



National Audit Office

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## **Report**

by the Comptroller  
and Auditor General

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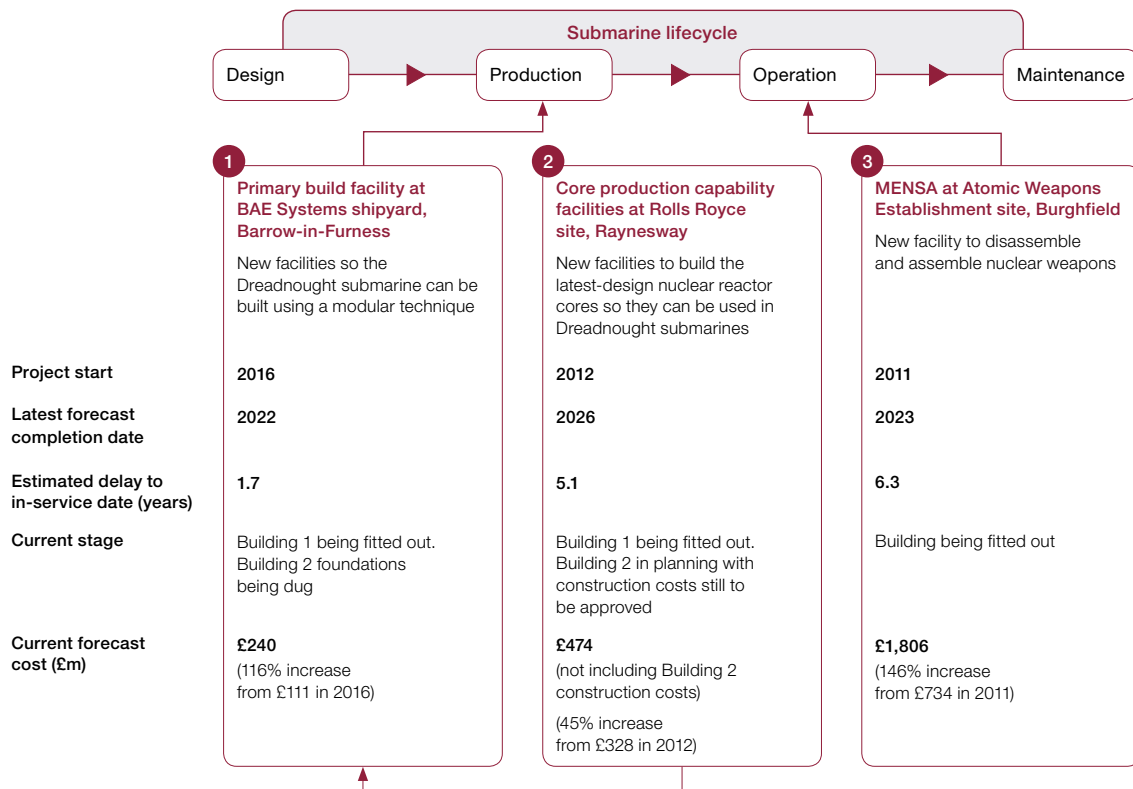
## **Ministry of Defence**

# Managing infrastructure projects on nuclear-regulated sites

# Key facts

<h2>£2.5bn</h2> <p>current forecast cost of the Ministry of Defence's three infrastructure projects under construction at its nuclear-regulated sites, October 2019<sup>1</sup></p>	<h2>£1.35bn</h2> <p>total increase (115%) in project costs between initial and latest position for the three projects reviewed</p>	<h2>£647m</h2> <p>estimate of the total cost increase across the three projects arising from the Ministry of Defence starting construction too early</p>	<h2>24%</h2> <p>percentage attributed to three projects, by their initial value, of the Ministry of Defence's 52 current Nuclear Enterprise infrastructure projects, initially valued at £4.9 billion</p>
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The Ministry of Defence's (the Department's) three infrastructure projects currently in construction at nuclear-regulated sites



**Note**  
 1 Figures cover the Ministry of Defence's three infrastructure projects at nuclear-regulated sites that are currently in the construction phase. It does not cover other projects, such as at Devonport, HM Naval Base Clyde and the Atomic Weapons Establishment Pegasus project which are in their earlier stages.

# Summary

## Introduction

**1** The Ministry of Defence (the Department) maintains a submarine-based continuous at sea nuclear deterrent to support the government's national security policy. To do so it relies on a network of equipment, people and infrastructure, often referred to as the Defence Nuclear Enterprise (the Enterprise).<sup>1</sup> The infrastructure includes sites critical to producing, installing, operating, maintaining and disposing of nuclear reactor cores and weapons. These are known as nuclear-regulated sites (sites). Some, but not all, sites are owned by the government, with several of the most significant ones owned or operated by contractors. For these sites to operate, independent regulators must provide assurance that they, and the facilities within them, can safely handle nuclear materials. This includes by having sufficiently thick walls to contain any nuclear material, and deep enough foundations to withstand an earthquake.

**2** Site regulators include the Office for Nuclear Regulation (ONR), which regulates Departmental sites licensed under the Nuclear Installations Act 1965, and the Defence Nuclear Safety Regulator (DNSR), which approves the safety of non-licensed Department-operated sites. For the construction of new facilities, the regulators carry out additional reviews, as well as providing any required legal permissions.

**3** The Department currently has a number of large and complex construction projects for facilities at nuclear-regulated sites. These include three projects, currently valued at £2.5 billion, where construction has already started. The Department is undertaking these projects for different reasons. These include replacing ageing facilities built as early as the 1950s when the UK first invested in a nuclear submarine capability. The projects we examined (see Appendix Three) are:

- **MENSA:** The Department is building a new nuclear warhead assembly and disassembly facility at the Department-owned and Atomic Weapons Establishment (AWE)-operated site in Burghfield (Reading).<sup>2</sup>
- **Core production capability (CPC) facilities:** The Department is replacing facilities at the Rolls Royce-owned and operated site in Raynesway (Derby) so it can produce the latest nuclear reactor core designs.

<sup>1</sup> Comptroller and Auditor General, *The Defence Nuclear Enterprise: a landscape review*, Session 2017–2019, HC 1003, National Audit Office, May 2018.

<sup>2</sup> AWE refers to both AWE Management Limited, the commercial entity with whom the Department contracts, and AWE Plc, who operate sites on their behalf.

- **Primary build facility:** The Department is building new facilities at the BAE Systems-owned and operated shipyard in Barrow-in-Furness (Cumbria), which will allow a modular-build approach for the Dreadnought-class submarines.

The Department is also considering further projects at nuclear-regulated sites, which include the docks in Devonport and at HM Naval Base Clyde. A further project, to build a replacement facility for storing and manufacturing enriched uranium components at the AWE-operated Aldermaston site, has been paused.

4 For nuclear-licensed sites, statutory arrangements mean that the Department does not itself have a formal regulatory role.<sup>3</sup> Under statute, the regulator ensures site operators reduce nuclear and other safety risks to levels that are as low as reasonably practicable. This involves the construction and maintenance of facilities meeting modern regulatory standards. Although the regulator and site operator recognise the need for value for money, they are not formally required to focus on this factor under statute. As the Department pays for the facilities, it is responsible for securing value for money from its contractors. These arrangements differ from those for civil nuclear projects, where the site operator, also regulated by the ONR, pays for the infrastructure, with costs then reimbursed by government and value-for-money incentives more easily created.<sup>4</sup> For the projects we examine, the nuclear regulators have continued to assess sites as safe to operate.

5 To ensure value for money during the early project stages, the Department must overcome both the inherent risks affecting all complex infrastructure projects, as well as the unique nuclear regulatory challenges. This report examines if the Department's management of these projects to date represents value for money. It assesses whether the Department works with site operators and regulators to produce cost-effective designs; if commercial arrangements transfer risks; and how these projects are managed. In doing so, it aims to set out lessons for the Department to consider when completing these projects and planning its next cycle of such projects, as well as for others managing similarly complex work.

6 Against this background, this report examines:

- progress to date with infrastructure projects on nuclear-regulated sites (Part One);
- the Department's approach to the nuclear regulatory environment (Part Two); and
- whether the Department's project management aligns with accepted programme and commercial management standards (Part Three).

Appendix One outlines our audit approach. We focus on the three projects listed in paragraph 3. We do not conclude on whether the Department's decisions to undertake these projects represent value for money.

3 For Departmental-owned and operated sites, the DNSR reports directly to the Secretary of State for Defence.

4 For the purposes of this report, reference to 'civil nuclear' relates to sites under the responsibility of the Nuclear Decommissioning Authority.

## Key findings

Performance to date

**7 None of the three projects in our review will be delivered to their original timeframe, with delays of between 1.7 to 6.3 years, and a combined £1.35 billion cost increase.** The projects all experienced cost increases and delays in their early stages, with projects for CPC facilities and MENSA being re-scoped. Given the complex nature of these programmes, a range of factors – similar to those identified across civil nuclear and earlier defence projects – contributed to the cost increases and delays. As described in paragraphs 16 to 19, the Department has since changed its project and commercial approach and has progressed each project (paragraphs 1.15 to 1.18, Figures 4 to 6).

**8 Delays and cost increases have impacted more broadly across the Enterprise.** The Department needs the facilities covered by these three projects to provide critical aspects of the Enterprise, such as the nuclear propulsion systems for submarines to operate and nuclear warheads to arm them. Delays with these projects affect the existing infrastructure, which must continue in service for longer, and the wider Enterprise. For example, following delays to MENSA, the Department and its contractor AWE had to continue using existing infrastructure. In 2016, the ONR stated AWE could do this for a further three years. The Department expects to spend £21 million between 2016-17 and 2019-20 on site upgrades to maintain regulatory approval to use the site. For the primary build facility project, the Department continues to consider how to mitigate the impact of potential delays to the project on the Dreadnought-class submarine production programme (paragraphs 1.14, 1.16 and 1.17, Figure 3).

**9 The Department has not learned all it could from the early stages of similar projects concluded in the UK and elsewhere.** The Department has experienced similar challenges to those identified during its last cycle of nuclear-regulated site investment in the 1980s and 1990s. These include starting to build before requirements or designs were sufficiently mature, increasing risks through inappropriate contracts, and failing to engage with regulators to understand requirements. Some of these challenges were also identified in UK civil projects and American defence projects. Many – including Department-wide projects – were subject to extensive reviews, but we did not identify examples of the Department formally capturing and sharing lessons learned (paragraph 3.19 and Figure 11).

## Understanding the reasons for past performance

### **Working with regulators and site operators**

**10 The Department did not manage the value-for-money risks arising from its lack of a formal regulatory role.** The Department, regulators and contractors all raised concerns with us that without further controls and a lack of consistent, three-way engagement, there is a risk of designs being over-specified and therefore more costly than necessary. Regulators do not specify the design, which is developed by the site operator based on publicly available regulatory standards. Without an in-depth technical review comparing designs to requirements, the extent of over-specification is difficult to establish. However, indications these risks have not been managed include the Department not having routine three-way discussions with the regulator and site operator around cost-effective designs, and an independent review identifying over-specified designs for the primary build facility (paragraphs 2.4 to 2.7).

### **Commercial management**

**11 The Department did not set up contractual arrangements to share financial risks, meaning it bore the full impact of cost increases itself.** The primary supplier contracts for the three projects we examined did not incentivise suppliers to control cost growth. In addition, the contract terms meant AWE earned additional fees when work got deferred, which partly resulted from the Department needing to achieve in-year savings. The Department's exposure to cost increases grew as its primary suppliers generally contracted with their supply chain on a cost-plus basis. This meant subsequent cost increases transferred to the Department. For example, for the primary build facility contract, the Department has to date paid £65 million for cost increases incurred by the supply chain (paragraphs 3.5 and 3.6).

**12 In two of three cases we looked at, the Department had limited contractual levers and insufficient oversight to reduce its risk exposure.** For project MENSA, both the Department and AWE failed to effectively oversee contracts. The Department told us that, as a result, it took them some time to identify emerging problems such as a lack of design maturity and poor sub-contractor performance, contributing to cost increases and delays. A lack of commercial expertise within the Department and its primary contractors contributed to this insufficient oversight. Also, for the CPC facilities contract, the Department has limited means to respond to poor performance. The overarching contract does not include performance measures and has limited termination opportunities should performance deteriorate. Like other infrastructure-related contracts, the Department will not be able to exit the contract without decommissioning the facilities (paragraphs 3.7 to 3.9).

## **Project management**

**13 By progressing projects too quickly early on, the Department increased its risk exposure.** A reliance on monopoly site operators (AWE, BAE Systems and Rolls Royce) weakens the Department's commercial negotiating position and means it is more likely to hold more of the contractual risks. Furthermore, the inherent uncertainties of early designs do not incentivise site operators, or their sub-contractors, to negotiate and share risks, increasing risks for the Department. Departmental risks further increased, when it started building before both the requirements and design were mature. For the three projects in our review, this contributed 48% of the total £1.35 billion cost increase. For example, for the primary build facility contract, construction costs increased by £108 million following changes in requirements (paragraphs 1.17, 3.2, 3.9, 3.16 and 3.17, and Figure 6).

**14 The Department did not always manage interdependencies across Enterprise projects, contributing to projects starting too early.** The three infrastructure projects in our review have interdependencies, both with each other and across the Enterprise. The Department did not always build into projects the flexibility to allow for changes. For example, the Department undertook a wider project to determine what the future nuclear reactor core would look like. However, it started building the new CPC facilities without a clear specification of the core design and a full understanding of how the facility would be used. The initial facility subsequently turned out to be too small, contributing to the £146 million total project cost increase. Unforeseen events, such as the Department's decision to refuel *HMS Vanguard*, also had time and cost implications for the project (paragraphs 3.16 and 3.17).

**15 The Department and its contractors struggled to secure the knowledge needed to design and build cost-efficient infrastructure.** Regulators require site operators to provide detailed documentary evidence to show that proposed site changes meet regulatory standards. This includes evidence of design specifications, testing and the source of all parts used in the build. Preparing such documents requires specialist knowledge and skills but, as we have previously reported, there remain nuclear-related skills gaps across the Enterprise. Given the specialist nature of the projects we reviewed, and the small pool of contractors able to design and construct them, the three site operators were using many of the same contractor firms. In addition, project MENSA had specific staff shortages (paragraphs 1.9, 2.6, 3.3, 3.15 and 3.16).

## Addressing the challenges affecting past performance

**16 After earlier challenges, the Department has made progress during the later stages of these infrastructure projects.** After developing greater certainty across project MENSA and the first phase of the CPC facilities project, by October 2019 the Department had built the facilities. It is now focused on fitting them out and seeking regulatory approval for the sites to be used. In 2018, the Infrastructure and Projects Authority assessed MENSA as 'Amber' in terms of delivery confidence, publishing the same assessment for the broader CPC project, which covers the new facilities and site operation, in July 2019. For the primary build facility, one building has now largely been constructed, and is being fitted out, with the construction of the foundations having started for the other building (paragraph 1.19).

**17 By introducing organisational changes, the Department aims to improve its oversight of infrastructure projects.** By establishing in 2016 the Defence Nuclear Organisation (DNO), which has a dedicated nuclear warhead team directly overseeing AWE-site projects, the Department aims to improve its project oversight and ability to identify and manage interdependencies. Also, in 2017, AWE sub-contracted the management of project MENSA to improve oversight and the handling of interdependencies. It is too early to assess the impact of these changes. The Department continues to consider the MENSA project as challenging, with successful completion dependent on managing significant delivery risks (paragraphs 3.13 to 3.15 and Figure 10).

**18 Since 2016, the Department, site operators and regulators have established more constructive relationships to better manage value-for-money risks.** Each party told us that after developing a clearer understanding of the previous project challenges, relationships and interactions had improved. Since the DNO's creation in 2016, the Department has been more directly involved in regulatory discussions. For example, at both AWE and in Devonport, a senior-engagement forum of all parties was created to discuss requirements and progress, with the Department looking to establish a similar group for the primary build facility project. Through these groups, the Department aims to develop more efficient approaches to designing infrastructure. From our work on the Nuclear Decommissioning Authority, we know how such forums can contribute to the better management of nuclear projects (paragraphs 2.8 and 2.9).

**19 The Department re-negotiated its contract covering the largest project, MENSA, but must still manage some commercial risks.** In 2016, the Department renegotiated its contract with AWE, which covered MENSA. This change ensured the contract complied with the Single Source Contract Regulations 2014, which are designed to give the Department greater visibility over costs. AWE also renegotiated contracts with its supply chain, with 85% now having a fixed price, either through a fixed or target cost contract. However, the Department was not able to renegotiate the contract covering its CPC facilities project with Rolls Royce. It did seek to mitigate the risk of contracting for uncertain designs by separating out the design and construction for the second phase of the project (paragraphs 3.4, 3.6 and 3.18).



## Conclusion on value for money

**20** To maintain the continuous at sea deterrent, the Department must complete three critical infrastructure projects, valued at £2.5 billion, on its nuclear-regulated sites. It has made some progress, with the MENSA facility to assemble and disassemble nuclear weapons and the CPC facilities now taking shape. However, these three projects experienced problems in their earlier and riskier stages, with a cumulative £1.35 billion cost increase and delays of between 1.7 and 6.3 years. Given the interdependencies across different elements of the Nuclear Enterprise, such delays have broader implications which the Department must manage.

**21** The challenges with these projects were not unique. It is therefore disappointing to see that in their early days the Department made the same mistakes, also experienced by others, as were made more than 30 years ago. To secure value for money, the Department should have managed the inherent challenges of these projects, such as not starting construction too soon and allowing some flexibility, as well as addressing the risk of not having a statutory role to agree cost-effective designs. In not doing so, the Department's early management of these projects has not delivered value for money. More recently, the Department has started to get to grips with the challenges through revised commercial, regulatory and governance arrangements, although it is too early to tell whether these will be effective.

## Recommendations

**22** Over the past three years, the Department has introduced revised governance arrangements and developed its relationship with regulators. As well as embedding these changes, the Department should, for these and future projects:

- a undertake work to better understand, quantify and manage the inherent risks presented by the regulatory arrangements.** Although not having a statutory regulatory role, the Department should work with regulators and site operators so that all parties understand value-for-money risks with designs and consider these risks through formal discussions;
- b more explicitly recognise and manage the inherent uncertainties associated with the early stages of these projects.** For each project, the Department should consider the appropriate milestones needed to reassess progress alongside the remaining uncertainties and flexibility needed. This should be balanced against allowing teams to press forward with projects;
- c agree commercial arrangements with site operators that better balance risks and ensure they share some risks, particularly as projects progress.** The Department should fully consider using all available levers to reduce its risk exposure, including the Single Source Contract Regulations or by splitting commercial arrangements into stages with agreed milestones for defined work;

- d put the structures in place to understand and manage interdependencies between projects.** The Department may need to take some risks by starting projects early given interdependencies across the Enterprise, and the uncertainties associated with future requirements. When it does so, the Department should ensure it recognises and manages the potential impact of these decisions;
- e introduce ways to identify and apply lessons learned from other projects, both within the Department and from other sectors.** Infrastructure projects at civil, military and overseas nuclear-regulated sites have experienced similar problems over the years, which have been the subject of multiple reviews. The Department should work across government to share lessons learned on how to challenge, interpret and apply regulations to achieve value for money; and
- f continue efforts to develop nuclear capacity and skills within the Department and its contractors.** As well as investing in graduate programmes and apprenticeship schemes, and working with civil nuclear colleagues, the Department should think more broadly as to how it can sequence its major projects to develop a smoother work profile and more stable job market. It should think innovatively about how to increase staff capacity, such as requiring contractual partners to maintain a minimum number of experienced specialist staff.