12. **Devonport Royal Dockyard:** operated by Babcock International and undertakes maintenance, refuelling and defueling of submarines.
13. **Rosyth Dockyard:** owned by Babcock International and base for seven decommissioned nuclear submarines.



Notes

1 The United States-operated Strategic Weapons Facility, with the joint shared pool of Trident missiles, is not shown.

2 The location for the Nuclear Firing Chain is not shown.

3 Sites 1, 2, 3, 4 and 5 are shown at their approximate locations but have been offset for presentation purposes.

Source: National Audit Office

Figure 8

Summary of selected Enterprise estate programmes, March 2018

The Department is investing in its estate, including seven significant programmes, over the coming decades

	Initial estimated lifetime cost (£m)	Current status
Atomic Weapons Establishment		
Upgrade to warhead assembly facility	734	Delayed six years from 2017 to 2023
Upgrade to uranium facilities	634	Suspended
Raynesway (Rolls-Royce)		
Nuclear core production facility	482	Delayed two years to 2023
Devonport Royal Dockyard		
Dock upgrade for Astute and Dreadnought classes	600	Concept phase, expected to complete 2025
Dock upgrade for Astute-class maintenance	284	Concept phase, expected to complete 2022
HMNB Clyde		
Infrastructure to support future nuclear operations	664	Part of a portfolio of projects
Other		
Locating and building reactor pressure vessel facility	139	Part of a portfolio of projects
Total	**3,537**	

Note

1 Shows upgrade programmes excluding those not approved or relating to decommissioning, with an original forecast cost of over £100 million. Costs and dates may have changed during the programme.

Source: National Audit Office analysis of departmental data

Decommissioning and disposal

1.22 As with all defence equipment, nuclear submarines, sites and warheads have finite service lives. The AWE decommissions and disposes of nuclear warheads. The UK has not yet fully disposed of any nuclear submarines. At the time of our report, the Department held 20 decommissioned nuclear submarines in different stages of disassembly, with nine still carrying fuel. Due to regulatory requirements, the submarines have incurred maintenance and storage costs averaging a total of £2.5 million a year over the last 10 years. In 2016-17, the Department held a £3.3 billion provision for the storage and disposal of these 20 submarines and a further seven Trafalgar and Vanguard-class submarines.

1.23 The Department manages two programmes to decommission and dispose of its submarines. These relate to the following:

- **defueling submarines**

  Following an Office for Nuclear Regulation review, in 2004 the Department suspended its defueling of decommissioned submarines in order to upgrade its Devonport facilities to meet regulatory requirements. It initially expected to provide defueling facilities from December 2017, but in late 2016 the Defence Board deferred wider infrastructure upgrades at Devonport which impacted the defueling programme. The Department is now developing a more integrated plan for the Devonport estate, and renegotiating the defueling contracts.

- **dismantling submarines**

  In 2000, the Department began to consider how to dismantle its decommissioned submarines. In August 2016, it approved £15 million for the first phase of a three–year programme. This includes the removal of all radioactive waste from HMS Swiftsure, the first submarine to be dismantled. In 2016, the Department told the House of Commons Defence Committee that it could not accelerate the programme given affordability pressures.

Part Two

Governance and accountability in the Enterprise

2.1 The Ministry of Defence (the Department) has overall responsibility for the Nuclear Enterprise (the Enterprise). It must have confidence that its governance structures allow it to provide the deterrent, and handle nuclear materials and weapons safely. This part describes the structures in place. Past National Audit Office work has highlighted the importance for successful programme outcomes of:

- clear accountability arrangements (including being clear about objectives, roles and responsibilities and spending commitments);
- rigorous decision-making structures; and
- comprehensive assurance arrangements.[4]

Accountability for the Enterprise

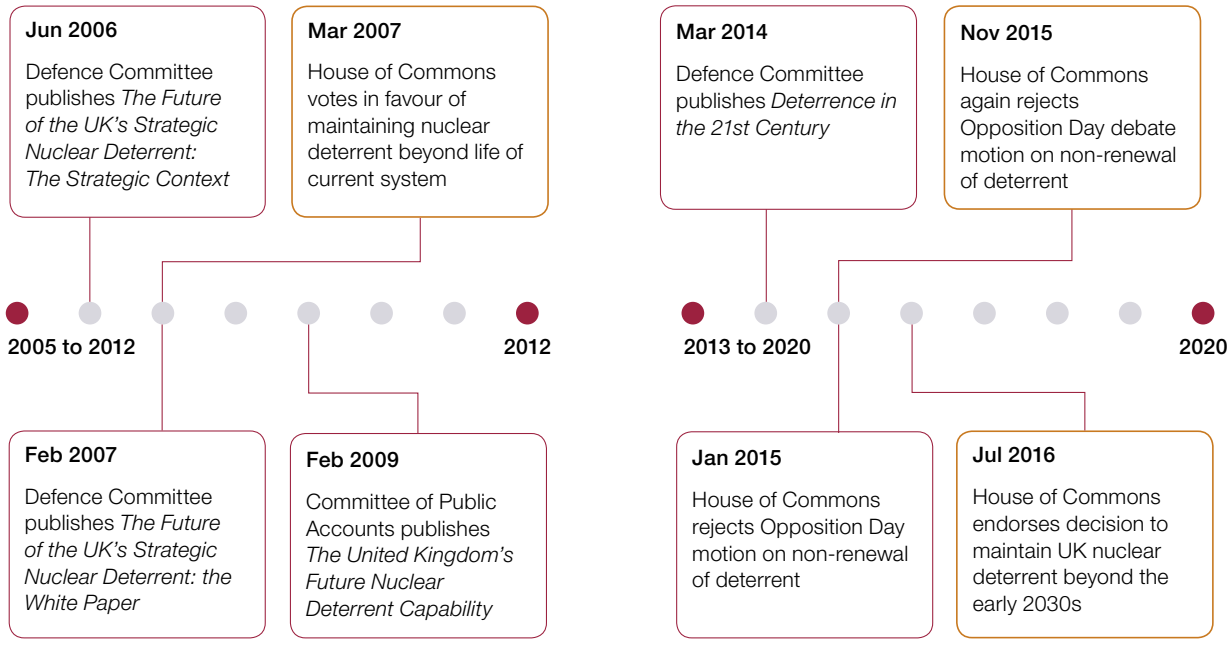
2.2 The National Security Council, a ministerial committee chaired by the Prime Minister, provides the government with a forum to discuss national security. One of its four sub-committees focuses on nuclear deterrence and security, and includes the Defence Secretary, the Foreign Secretary and the Chancellor of the Exchequer. The Department delivers the requirements set out by the National Security Council.

2.3 The Department is held to account in a number of ways. Within the constraints of national security, Parliament has occasionally examined aspects of the Enterprise (**Figure 9** overleaf). The Department's nuclear programmes have often been the subject of Parliamentary questions. The Department answered 373 written questions between June 2014 and March 2018.

4 Comptroller and Auditor General, *Accountability to Parliament for taxpayers' money*, Session 2015-16, HC 849, National Audit Office, February 2016.

Figure 9
Parliamentary scrutiny of the Enterprise

Parliament has occasionally examined aspects of the Enterprise



Notes

1 Broader parliamentary debates, such as on defence estimates (2018), have also considered the Enterprise.

2 The Department provides Parliament with a brief annual update on spend and progress across the Dreadnought programme, but not other programmes within the Enterprise.

Source: National Audit Office

2.4 The Comptroller and Auditor General audits Enterprise expenditure as part of his statutory annual financial audits. He also considers selected nuclear programmes in his annual report on the Department's Equipment Plan, and last specifically reported on the Enterprise in 2008. This work has been examined in open hearings of the Committee of Public Accounts.

2.5 The Infrastructure and Projects Authority (IPA) scrutinises and assures all major projects across government, including Enterprise programmes, reporting to the Cabinet Office and HM Treasury. It provides senior responsible owners with assessments of project risk and confidence in delivery. In its 2016-17 Annual Report, the IPA assessed the successful delivery of both the Dreadnought and Astute-class submarine programmes as being in doubt (**Figure 10**).

Figure 10

Infrastructure and Projects Authority (IPA) assessment of Enterprise programmes, 2012-13 to 2016-17

The IPA reports its confidence in the major Enterprise programmes annually

	2012-13	2013-14	2014-15	2015-16	2016-17
Astute-class submarine (boats 1–7)	Amber	Amber	Amber/Red	Amber/Red	Amber/Red
Dreadnought-class submarine	No data	Amber/ Green	Amber/Red	Amber/Red	Amber/Red
Core Production Capability	Green	Green	Amber	Amber	Red
Nuclear Warhead Capability Sustainment Programme	No data	No data	No data	No data	No data

Green	Successful delivery of the project on time, budget and quality appears highly likely and there are no major outstanding issues that at this stage appear to threaten delivery significantly.
Amber/Green	Successful delivery appears probable; however, constant attention will be needed to ensure risks do not materialise into major issues threatening delivery.
Amber	Successful delivery appears feasible but significant issues already exist, requiring management attention. These appear resolvable at this stage and, if addressed promptly, should not present a cost/schedule overrun.
Amber/Red	Successful delivery of the project is in doubt with major risks or issues apparent in a number of key areas. Urgent action is needed to address these problems and/or assess whether resolution is feasible.
Red	Successful delivery of the project appears to be unachievable. There are major issues with project definition, schedule, budget, quality and/or benefits delivery, which at this stage do not appear to be manageable or resolvable. The project may need re-scoping and/or its overall viability reassessed.

Note

1 Dreadnought entered the Government Major Programme Portfolio (GMPP) in 2013-14. The Nuclear Warhead Capability Sustainability Programme is exempt from reporting under the Freedom of Information Act.

Source: Infrastructure and Projects Authority, Annual Report on Major Projects, 2016-17

2.6 The Defence Secretary is accountable for all activities carried out by the Department and the Armed Forces. As part of this arrangement, the Defence Nuclear Enterprise operates within a unique regulatory environment. Many of the Department's nuclear programmes fall outside the scope of the UK's civil nuclear regulatory legislation. However, the Department has a long-standing policy of trying to achieve outcomes that are, as far as reasonably practicable, as least as good as those required by UK legislation across the civil sector.

2.7 The Enterprise is regulated as follows:

- **The Office for Nuclear Regulation** regulates the contractor-owned and operated sites where nuclear-related activities are undertaken. It ensures that the nuclear industry controls its hazards effectively, continually improves its practices and maintains high standards. It oversees the transportation of certain nuclear materials and the design, build, operation and decommissioning of nuclear facilities.
- **The Defence Nuclear Safety Regulator** regulates nuclear activities and facilities at Department-owned and operated sites. It reports independently to the Defence Secretary and regulates the Department's nuclear propulsion programmes, nuclear weapons programmes and the transport of defence nuclear materials. Until 2015-16, the Regulator published an annual report on its findings, although it has not done so more recently for national security reasons.

Establishing effective decision-making arrangements

2.8 The Department's governance of the Enterprise has evolved. In 2008, we reported that a senior responsible owner (SRO) covered the Dreadnought programme, as it is now known, rather than the whole Enterprise. The SRO had to work within complex structures, and did not have authority over the programmes required for the deterrent. Following a 2011 internal review, the Department introduced a devolved model that proposed a strong centre providing strategic direction, and business areas running their activities in line with that strategic direction and within set budgets.[5] The Department's Strategic Programmes team retained financial control over significant nuclear programmes, but the SRO role for the Dreadnought programme transferred to Defence Equipment & Support (DE&S). Other nuclear responsibilities were shared across two senior staff in the Department's Head Office.

2.9 Since 2014, the Department has increasingly recognised that the governance of the Enterprise needed to be improved. A 2015 review concluded that moving responsibility for the Dreadnought programme had undermined the separation of responsibilities between the customer (Head Office) and supplier (DE&S). It also recognised that having three senior nuclear-related roles in Head Office had fragmented responsibility and accountability for the Enterprise.

5 Ministry of Defence, *Defence Reform: An independent report into the structure and management of the Ministry of Defence*, June 2011.

2.10 In response, the Department reorganised how it made decisions across the Enterprise in order to focus more on nuclear programmes and attract people with the required skills. In particular, it created two bodies:

- **The Defence Nuclear Organisation (DNO)**

  The DNO provides a single point of accountability for the Enterprise. It is headed by the Director General Nuclear (DG Nuclear) who reports to, and is held to account by, the Defence Nuclear Executive Board. He is responsible for providing the Secretary of State, through the Board, with a coherent and comprehensive view of the Enterprise and its risks. The DNO was set up in April 2016 and became a top-level budget in April 2017.[6]

- **The Submarine Delivery Agency (SDA)**

  The SDA has been an executive agency since April 2018, after operating in shadow form alongside DE&S from April 2017. It manages 51 Enterprise-related procurement and support programmes on behalf of the DNO and the Navy, its customers. Although separate, it depends on DE&S for certain administrative functions and procuring spare parts. For example, some 75% of submarine spare parts are provided through DE&S.

2.11 The DNO sponsors the SDA, with DG Nuclear chairing periodic sponsor review meetings. For 2018-19, the SDA will manage equipment and support programmes worth £2.8 billion and has been given £165 million by DNO to operate. The DNO will hold the SDA to account for:

- corporate performance: ensuring that the SDA is achieving the anticipated benefits of establishing a dedicated submarine delivery organisation;
- acquisition and support performance: providing confidence in the SDA's ability to deliver the Enterprise's procurement and support programmes to agreed quality, time and cost;
- the supply chain: assuring the SDA's relationship with industry and the supply chain to achieve cost-efficient delivery and maintain future capability; and
- safety and security: ensuring that the SDA achieves continuous improvement in safety and security.

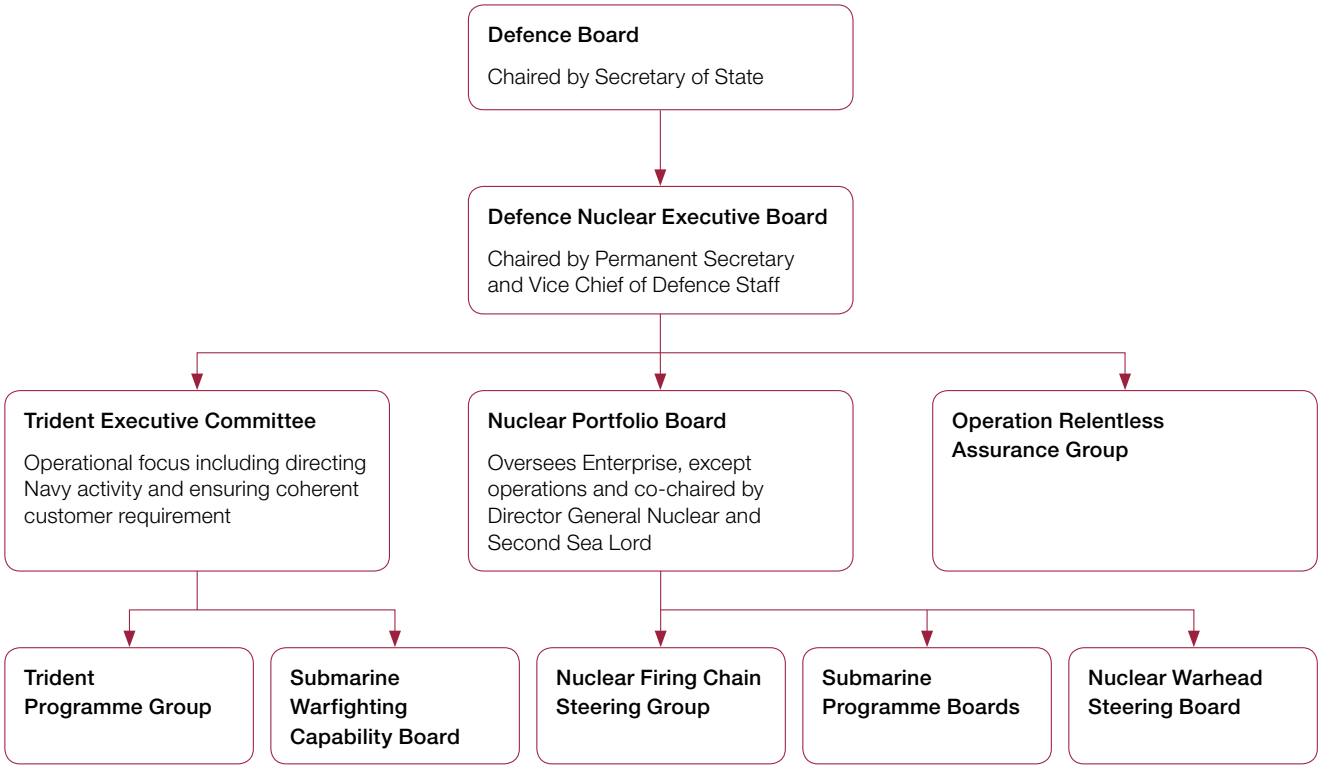
2.12 The Royal Navy (the Navy) operates the submarines and provides the people and training needed for in-service submarines. The SDA manages the contracts to support in-service submarines on the Navy's behalf, although it uses DE&S to source most of the required parts. The Submarine Acquisition and Support Plans (SASPs) set out the programme of work and funding for the SDA. The DNO and Navy Command hold the SDA to account for their agreed SASPs through monthly reviews.

6 Top-level budgets, of which there are seven, are a financial structure within the Department.

2.13 The DNO, SDA and Navy work together through a series of boards and committees within the Department's overall governance structure (**Figure 11**). The Defence Board, chaired by the Secretary of State, holds the Permanent Secretary to account across all defence matters, and considers the strategic Enterprise risks. A sub-committee of the Board, the Defence Nuclear Executive Board, jointly chaired by the Permanent Secretary and Vice Chief of Defence Staff, focuses on nuclear issues. This Board provides strategic oversight of the deterrent and the Enterprise, and advises the Defence Board on the overall health of the Enterprise.

Figure 11
Governance arrangements across the Enterprise, May 2018

Specific boards and committees overseeing the Enterprise



Note

1 Shows direct report lines and not those providing information only.

Source: National Audit Office

2.14 The revised governance arrangements, which the Department began to develop in 2014, took 18 months to introduce after they were announced in SDSR 2015. During this period, the Department developed a new organisational structure and considered the financial delegations, flexibilities and relationships needed so the new organisations could work together. It took some time for the Department to make senior leadership appointments. For example, it first advertised the DG Nuclear role in March 2016, before it was withdrawn and re-advertised in October 2016. The post was filled in May 2017.

2.15 When it was setting up the new organisations, the Department had to make significant commercial decisions, by April 2018, to maintain a continuous at sea deterrent. These decisions included approving the second delivery phase of the Dreadnought programme, which involved entering new contractual commitments worth £960 million and agreeing to make further commitments over the next three years. It also agreed to establish a £1.5 billion contract for the seventh and final Astute-class submarine over eight years and developed new ways of working with its Dreadnought contractors.

2.16 Those we interviewed within the Department and external bodies were broadly positive about the revised governance arrangements. In particular, they considered that roles and responsibilities were now more clearly defined and the changes were a positive step towards greater trust and transparency, both internally and with contractors. However, they also recognised considerable further work was required in some areas to:

- **Increase capacity, including among senior leadership.** Both the DNO and SDA need to increase staff numbers in line with their requirements. As at February 2018, 56 of the DNO's required 184 posts (31%) were vacant. In 2017, the DNO paused recruitment to non-critical positions pending a review of its staffing requirements. As at March 2018, the SDA had 1,193 full-time equivalent staff and was reviewing its staffing requirements. It expects to increase staff numbers during 2018-19.

- **Clarify ways of working where there are two customers.** Where both the DNO and Navy are SDA customers, difficult decisions on prioritising work are needed to support the whole Enterprise.

- **Embed cultural change.** By bringing in senior staff from outside to run the new organisations, the Department aimed to introduce cultural change and encourage greater transparency and collaborative working. Those we spoke to were positive that the new leadership had begun to instil these values. The Department recognises that it needs to do more and avoid relying on a few senior individuals. Senior staff at the SDA and DNO told us that developing their organisations will be a priority for 2018.

Assurance arrangements and information within the Department

2.17 Programmes within the Enterprise are subject to the same internal scrutiny as other areas of the Department's work. For example, the Investment Approvals Committee (IAC), chaired by the Department's Director General Finance, considers all major investment proposals on behalf of the Defence Board. The IAC considered the highest-value and most contentious aspects of the Enterprise 120 times in the five years between 2013-14 and 2017-18. This is just over half of maritime-related submissions.[7] The IAC has iteratively reviewed programmes by considering 55 programme updates, 37 notifications of past decisions being exceeded and 28 formal business cases for their approval. In some cases, the IAC requested further information before making a decision; for example on Dreadnought and Astute-class submarine production before approving the proposals in March 2018. It does not collect data on how often this occurs.

2.18 The Department uses other assurance mechanisms across the Enterprise. These include:

- **Defence Internal Audit (DIA)**

  Since 2012, the DIA has produced three reports on the Enterprise. It has developed a three-year audit plan with 16 proposed DNO audits (five on individual contracts) and 11 SDA audits.

- **Cost Analysis and Assurance Service (CAAS)**

  CAAS provides expertise to support teams in pricing work and challenges teams' forecast cost estimates. In 2017-18, CAAS produced independent cost estimates for 13 SDA equipment and support programmes, covering 90% of its programme costs.

- **Directorate of Financial Planning and Scrutiny**

  This Directorate scrutinises and advises on, for example, the business cases for major procurement and support programmes.

- **Directorate of Operational Capability**

  This military team audits defence capabilities to identify lessons from operations and training. It last assessed the Enterprise in 2015.

7 The Department's top-level budgets, such as the DNO and Navy Command, consider those lower-value and less contentious programmes and decisions.

Part Three

Managing the Enterprise

3.1 Our past reports on complex programmes, including the 2008 report on the nuclear deterrent, have highlighted common risks concerning costs, commercial relationships, people and timeframes.[8] This part describes how the Ministry of Defence (the Department) approaches these core aspects of programme management across the Nuclear Enterprise (the Enterprise).

Managing costs

3.2 Most Enterprise spending – 96% of the 2018-19 forecast costs – relates to long-term equipment procurement and support programmes. In spring 2018, the Department forecast the Defence Nuclear Organisation (DNO) would spend £43.9 billion on these programmes between 2018 and 2028, with Navy Command (the Navy) spending £6.7 billion and Joint Forces Command spending £355 million (**Figure 12** overleaf).

3.3 The Department forecasts the costs of the Enterprise to help identify how much money it needs to request from HM Treasury. As we recognised in 2008, doing this with a high degree of confidence for complex equipment programmes, such as submarines, can be difficult given the uncertainties involved. The Department expects its forecast costs to change as programmes develop and the underlying risks and economic assumptions become clearer. We have previously highlighted significant increases for both the Dreadnought and Astute-class 10-year forecasts in our annual Equipment Plan report.[9] These increases stemmed from changes in labour and overhead costs, design changes and more accurate forecasting.

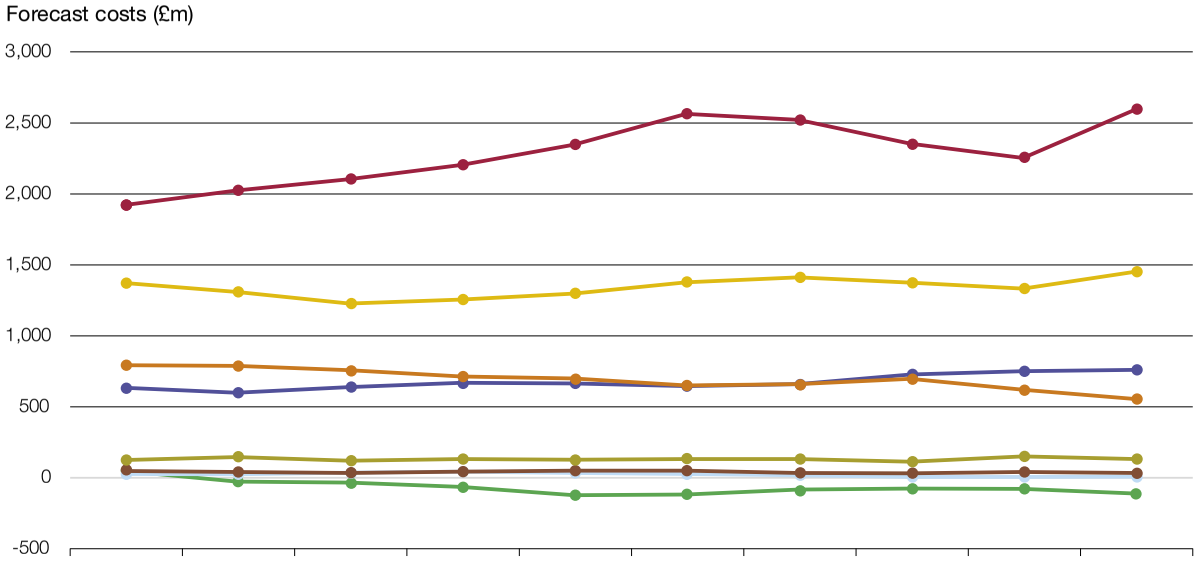
3.4 In the last two years, the Department's expenditure on the Enterprise has been within 2% of the allocated budget. It has previously recognised and managed affordability concerns across its nuclear programmes. For example, in July 2016 it approved the first Dreadnought build phase, recognising the programme was unaffordable within budget at that time. It has also cut costs, for example, by delaying construction of a submarine refit centre, suspending the defueling of submarines and seeking additional funding to complete the seventh Astute-class submarine. In 2017-18, the Department also brought forward £300 million for DNO to spend on Dreadnought production.

8 Comptroller and Auditor General, *Capability in the Civil Service*, Session 2016-17, HC 919, National Audit Office, March 2017; *Modernising the Great Western railway*, Session 2016-17, HC 781, National Audit Office, November 2016.
9 Comptroller and Auditor General, *The Equipment Plan 2017 to 2027*, Session 2017-19, HC 717, National Audit Office, January 2018.

Figure 12

Enterprise equipment and support programmes 10-year forecast costs, 2018 – 2028

The Department expects to spend £50.9 billion across its programmes



	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Submarines	1,920	2,022	2,101	2,203	2,346	2,562	2,521	2,352	2,251	2,593	**22,872**
Strategic weapons and warhead	1,370	1,307	1,225	1,254	1,295	1,374	1,408	1,373	1,329	1,448	**13,384**
Nuclear propulsion	789	785	755	711	695	645	655	694	615	550	**6,893**
Navy support programmes	630	594	635	666	660	641	655	724	747	756	**6,707**
Nuclear liabilities	121	140	115	127	122	126	127	107	146	126	**1,257**
Joint Forces Command programmes	43	35	29	37	46	46	29	27	35	28	**355**
Information Systems and Services	23	19	30	39	29	20	12	1	1	2	**175**
Efficiencies, adjustments and other	43	-33	-40	-70	-127	-123	-88	-82	-85	-117	**-722**
Total	**4,939**	**4,869**	**4,850**	**4,966**	**5,065**	**5,293**	**5,318**	**5,195**	**5,039**	**5,386**	50,920

Notes

1 Support costs included in 'Submarines'.

2 Figures do not sum due to rounding.

Source: National Audit Office analysis of departmental data

3.5 To inform the 2018-19 funding round, in summer 2017 the Department sought to develop a more coherent and realistic understanding of the DNO costs through a bottom-up review of equipment and support programmes. This work gathered the views of programme teams about costs over the next 10 years, based on identified risks and particular costing scenarios. The exercise involved:

- **Revisiting the confidence levels used for programmes**

  Previously, forecasts were based on a 50% chance of programmes costing more or less than the forecast. Other complex programmes such as Hinckley Point C, the civil nuclear power station, estimate costs at the 80% confidence level. After reviewing the appropriateness of confidence levels, 48% of projects within the exercise were costed on a 'most likely outcome' basis, and 17% of the projects were costed at the higher confidence level of 70%.

- **Applying common standards**

  Programme teams previously costed risk and uncertainty differently. During the 2017 exercise, teams applied a common approach to costs and assumptions, such as pay rates and contractors' performance, and were encouraged to be realistic about risks.

- **Considering Navy-controlled programmes**

  The Navy provided information on operational assumptions, such as in-service dates, and ensured that assumptions were coordinated. It produced its own cost estimate alongside the SDA, but did not conduct a similar bottom-up costing exercise.

- **Review by the Department's independent cost assurance team**

  After reviewing 90% of the SDA's programme costs, the team forecast a 3% higher cost. This resulted from different views on submarine design maturity, the schedule, efficiencies and contractor engagement.

3.6 On the basis of the summer 2017 review, the Department developed detailed cost forecasts for DNO's procurement and support programmes, including the warhead. For the Dreadnought programme, the review considered ways to reduce costs and also re-profiled costs, increasing forecast spending by 26% in the first four years. The aim of this was to keep the programme on schedule and within the £31 billion Strategic Defence and Security Review (SDSR) 2015 forecast whole life cost commitment.

3.7 Using the 2017 review as a baseline, the Department subsequently reached a formal departmental forecast cost position of £43.9 billion over the next 10 years for its DNO equipment and support programmes. Comparing these cost forecasts against its final agreed budget, after reflecting agreed budget increases, created a £2.9 billion affordability gap (**Figure 13**). In developing this position, the Department:

- **reduced costs by delaying programmes and altering requirements.**

  The March 2018 decision to delay by two years the development of a replacement for the Astute-class removed £1.2 billion of costs. In addition, the Department reduced the Astute-class acquisition support costs from £590 million to £430 million over the project lifetime.

- **agreed with HM Treasury that they would have access to up to £600 million in 2018-19 from the £10 billion Dreadnought contingency announced in the SDSR 2015.**

  The Department expects to use this to 'de-risk' the programme, maintain the build schedule, and ensure the programme remains within the total £31 billion lifetime cost commitment also set out in the SDSR 2015.

- **included commitments to deliver existing efficiency requirements.**

  This included the Submarine Enterprise Performance Programme and £669 million of warhead savings (**Figure 14** on page 38). Should the Department be unable to meet this target, it will need to consider additional measures to make the Enterprise affordable.

3.8 Looking beyond 2018-19, the Department's Modernising Defence Programme (MDP) will consider further options across its nuclear programmes to address the remaining £2.7 billion affordability gap, representing 6% of its forecast cost over the nine years. As part of the MDP, the Department will consider how to use the Department-controlled nuclear contingency. We have previously reported that the Department allocated £580 million of this contingency to the DNO in the three years up to 2019-20, which has been reflected in the Department's agreed costing position. It has a further £1.1 billion of nuclear-related contingency it could allocate from 2020-21 to 2027-28.

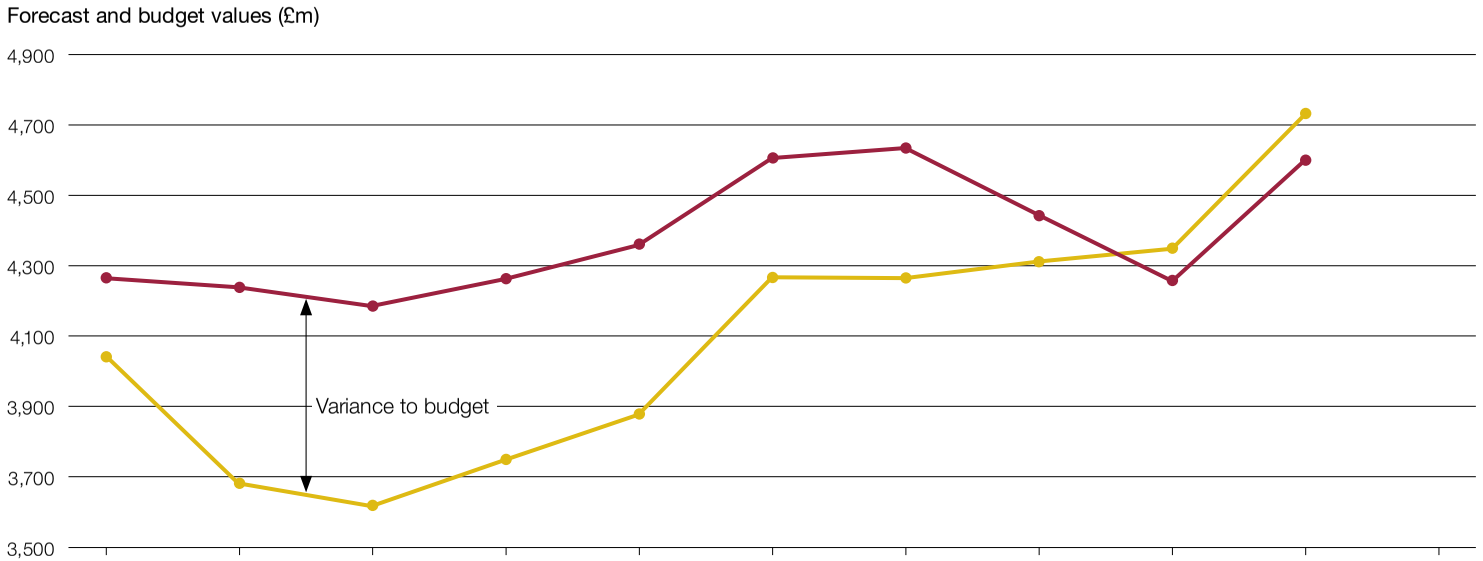
3.9 If the Department were to access the full £600 million it has agreed with HM Treasury that it can take from the Dreadnought contingency in 2018-19, £9.4 billion would remain. The Department will need to agree with HM Treasury under what conditions it can access the remainder if it is required.

3.10 The overall cost, size and complexity of Enterprise programmes mean they have the potential to affect the affordability of the overall Equipment Plan. For example, the £941 million increase that we reported in January 2018 for both Astute-class and Dreadnought-class submarines, represented 52% of the overall increase in the Equipment Plan from 2016-26 to 2017-27. Nuclear programmes represent around a quarter of the Department's overall spend in the Equipment Plan.

Figure 13

Variance between the DNO equipment and support programme forecast costs and budgets, 2018–2028

There is currently a £2.9 billion variance between the Department's agreed forecast costs and its budget



Annual variance between budget and forecast cost	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Forecast cost	4,266	4,240	4,186	4,263	4,359	4,606	4,634	4,444	4,257	4,603	**43,859**
Budget	4,049	3,684	3,620	3,751	3,879	4,268	4,266	4,313	4,349	4,732	**40,911**
Variance to budget	217	555	567	513	480	338	369	131	-92	-130	**2,948**

Note

1 Does not include Joint Forces Command and Navy Command equipment and support programmes.

Source: National Audit Office analysis of departmental data

Figure 14
Target and forecast Enterprise efficiencies, 2018–2028

The latest Enterprise funding bid includes £3 billion of efficiency targets

	Target (£m)	Forecast (£m)	Variance (£m)
Targets included in the Equipment Plan			
Strategic Defence and Security Review 2015	1,323	646	677
Submarine Enterprise Performance Programme (SEPP) – Built into BAE Systems, Rolls-Royce and Babcock contracts	982	602	380
Sub-total	**2,305**	**1,248**	**1,057**
Targets outside the Equipment Plan			
Atomic Weapons Establishment	669	n/a	n/a
Total	**2,974**		

Notes

1 Partially covers £2.3 billion identified in the Department's £16 billion Equipment Plan efficiencies target for 2017 to 2027, for which the SDA will be responsible.

2 SEPP includes four years, £208 million, of the remaining Equipment Plan target, with £774 million from 2022-2023 onwards.

Source: National Audit Office analysis of departmental data

3.11 The Department also needs to manage its long-term Enterprise costs, including for decommissioning and disposing of dockyards, nuclear-licensed sites and 30 submarines. As at March 2017, these liabilities were estimated at £10.3 billion over the next 120 years (**Figure 15**). Over the past three years, the value of nuclear liabilities has increased by 186%, following changes to HM Treasury's discount rates, the inclusion of new provisions and updated estimates. The Department expects the estimated liability to vary with changes to HM Treasury's discount rate guidance.

Managing contractors

3.12 During 2017-18, the Department had 201 active contracts, valued at £48.9 billion, across the Enterprise. They covered building and maintaining submarines, and designing and building nuclear propulsion systems and warheads. Given the specialist requirements, only a small number of contractors can usually undertake Enterprise-related work. During 2017-18, the Department had contracts with 74 companies, of which 50 were UK firms, or subsidiaries of UK firms. The remaining 24 are non-UK firms or subsidiaries of non-UK or mixed parent companies.

Figure 15

Summary of the Department's nuclear liabilities over 120 years

The Department's nuclear-related liabilities have increased significantly

Liability	As at 31 March 2018 2015 (£m)	2016 (£m)	2017 (£m)	Description
Fuel management and disposal	550	2,335	2,678	Management of nuclear fuel and removal and reduction of nuclear waste.
Geological Disposal Facility	383	1,305	1,329	Storage of medium- to high-level nuclear waste.
Nuclear propulsion	72	145	141	Includes the core production capability and test reactor.
Site decommissioning and disposal	1,794	3,213	2,773	Covers nuclear-licensed sites and Navy bases.
Submarine decommissioning	176	1,827	1,931	Decommissioning 30 submarines.
Submarine defuel and disposal	625	1,535	1,393	Defueling and disposal of all submarines.
Other	0	57	61	
Total	**3,600**	**10,417**	**10,306**	

Note

1 Values are rounded and best estimates at a point in time.

Source: National Audit Office

3.13 The Department's policy is to pursue open competition for its contracts wherever possible. In 2014, it introduced the Single Source Contract Regulations to ensure it secures better value for money where competition is not feasible. These regulations should apply to all Enterprise-related contracts agreed after 2014 and those undergoing significant amendment. The Department's contracts include a £25 billion contract for managing the Atomic Weapons Establishment (AWE), which it renewed non-competitively in 2008 given programme risks and supplier confidence.[10] Of the remaining contracts, 77% by value were procured through a single source, compared with 57% of all the Department's contracts valued at over £400 million.

10 Contract currently valued at an estimated £20 billion which may change as it is re-negotiated each year.

3.14 Currently, four contractors hold 97% by value (£47.3 billion) of Enterprise-related contracts (**Figure 16**). They won 83% of the Department's competitively let contracts and 96% of the single source procurements after removing the 2008 AWE contract. Dependence on a small number of specialist contractors brings challenges. We noted in our 2008 report the difficulties the Department has in giving monopoly contractors incentives to deliver work to time and cost.

3.15 The Enterprise is supported by an estimated 1,500 sub-contractors. During 2018-19, the SDA plans to review the role and interdependencies between its sub-contractors. Many are small and specialist businesses providing bespoke products, and the intermittent and long-term nature of many nuclear programmes creates risks for them.

3.16 Since 2014-15, the Department has become increasingly aware that poor performance by contractors has affected the time, cost and quality of its nuclear programmes. Along with the Infrastructure and Projects Authority (IPA), it assesses contractors' performance as a high risk to programme delivery for the Dreadnought-class, Astute-class and nuclear core production programmes. On the Dreadnought programme, the Department found that commercial arrangements did not provide incentives for contractors to complete work on schedule and within budget, or to perform as needed. On Astute, contractors saw their profits fall for the first four submarines as a result of poor performance. Following this, contractors' performance has improved with Rolls-Royce delivering several key components ahead of schedule in 2017 and BAE Systems meeting overall targets at the start of 2018.

3.17 The Department must also meet its own commitments as a supplier. It frequently provides its contractors with parts and skilled personnel. For example, the Department provides around one-third of the parts to BAE Systems to build the Dreadnought-class submarines. It also supplies parts provided by other governments and contractors, such as the nuclear propulsion system that it will receive from Rolls-Royce, to be passed on to BAE Systems. The Department is liable for managing the risk of Rolls-Royce not delivering the components to time or quality.

3.18 The Department has considered different ways to manage its contracts and improve contractors' performance. For example:

- **Atomic Weapons Establishment**

  In 2016, the Department sought to improve its oversight by revising its contract with AWE Management Limited. It split the work into five areas, each with incentives and milestones: warhead and core capability, infrastructure, capital projects, nuclear threat reduction, and leadership and integration.

- **In-service support**

  The Single Source Contract Regulations provide the Department with greater insight into contractors' costs and activities. The Department told us that this meant it had been able to apply the contract terms more rigorously.

Figure 16
Main Enterprise contractors, 2017-18

Four contractors hold 97% of the Enterprise-related contracts by value

Contractor	Total value (£m)	Proportion by value of nuclear-related contracts (%)	Includes	Contract duration (years)	Value (£m)
AWE Management Limited	£25,430	52	Management and operation of three sites and delivery of the Nuclear Weapons Capability Sustainment Programme	1999–2024 (25)	25,315
BAE Systems	£12,978	27	Five contracts covering production of Astute-class submarines 4–7	Covering range 1997–2025 (28)	9,279
			Two contracts for design and initial production of Dreadnought-class submarines	2011–2023 (11)	3,051
Rolls-Royce	£4,686	10	In-service support and decommissioning for nuclear propulsion systems	2007–2019 (12)	1,213
			Two contracts for design and production of new propulsion system for Dreadnought	Covering range 2009–2022 (13)	1,082
			Upgrade to site facilities to enable continued production of nuclear cores	2012–2023 (11)	938
			Foundation contract	2013–2022 (9)	551
Babcock International	£4,182	9	Provision of support and maintenance to in-service submarines	2014–2020 (6)	2,960
			Overhaul and upgrade to HMS Vengeance	2012–2018 (6)	283
			Overhaul, upgrade and refuel of HMS Vanguard	2016–2019 (4)	204
Other	£1,634	3			
Total	**£48,910**	**100**			

Notes

1 Figures do not sum due to rounding.

2 BAE Systems, Rolls-Royce and Babcock International include contracts held by their subsidiaries.

3 AWE Management Limited comprises Lockheed Martin Corporation, Jacobs Engineering Group and Serco Group. Contract value provides the Department's initial estimate of the overall contract value at the start of the contract. This will change with annual contract renegotiations. As at March 2018, the Department valued the contract at £20 billion.

4 Does not include contracts signed by the Department in late March 2018.

Source: National Audit Office analysis of departmental data

3.19 The most significant change to how the Department manages contractors affects production of the Dreadnought-class submarine. Following an internal review in 2014-15, the Department, Rolls-Royce and BAE Systems agreed to work towards establishing an overarching commercial agreement and coordinated incentives, which it describes as the 'alliance'. The arrangements have evolved and differ from the Department's initial aspiration. The new ways of working, effective from April 2018, consist of:

- the SDA continuing to agree bilateral contracts with contractors;
- a managing director, supported by a management committee, responsible for the day-to-day running of the alliance and accountable for delivering Dreadnought. They will set cost and schedule baselines, authorise under/overspends, challenge contractor performance and develop a procurement strategy;
- a leadership board, involving all three organisations, to govern the alliance on behalf of all the parties and hold the managing director to account;
- a shared cost model; schedule and breakdown of work; and reporting arrangements; and
- an incentive scheme, linked to an agreed percentage profit variation, weighted to achieving milestones where two or more members need to work together.

3.20 The Department believes these arrangements will improve information-gathering, cost control and contractor performance. It hopes to move towards a more integrated model as the Dreadnought programme matures.

Managing people and skills

3.21 Having insufficient skilled staff remains a risk across the Department, and mitigating this risk is one of the Navy's top three priorities. The Enterprise depends on civilian and military staff within the Department and industry to design, build and safely operate nuclear submarines, systems, weapons and the supporting estate. These people have a wide range of skills and expertise, including those skills specific to the Enterprise. Since 2014-15, the Defence Nuclear Safety Regulator has identified that sustaining sufficient civilian and military nuclear staff remains one of the Enterprise's top strategic issues.

Nuclear specialists

3.22 Government and industry expect that the shortage of both civil and military nuclear skills, which they have experienced for some time, will continue. They recognise the need to close this gap. This shortage includes manufacturing and project management roles, as well as highly skilled scientific and engineering roles. A diverse range of nuclear skills are required across the United Kingdom, including at eight civil and military sites in Scotland.

3.23 In 2017, government and industry predicted a growing demand for the nuclear workforce from 88,000 in 2017 to a peak of 101,000 in 2021 (**Figure 17** overleaf). For this period, it would mean an additional 7,000 full-time equivalent staff a year are needed up to 2021, doubling the current inflow, of which around a quarter would need to be highly skilled scientists and engineers.[11] The government has prepared a defence and civil industry national nuclear skills strategy.[12]

3.24 The Department has had long-standing gaps in skilled military nuclear personnel.[13] In January 2018, it identified a shortage of 337 skilled personnel across seven nuclear trades and specialisms. These included nuclear marine engineers and weapons engineers. It assessed five of these shortages as having at least a 'high impact' on operations, meaning they regularly placed demands on staff – such as cancelling leave and training – to maintain operations.

3.25 The shortfall in nuclear skills has resulted from:

- **a decline in activity** across both the defence and civil nuclear sectors in recent decades, leading to a skills shortage and an ageing workforce;
- **the time needed to develop nuclear specialists,** which, depending on the skills required, can take between five and 12 years; and
- **increased competition for skills** arising from recent investment in both civil and military nuclear projects.

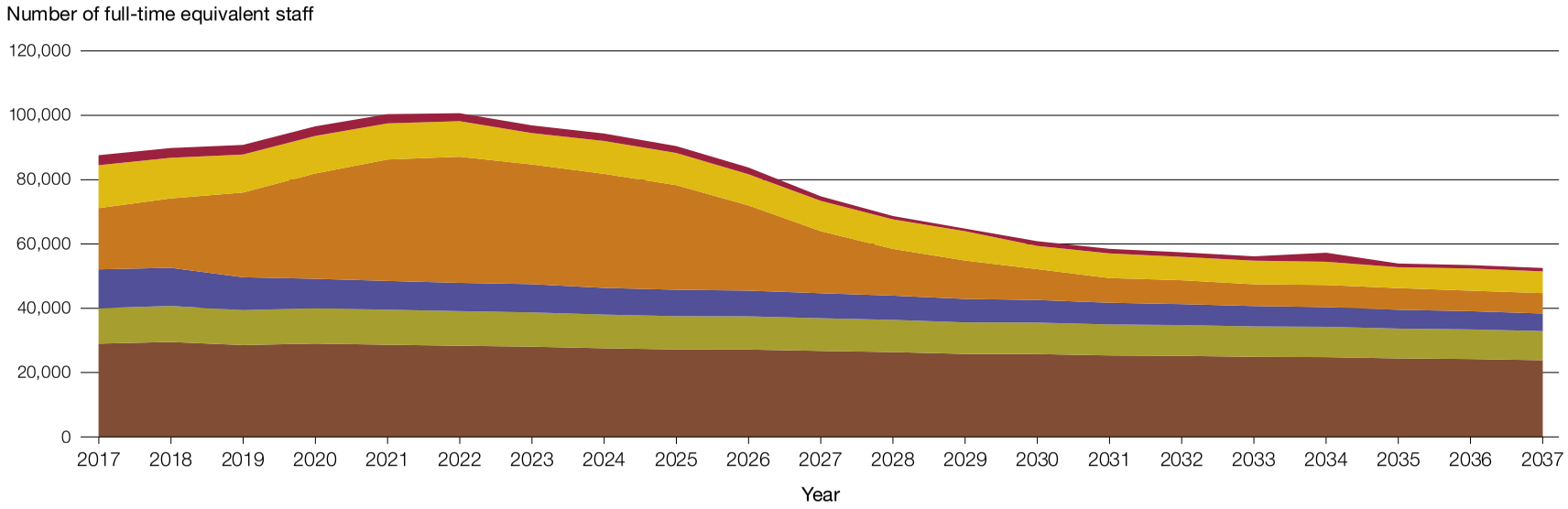
3.26 The Department acknowledges that it has shortfalls, and the Navy has, over the last three years, introduced initiatives to address them. In particular, it has:

- established a dedicated submarine recruitment team;
- developed Navy-based schemes, including for graduates and apprenticeships, to speed up development of nuclear marine engineers;
- increased numbers by, for example, bringing in people from ships to become submariners, offering service extensions and using reserve forces for more critical trade shortages;
- introduced financial and non-financial incentives for nuclear specialists, leading to increased retention;
- started consolidating all submarine-related training and operations into a new centre at Her Majesty's Naval Base Clyde; and
- requested an additional crew of submariners to provide resilience.

11 Highly skilled assessed as those being broadly above NVQ level 5 based on their skills, knowledge and experience.
12 Nuclear Skills Strategy Group, *Nuclear Skills Strategic Plan*, December 2016.
13 Comptroller and Auditor General, *Recruitment and retention in the Armed Forces*, Session 2005-06, HC 1633-1, National Audit Office, November 2006.

Figure 17
National skills requirement, 2017 to 2037

The demand for nuclear specialists will peak in 2021



Notes

1 Other includes full-time equivalent staff based in headquarters and research and development. Manufacturing includes those involved in generation activities.

2 Measured as full-time equivalent staff for one year.

3 Data relates to 1 October 2016.

4 Based on civil new builds across five sites with an expected electrical generating capacity of 16 Gigawatts.

Source: Nuclear Skills Strategy Group, *NESA Nuclear Workforce Assessment 2017*, November 2017

3.27 The Department has also struggled to attract people with commercial, programme management and project controls skills. Our 2008 report highlighted shortages across both the Department and its contractors, and the Department recognised significant gaps in financial, programme, commercial and technical controls in 2016. Recently, the IPA has identified that the SDA team in Barrow and Bristol needs to grow, with a significant injection of commercial and project control specialists required.

3.28 As at March 2018, the Department used 80 contractors to fill gaps in the SDA. It does not use contractors to fill gaps in the DNO, and expects to spend £6 million in 2018-19 for consultancy expertise. The Department's terms of employment vary between different parts of the organisation. For example, pay caps in the civil service affect the salaries and benefits the DNO can offer, but the SDA has been set up with similar pay freedoms to DE&S, and so has more flexibility in the packages it can offer.

Managing complex programmes to a fixed timetable

3.29 The Department needs to bring together at the right time the submarines, people, infrastructure and weapons required to maintain the continuous at sea deterrent. It manages around 75 programmes that must be carefully sequenced so that interdependencies are identified and managed.

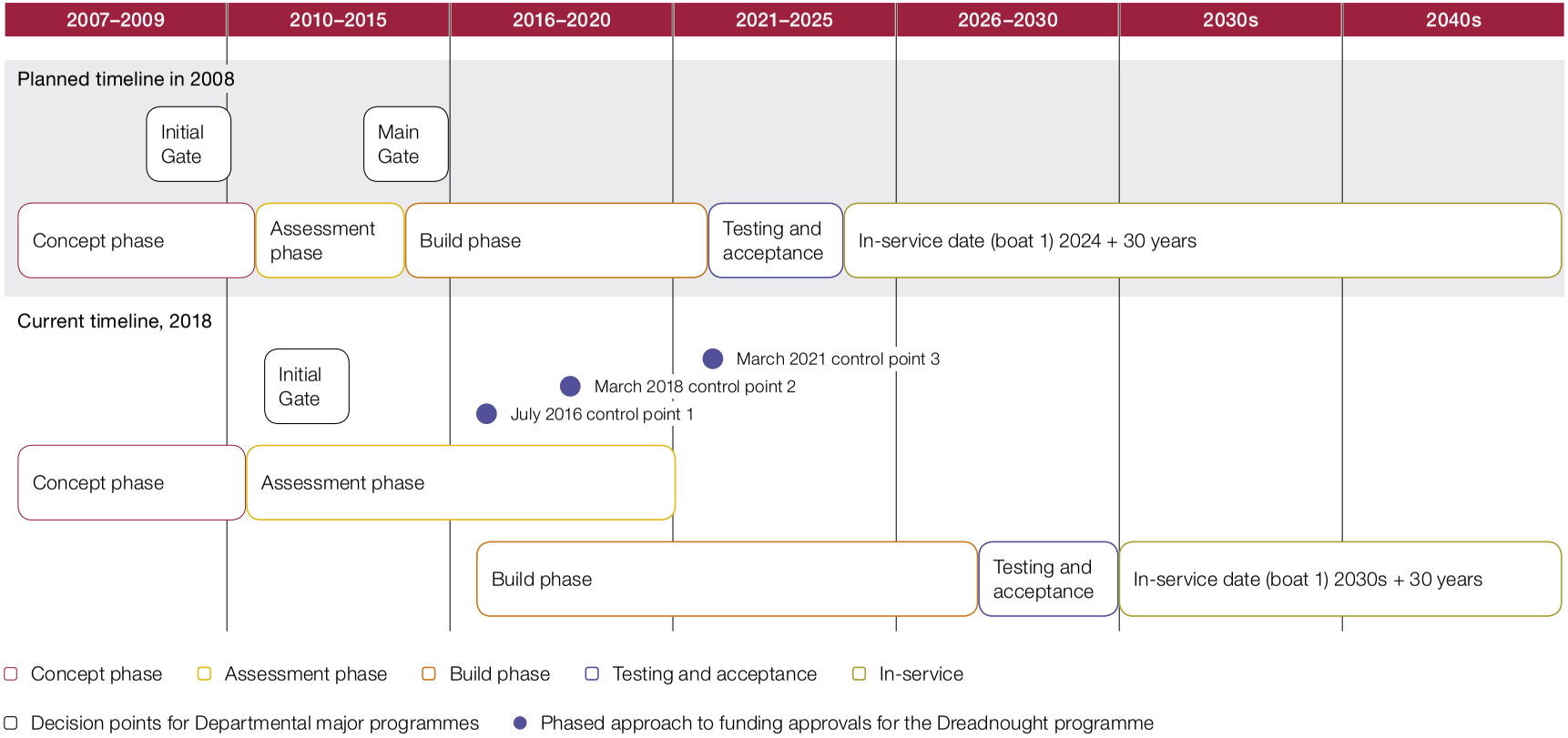
Bringing submarines into service

3.30 In 2008, we reported that the Department had to bring into service the first of its new deterrent submarines by 2024, in line with its then expected end-of-service life for the Vanguard class. At that time, the Department estimated that it could extend the life of these submarines safely until then.

3.31 In 2010, the Department established that a 2024 in-service date for the Dreadnought class was unlikely and changed its timetable (**Figure 18** overleaf). This arose from delays developing the design and engineering requirements, and securing cross-government agreement. Delaying the in-service date has impacts across the Enterprise. It means, for example, keeping the Vanguard-class submarines in service for longer. As the first Vanguard-class submarines entered service in 1993, they will need to be operated for at least 37 years. This is longer than their 25-year design life and longer than any previous nuclear submarine. The Department currently estimates to spend £400 million over the next 10 years on a life-extension and optimisation programme aimed at ensuring these submarines can continue to be used safely.

Figure 18
Comparison of Dreadnought-class schedules, 2008 and 2018

The schedule for delivery of the new deterrent submarines has changed



Notes

1 Concept phase: selected a submarine as the basis for the continuous at sea deterrent.

2 Assessment phase: considered options, user requirements and programme design.

3 Build phase: Following SDSR 2015, HM Treasury and the Department agreed an alternative approvals process reflected in the current timeline. This established three control points aligning with build phases to manage funds in shorter timeframes control point.

4 In-service date: submarines handed over to the Navy.

Source: National Audit Office analysis of departmental data

3.32 The Department's ability to meet submarine production timetables depends on factors such as whether the submarines currently in production are built on time (**Figure 19** overleaf). BAE Systems is constructing both types of submarines at its Barrow shipyard, using the same docks and people. The Department brought into service the first three of its seven Astute-class submarines an average of 19 months late, and the remaining four are an average of 27 months behind schedule.

3.33 Delays in other programmes across the Enterprise may affect the build of the Astute class. Refuelling HMS Vanguard resulted in delays as a core component was diverted to HMS Vanguard. It also affected the cost and timeframes for the Department's programme to defuel decommissioned submarines, leading to a £4 million, six-month delay, and its programme to upgrade the facilities required to produce nuclear reactor cores.

Infrastructure

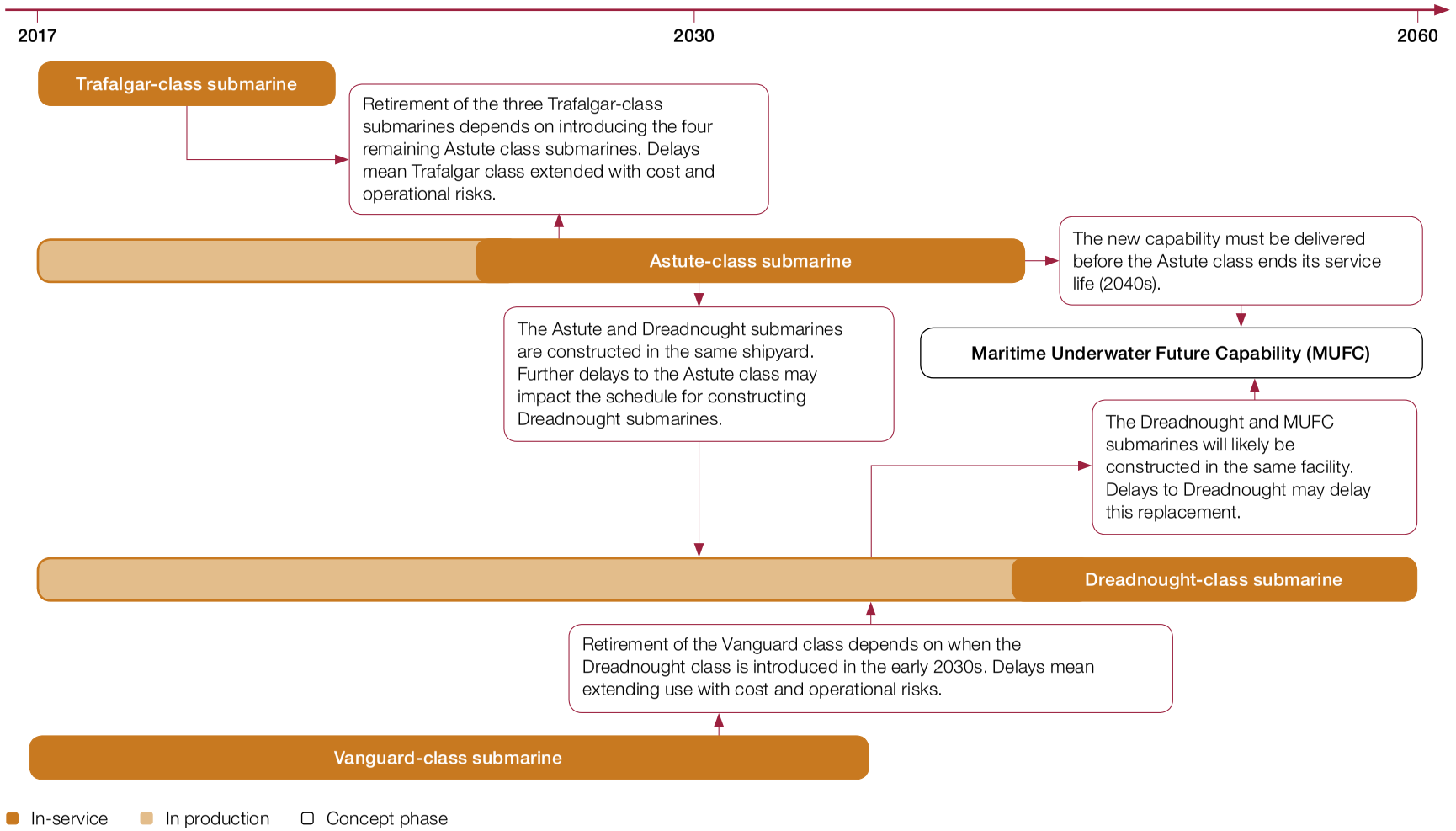
3.34 To maintain and decommission its submarines, the Department needs capacity and capability across its built estate. The Department has identified a shortfall in dockyard capacity, meaning it would not have the space to conduct scheduled deep maintenance on the Astute-class submarines in the early 2020s or on the first Dreadnought class in the early 2040s.

3.35 In considering the infrastructure it needs, the Department is examining how the interdependencies between programmes impact its requirements. For example, across its Devonport estate the Department is considering a work programme, estimated to cost around £1 billion, to address dock availability. This includes for:

- **Maintaining and defueling larger deterrent submarines.** The site currently has only one dock that is suitable for maintaining and defueling deterrent submarines. The Department needs this to both maintain its Dreadnought submarines and to defuel the Vanguard class as they retire. The Department is considering upgrading another dock so that it can undertake these activities simultaneously.
- **Maintaining its attack submarines.** The Department may need to upgrade an existing dock to nuclear regulatory standards so it can be used to maintain attack submarines.
- **Defueling its attack submarines.** As a result of savings measures, the Department paused work on upgrading a dock so it could defuel attack submarines. The Department has since realised that it cannot complete this work until it has decided on the work required to upgrade its neighbouring attack submarine maintenance dock. The Department has a backlog of nine submarines that will need to be defueled, and then disposed of, so there will be space for the Vanguard and Astute-class submarines when they leave service.

Figure 19
Interdependencies between submarine production timetables

The Enterprise programmes have a large number of interdependencies



Note

1 Submarine service dates are indicative.

Source: National Audit Office

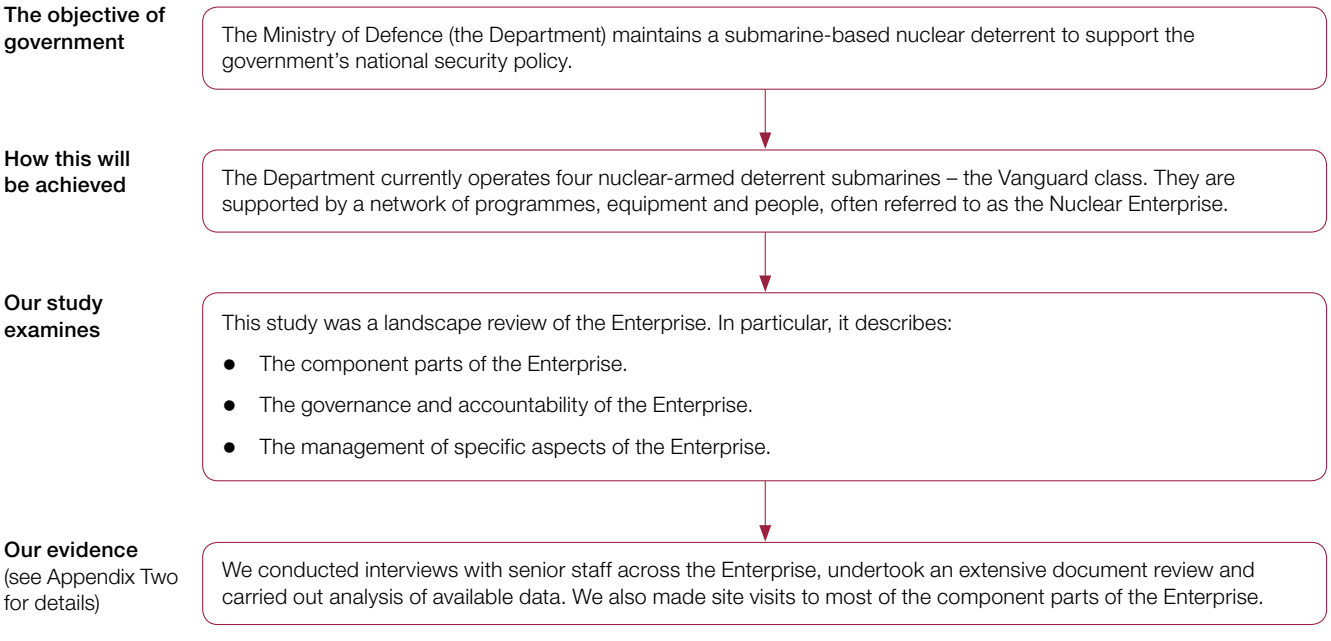
Appendix One

Our audit approach

1 This landscape report was prepared to help Parliament better understand one of government's most complex and costly programmes. It does not evaluate the value-for-money of the Nuclear Enterprise (the Enterprise) and its programmes, or comment on the overarching policy. Our audit approach is summarised in **Figure 20**. The report:

- describes the policy context and the elements that make up the Enterprise;
- details the organisations and bodies through which the Enterprise is governed, and recent reforms; and
- sets out how the Department is managing the Enterprise and some of the issues it faces in doing so.

Figure 20
Our audit approach



Appendix Two

Our evidence base

1 Our review of the Nuclear Enterprise (the Enterprise) was primarily based on evidence gathered in 2016 and between December 2017 and March 2018. Our audit approach is outlined in Appendix One.

Interviews and visits

2 We conducted semi-structured interviews with:

- project teams in Defence Equipment & Support (DE&S) and the Submarine Delivery Agency (SDA);
- senior staff in the Defence Nuclear Organisation within the Ministry of Defence (the Department);
- senior staff in Navy Command in Portsmouth and Faslane;
- representatives of contractors including BAE Systems, Rolls-Royce, Babcock International and AWE Management Limited;
- teams in the Department's Head Office – central finance and Defence Internal Audit;
- Infrastructure and Projects Authority and UK Government Investments;
- HM Treasury; and
- United States Department of Defense and Department of Energy.

3 We also visited the majority of the locations associated with the Enterprise including: Her Majesty's Naval Base Clyde, the Atomic Weapons Establishment Aldermaston, BAE Systems Barrow, Rolls-Royce Raynesway, DE&S and the SDA in Bristol, and the Devonport Royal Dockyard.

Document review

4 We reviewed a wide range of documentation from across the Enterprise, including board and committee papers, organisations' terms of reference, organisational structure documents, investment approval submissions, Defence Internal Audit reports, Defence Nuclear Safety Regulator reports, programme reviews, business cases, presentations, published National Audit Office reports and analysis papers.

Data analysis

5 We analysed cost data relating to the Enterprise, including those from programme teams at the Submarine Delivery Agency, the previous Equipment Plans, the Department's Annual Report and Accounts 2016-17, internal costing reviews and final agreed cost positions, historical financial data, investment approval committee submissions and the Cost Assurance and Analysis Service independent cost estimates and reviews. We also analysed departmental data on nuclear-related contracts, the quality of which we reported on in 2017, and infrastructure programmes.[14]

14 Comptroller and Auditor General, *Improving value for money in non-competitive procurement of defence equipment*, Session 2017–2019, HC 412, National Audit Office, October 2017.

Appendix Three

Roles of organisations within the Enterprise

Figure 21

Roles of organisations within the Enterprise

Organisation	Submarines	Propulsion	Strategic weapons	Supporting capability
Defence Nuclear Organisation (DNO) (Department Head Office)	From 2016, took responsibility for specifying, funding and overseeing the delivery of the Department's nuclear capability from the Strategic Programmes Team. Acts as the customer for the procurement of submarines, their propulsion systems and the Trident missile system. Since April 2018 has been responsible for the customer and delivery roles for the nuclear warhead. Acts as customer to the Submarine Delivery Agency (SDA).			
Navy Command	The Royal Navy is responsible for operating nuclear submarines. Navy personnel are found in all aspects of submarine activity, including their use at sea, programme management and assurance, and technical and safety regulation. Navy Command is also responsible for the operation of the UK's primary submarine base at the Clyde. Acts as customer to SDA for in-service support.	Maintains specialist technical personnel who enable the nuclear propulsion system to be operated safely and effectively while at sea.	Maintains specialist technical personnel who enable the strategic weapons system to be operated safely and effectively while at sea.	Provides: naval bases, security forces to defend nuclear assets, and anti-submarine warfare ships and attack submarines to protect deterrent submarines.
Joint Forces Command (JFC)				Provides communications infrastructure for the operation of deterrent submarines.
Submarine Delivery Agency (SDA)	Manages submarine programmes and contracts with teams involved in submarine construction and support; production; future submarines (primarily Dreadnought); and in-service submarines. This role was previously carried out by the Submarine Operating Centre in Defence Equipment & Support. Acts as delivery body to DNO and Navy Command.	Manages programme delivery and commercial relations with contractors, as well as acting as the delivery body to DNO and Navy Command.	Manages the UK's pool of Trident missiles and supporting equipment. Responsibility for the nuclear warhead was transferred from this team to the DNO as part of the Department's organisational reforms.	

Figure 21 *continued*
Roles of organisations within the Enterprise

Organisation	Submarines	Propulsion	Strategic weapons	Supporting capability
Industry				
Babcock International	Primary contractor for submarine maintenance, owns and operates Devonport dockyard, and has a presence at HMNB Clyde where operational submarines receive routine maintenance and upkeep.	Maintenance, repair and, in some cases, refuelling and defueling of submarines.		
Rolls-Royce		Only UK contractor capable of designing and manufacturing nuclear propulsion systems. Owns and operates the only UK site (Raynesway) where this can be undertaken.		
BAE Systems	Primary contractor for the construction of nuclear submarines. Owns and operates the only UK shipyard (Barrow) licensed to design and build nuclear submarines.			
AWE Management Limited			A consortium of Lockheed Martin, SERCO and Jacobs Engineering, which operates the Atomic Weapons Establishment (AWE) on behalf of the Department. AWE is responsible for the design, manufacture and support of UK nuclear warheads.	

Figure 21 *continued*
Roles of organisations within the Enterprise

Organisation	Submarines	Propulsion	Strategic weapons	Supporting capability
International partners				
United States		Provides technology, technical assistance and advice to the UK's nuclear propulsion programmes. Naval Reactors is a US government office that provides nuclear propulsion plants to the US Navy.	Provides technology, technical assistance and advice to the UK's warhead programme. Also operates a number of US nuclear laboratories that cooperate with AWE in nuclear weapon design, testing and safety. The US National Nuclear Security Administration manages the US nuclear stockpile.	
France			The UK is developing a joint programme with France (Teutates) to model performance of nuclear warheads and materials to ensure long-term viability, security and safety.	

Appendix Four

Summary of previous National Audit Office (NAO) report findings and recommendations

Figure 22

Summary of previous National Audit Office (NAO) report findings and recommendations

The NAO has commented on the Enterprise over a number of years

Findings **(recommendations)**	Trident project February 1984	Control and management of the Trident Programme July 1987
Governance and accountability	Single senior owner for many programmes Clear lines of responsibility for technical and financial elements Periodic Committee of Public Accounts reporting **Recommended need for coordination between teams**	Lack of programme coordination **Recommended need to improve project coordination**
Cost	Accurate costs difficult given uncertainties Some costs not included Represents 1–1.5% of the Defence budget, increasing to 5% by 1990 **Recommended more central approach**	Increase in work programme and Atomic Weapons Establishment costs Concern that programmes place pressure on the defence budget
Contractor	Continuing a US programme has benefits and limitations	£2,100 million of contracts awarded by end of 1986 for submarines, weapons and building works
People	Decisions made without establishing Navy requirements	Shortage of specialist skills (weapon and systems development) Atomic Weapons Research Establishment (AWRE) staffing issues led to special measures and staff transfers that had detrimental effects across the Department
Interdependencies and infrastructure		Delays and cost escalation to AWRE infrastructure projects with uncertainty in infrastructure and shoreline projects Deficiencies in planning and control of programmes

Management of the Trident works programme July 1994	The construction of nuclear submarine facilities at Devonport December 2002	The United Kingdom's future Nuclear Deterrent Capability November 2008
Lack of coordinated communication leads to programme incoherence, undermining procurement strategy	The Department needed to consider significant regulatory challenges Lessons learnt from the programme to implement in future projects	Arrangements increase the risk of cumbersome decision-making **Recommended coordinated approach with timely action from senior decision-makers across government and industry**
Cost increases due to difficulty of a tight timetable and recovery work	**Recommended the Department budgeted for the risk of contractor not delivering**	High level of uncertainty and risk of rapid cost growth **Recommended update to 2006 estimates**
	The Department late in providing contractor with information required **Recommended the Department needs to allocate risk to the party best able to manage them. Should have a joint risk register and contract early**	Strong sense of collaboration between the Department and contractors. Important to sustain and develop these relationships Monopoly suppliers in a specialised sector make it difficult to incentivise contractors and drive value for money. No way of eradicating monopoly risk but could reduce
		Issues across the Department and contractors for submarine building expertise, financial, commercial, programme management and nuclear-specific skills Navy shortages includes nuclear watchkeepers
18 of 20 top projects were at HMNB Clyde Difficulty meeting deadline due to interconnecting projects. Some are unique and complex Delays affected delivery of HMS Vanguard for sea trials	Required upgrade and construction of new facilities to enable refitting and refuelling of submarines Delays to design and construction led to recovery action, impacting the ability to refit HMS Vanguard Delays to Reactor Access House, was not completed on time for 2002	Assumption that infrastructure and facilities will be able to support future deterrent through modernisation Critical path does not include missile procurement, warhead development and infrastructure Challenging timetable given interdependencies and the Department has little time contingency The Department needs certainty on the safe extension of the Vanguard-class submarines

Figure 22 *continued*

Summary of previous National Audit Office (NAO) report findings and recommendations

The NAO has commented on the Enterprise over a number of years

Source: Comptroller and Auditor General, *Ministry of Defence: Trident project*, Session 1983-84, HC 287, National Audit Office, February 1984; *Ministry of Defence and Property Services Agency: Control and Management of the Trident Programme*, Session 1987-88, HC 27, National Audit Office, July 1987; Ministry of Defence: *Management of the Trident Works Programme*, Session 1993-1994, HC 621, National Audit Office, July 1994; *Ministry of Defence: The Construction of Nuclear Submarine Facilities at Devonport*, Session 2002-03, HC 90, National Audit Office, December 2002; *Ministry of Defence: The United Kingdom's Future Nuclear Deterrent Capability*, Session 2007-08, HC 1115, November 2008.

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