



National Audit Office

REPORT BY THE
COMPTROLLER AND
AUDITOR GENERAL

HC 630
SESSION 2012-13

7 NOVEMBER 2012

Nuclear Decommissioning Authority

Managing risk reduction at Sellafield

Our vision is to help the nation spend wisely.

We apply the unique perspective of public audit to help Parliament and government drive lasting improvement in public services.

The National Audit Office scrutinises public spending for Parliament and is independent of government. The Comptroller and Auditor General (C&AG), Amyas Morse, is an Officer of the House of Commons and leads the NAO, which employs some 860 staff. The C&AG certifies the accounts of all government departments and many other public sector bodies. He has statutory authority to examine and report to Parliament on whether departments and the bodies they fund have used their resources efficiently, effectively, and with economy. Our studies evaluate the value for money of public spending, nationally and locally. Our recommendations and reports on good practice help government improve public services, and our work led to audited savings of more than £1 billion in 2011.



National Audit Office

Nuclear Decommissioning Authority

Managing risk reduction at Sellafield

Report by the Comptroller and Auditor General

Ordered by the House of Commons
to be printed on 5 November 2012

This report has been prepared under Section 6 of the
National Audit Act 1983 for presentation to the House of
Commons in accordance with Section 9 of the Act

Amyas Morse
Comptroller and Auditor General
National Audit Office

30 October 2012

This report examines the Authority's progress since the Committee's 2008 report in securing an improved lifetime plan for Sellafield and the performance of its portfolio of 14 major capital projects.

© National Audit Office 2012

The text of this document may be reproduced free of charge in any format or medium providing that it is reproduced accurately and not in a misleading context.

The material must be acknowledged as National Audit Office copyright and the document title specified. Where third party material has been identified, permission from the respective copyright holder must be sought.

Links to external websites were valid at the time of publication of this report. The National Audit Office is not responsible for the future validity of the links.

Printed in the UK for the Stationery Office Limited on behalf of the Controller of Her Majesty's Stationery Office

2521278 11/12 PRCS

Contents

Key facts 4

Summary 5

Part One

The Sellafield site 12

Part Two

Developing the lifetime plan 19

Part Three

Major project performance 28

Appendix One

Our audit approach 45

Appendix Two

Our evidence base 47

The National Audit Office study team consisted of:
Alex Black, Richard Gauld and George Last (with additional support from Jayne Ogilvie and Tina Patel), under the direction of Jill Goldsmith.

This report can be found on the National Audit Office website at www.nao.org.uk/nda-2012

For further information about the National Audit Office please contact:

National Audit Office
Press Office
157–197 Buckingham Palace Road
Victoria
London
SW1W 9SP

Tel: 020 7798 7400

Enquiries: www.nao.org.uk/contactus

Website: www.nao.org.uk

Twitter: @NAOorguk

Key facts

£67.5bn

is the provision for the cost of decommissioning and cleaning up Sellafield, before discounting future cash flows to their present values

£4.6bn

is the estimated lifetime cost of the 14 major projects at Sellafield, before discounting future cash flows to their present values

2120

is the target year for completing the clean-up of Sellafield

55	buildings at Sellafield have been decommissioned
1,400	buildings remain at Sellafield
£1.6 billion	spent on running and cleaning up Sellafield during 2011-12
£411 million	spent on major projects at Sellafield in 2011-12
£1.3 billion	is the estimated undiscounted lifetime cost of the largest project at Sellafield
9,231	permanent staff employed at the site on average by the site's operator (Sellafield Limited) during 2011-12
276	permanent full-time equivalent staff employed by the Nuclear Decommissioning Authority at 31 March 2012

Summary

1 Sellafield is the UK's largest and most hazardous nuclear site. The Nuclear Decommissioning Authority (the Authority) owns Sellafield and 18 other UK civil nuclear sites. The Authority is an arm's-length body sponsored by the Department of Energy and Climate Change (the Department).

2 Nuclear operations at Sellafield started in the 1940s. Successive operators of the site did not give sufficient thought to decommissioning or retrieving and disposing of radioactive waste. The Authority inherited a legacy of poor planning, neglect and gaps in information when it took ownership of Sellafield in April 2005. Around 240 of the 1,400 buildings on the site are operating nuclear facilities or legacy buildings containing radioactive materials. Some that are deteriorating or fall short of modern standards pose significant risks to people and the environment. Any significant containment failure, particularly in legacy storage ponds and silos, could result in highly hazardous radioactive material causing enduring contamination, affecting people and the environment.

3 Sellafield Limited manages the site under contract to the Authority. The Authority sets strategic objectives and Sellafield Limited develops and implements an Authority-approved 'lifetime plan'. Sellafield Limited consults on the plan with the Office for Nuclear Regulation, which regulates nuclear safety and licenses Sellafield Limited to operate the site under the Nuclear Installations Act 1965. It also consults the Environment Agency, which oversees compliance with environmental regulations.

4 In November 2008, the Authority appointed Nuclear Management Partners Limited, a consortium of private sector companies (URS, AMEC and AREVA), as the 'parent body organisation' of Sellafield Limited to improve performance by using outside expertise. The new parent body, which the Authority appointed through a competitive process, owns Sellafield Limited for the duration of the parent body agreement with the Authority. The agreement has an initial five-year term, and could be extended by up to a further 12 years, at the end of which the Authority regains ownership of Sellafield Limited.

5 The Authority reimburses Sellafield Limited's allowable costs for managing and operating the site, which in 2011-12 totalled £1.6 billion. The Authority incentivises Sellafield Limited's performance through fee payments. As at September 2012, the Authority's provisional estimate of fees for 2011-12 was £54 million. Sellafield Limited passes fees to Nuclear Management Partners Limited as dividends.

6 The Authority estimates that Sellafield Limited will clean-up Sellafield by 2120. The Authority's provision for the cost of decommissioning and cleaning up the site, before discounting future cash flows to their present values, was £67.5 billion as at March 2012 (£36.6 billion discounted to a net present value). This estimate is based on the lifetime plan for the site. The plan sets out the timescales and budgeted costs for all activities including decommissioning, commercial operations (mostly reprocessing spent nuclear fuel), and projects to treat, package and store waste. The Committee of Public Accounts (the Committee) has previously highlighted the considerable uncertainty over decommissioning costs. The costs had risen each time site operators had revised their lifetime plans, partly as they had improved their approach to preparing them.¹ The Committee recommended that the Authority publish the likely range of costs, incentivise site operators more effectively, monitor lifetime costs better and work with site operators to strengthen their supply chain.

7 This report examines the Authority's progress since the Committee's 2008 report in improving the lifetime plan for Sellafield and the performance of its portfolio of 14 major capital projects, which are key enablers of risk reduction. These projects have a total undiscounted estimated lifetime cost of £4.6 billion (in 2011-12 prices)² and accounted for 26 per cent of the Authority's spending at Sellafield in 2011-12. The projects have long schedules and some began before the Authority was created and Nuclear Management Partners Limited were appointed. Commercial operations, waste management and nuclear materials management are outside the scope of the report.

Key findings

Planning

8 In May 2011, the Authority achieved an important planning milestone when it approved a lifetime plan for Sellafield that met its strategic priorities and funding requirements, as well as those of the regulators and the Department of Energy and Climate Change. The previous 2007 plan was designed to meet legally binding regulatory specifications but had been rejected by the Authority as undeliverable. Improving the plan was therefore a core requirement after appointing Nuclear Management Partners Limited in November 2008. The Authority accepted the revised plan in May 2011, a year later than expected, because of the time needed for Sellafield Limited to revise the plan and for the Authority to assure it. The Authority concluded that its assurance work meant the revised plan was good enough to monitor performance and assess efficiencies over the initial term of the parent body agreement up to 2014. The Authority has an option to agree a new contractual baseline with Sellafield Limited that will take effect from 2014 (paragraphs 2.4 to 2.6).

¹ HC Committee of Public Accounts, *Nuclear Decommissioning Authority – Taking Forward Decommissioning*, Thirty-eighth Report of Session 2008-09, HC 370, July 2008.

² The Authority has a specific inflation index for nuclear projects, but adjusts the provision for inflation using the retail price index. Project and provision costs are therefore not directly comparable.

9 Changes to the lifetime plan significantly increased delivery timescales and costs, as Sellafield Limited removed unrealistic assumptions and estimates from the previous unapproved plan:

- **The revised plan continued to require final clean-up of the site by 2120 but extended the date for completing waste retrieval from legacy ponds and silos by seven years to 2036.** The extended timescales were because Sellafield Limited had made limited progress under its previous management towards starting some key waste retrieval projects and used more realistic schedules in the revised plan. This increased spending on maintaining hazardous legacy facilities to safety requirements over a longer period. The revised schedules did not meet the legally binding timetables set by the Nuclear Installations Inspectorate for hazard reduction. However, they were acknowledged by the Authority, the Office for Nuclear Regulation³ and the Environment Agency as being more realistic based on previous performance (paragraph 2.9).
- **The estimated undiscounted cost during the maximum term of the parent body agreement up to March 2026 was £24.3 billion. This was one-third higher than the £18.2 billion in the previous unrealistic plan.**⁴ Sellafield Limited increased its estimates to address a lack of realism in the 2007 plan. The revised plan assumed efficiency savings of £1.4 billion over the first five years of the parent body agreement compared with the estimated costs based on Sellafield's performance under previous management (paragraph 2.10).
- **The Authority's undiscounted provision for the lifetime cost of the clean-up of Sellafield up to 2120 increased from £46.6 billion as at March 2009 (in 2011-12 prices) to £67.5 billion as at March 2012.** The Authority expects that the lifetime cost will continue to rise, as uncertainties in the lifetime plan are addressed, then plateau, and finally decline as Sellafield Limited manages the decommissioning process better (paragraph 2.10).

10 Although the revised plan is significantly better than the previous plan, uncertainties remain. The Authority's assurance of the revised plan was extensive and it challenged proposed timescales and costs. The Authority did not have robust benchmarks to make judgements on proposed levels of performance, the scope for acceleration, or the potential for efficiencies. Nor did the revised plan provide sufficient information to allow the Authority to understand programme-level risks fully. The Authority is working to understand and address the significant delivery uncertainty and scheduling risks that still remain, for example, in completing facilities to treat material from legacy ponds and silos. Many activities at Sellafield are unique, which makes it very difficult to benchmark whole project costs and timescales, particularly for legacy ponds and silos. The Authority is, however, trialling a benchmarking tool, starting with less complex sites. The Authority continues to reassess time and cost estimates for large projects, by reviewing business cases before work proceeds and monitoring Sellafield Limited's progress. Our findings on major projects, set out below, suggest there is still considerable uncertainty in the schedules and costs of the projects that account for 26 per cent of annual spending (paragraphs 2.7 to 2.8).

³ The Office for Nuclear Regulation superseded the Nuclear Installations Inspectorate in 2011.

⁴ Costs are adjusted for inflation to 2011-12 prices using the retail price index.

Delivery

11 Between May 2011 and March 2012, 12 of the Authority's 14 major projects delivered less than planned. Sellafield Limited extended estimated completion dates for seven and increased the total cost estimate by £0.9 billion. Delays in project delivery could jeopardise timetables for risk reduction and increase spending on maintaining legacy facilities. We found that between May 2011 and March 2012 Sellafield Limited:

- **Achieved less than planned in 12 of the 14 major projects, with five achieving less than 90 per cent of the planned scope. This could jeopardise target dates for risk reduction.** Five projects overran the budgeted cost of work completed, of which three exceeded it by more than 10 per cent (paragraph 3.6).
- **Brought forward the estimated completion date for one of the seven projects in the design phase. Five remained unchanged but their overall cost increased by £0.6 billion to £2.8 billion.** The complexity of these projects means that changes during the design stage are inevitable. However, Sellafield Limited did not allow sufficiently for uncertainty in the cost estimates it initially submitted to the Authority for the silos direct encapsulation plant project. It prepared these estimates before it had assessed the full cost implication of the design. The 92 per cent increase in the estimated cost of the project accounted for nearly all of the £0.6 billion increase (paragraph 3.4).
- **Put estimated completion dates back by between 2 and 19 months in six of the seven projects in construction.** This was associated with a £0.3 billion increase in the total estimated lifetime cost of these projects to £1.8 billion. Eighty-three per cent of the increase was due to cost escalation in the 'evaporator D' project (paragraph 3.5).

12 Delays and increases in some estimated project costs are partly due to the inherited conditions and inherent complexity of the hazards at Sellafield. They also reflect poor project design and delivery by Sellafield Limited and weaknesses in the Authority's oversight. We identified five factors that led to cost escalation and delays:

- **The Authority's contract requires it to reimburse Sellafield Limited for all allowable costs. This means that Sellafield Limited does not bear risks for delay and cost increases.** The Authority used a cost reimbursement contract as the complexity and risk of work at Sellafield means that there is very limited scope to transfer risk and no alternative to cost reimbursement. Even if it were possible to transfer risk, the Authority would have to pay very high risk premiums to the site operator. The Authority uses fees to incentivise efficiencies and achieve milestones. Its provisional estimate of fees across all activities at Sellafield for 2011-12 is £54 million. This is £19 million less than the maximum potential fee, largely because of major project costs escalating. This reduction is, however, far outweighed by the increased project costs and delays borne by the Authority (paragraphs 3.8 to 3.10).

- **There are gaps in the capacity of subcontractors to undertake the required work.** The supply chain lacks capacity to take on cost risks in complex nuclear projects. This means that Sellafield Limited often uses cost reimbursement contracts with its supply chain. The Authority is working with Sellafield Limited to strengthen its procurement strategies and long-term plans to help develop supply chain capabilities (paragraphs 3.11 to 3.12).
- **There has been a long-standing problem, which existed before the Authority was created in 2005, of the site operator starting construction before design risks had been sufficiently addressed.** For example, the site operator spent some £400 million between 1994 and 2002, and a further £128 million between 2006 and 2008, on building a plant to treat waste from a legacy facility. It subsequently found the design could not deal with the waste safely. More recently, after appointing Nuclear Management Partners Limited in 2008, the Authority gave approval for the construction of evaporator D to start in 2009 before design issues were resolved, which contributed to cost escalation and delays. The Authority has revised its approvals processes to try to prevent construction starting prematurely (paragraphs 3.13 to 3.16).
- **Weaknesses in cost and schedule estimation by Sellafield Limited remain significant issues for the Authority.** Sellafield Limited has included contingencies for risk and uncertainty on the major projects ranging from 0.9 per cent to 13.5 per cent of estimated costs. These are lower than historic cost increases on the major projects in construction at Sellafield, which have ranged from 10 to 117 per cent. The estimates do not include adjustments for optimism bias. There is significant uncertainty as to how Sellafield Limited can meet the performance plan target to complete the silos direct encapsulation plant project in 2017. The project plan is based on completing it later, during 2018-19 (paragraphs 3.17 to 3.18).
- **Until mid 2011, the Authority did not collect enough robust and timely information on projects from Sellafield Limited to enable timely intervention.** The Authority introduced improved major project reporting in May 2011 to identify emerging issues better (paragraphs 3.19 to 3.21).

13 Nuclear Management Partners Limited expects to make at least 80 per cent of its planned savings of £1.4 billion. The Authority has verified that Sellafield Limited has already saved £425 million, and is reviewing a further £270 million of reported savings. The Authority can automatically renew its parent body agreement with Nuclear Management Partners Limited if Sellafield Limited meets minimum performance standards, including making at least 80 per cent of forecast savings (paragraphs 2.14 to 2.15).

14 The Authority does not report externally on the performance of its major projects. It is accountable to the Department of Energy and Climate Change for performance, but these projects are outside the scope of the central government assurance from the Major Projects Authority. The Nuclear Decommissioning Authority's annual report and online reporting show measures of performance against costs and schedules but only selective references to the performance of individual major projects. The Nuclear Decommissioning Authority has not always kept its online reporting up to date. It routinely reports on performance to the Department of Energy and Climate Change and is reviewing the indicators it reports to the Department to ensure that they cover the full range of issues at Sellafield. Most major projects require approval from the Department of Energy and Climate Change, but are not reviewed by the Major Projects Authority (paragraph 3.21).

On the Nuclear Decommissioning Authority's response

15 The Authority is taking appropriate steps to improve Sellafield Limited's performance on major projects and its own capacity to oversee delivery, but it is too early to identify the impact of these changes. From September 2011, the Authority established a programmes and projects review group to identify and address underperformance and to work with Sellafield Limited on improvement plans for key projects. Since April 2012, the Authority has also increased the direct involvement of its Chief Operating Officer in overseeing Sellafield. The Authority has reviewed the increase in staff seconded by Nuclear Management Partners into Sellafield Limited, which cost the Authority £76 million between November 2008 and March 2012. The Authority is considering how to strengthen the existing fee incentive framework if it chooses to renew the parent body agreement in 2014 (paragraph 2.16).

Conclusion on value for money

16 The Authority faces a considerable challenge in decommissioning at Sellafield owing to past neglect. Since 2008, it has made progress by appointing a parent body to the site and agreeing with Sellafield Limited a more robust lifetime plan. The plan, which was agreed in May 2011, still contains uncertainties about delivery schedules and costs in the short and long term. The Authority does not yet have adequate external benchmarks to assure whether the plan is sufficiently challenging.

17 It is too early to judge whether the Authority's appointment of Nuclear Management Partners Limited as the parent body of Sellafield Limited is value for money. Sellafield Limited has saved £425 million, compared to previous expected costs, and it has reported further savings that the Authority is reviewing. However, the portfolio of 14 major projects at Sellafield has so far not provided good value for money, with significant lifetime cost increases and delays of between 2 and 19 months during 2011-12. The Authority is working with Sellafield Limited and Nuclear Management Partners Limited to understand

and address project underperformance. Other activities on the site have improved, notably the increase in the amount of spent nuclear fuel reprocessed each year. Securing value for money will depend on how well the Authority develops its intelligent client capability by benchmarking Sellafield Limited's proposed performance and strengthening contract levers to incentivise progress towards risk reduction.

Recommendations

- a The Authority must better understand how Sellafield Limited has prepared cost and schedule estimates in the lifetime plan and business cases. Where possible, it should benchmark them against previous experience and externally; for example, for support and overhead costs, or materials and labour.** Identifying and routinely collecting data is essential for internal and external benchmarking. The Authority should ensure Sellafield Limited's processes include gathering market data for benchmarking, including from its parent body, and for other sites in its estate if possible. It should also require Sellafield Limited to consider the evidence on optimism bias based on past performance. This would allow the Authority to get stronger assurance that future plans are deliverable but stretching.
- b To gain better value for money from its cost reimbursement contract with Sellafield Limited, the Authority should gather lessons from other organisations that use this type of contract.** The end of the initial term of the parent body agreement in 2014 provides an opportunity for the Authority to strengthen existing incentives, which so far have not improved project performance as the Authority expected. The Authority needs incentives for risk reduction that sufficiently emphasise the timely completion of projects that meet quality standards for nuclear facilities.
- c The Authority should obtain assurance that Sellafield Limited has fully assessed risks to time and cost from its approach to supply chain management and put sufficient mitigations in place, with clear individual responsibilities.** Sellafield Limited has typically used cost-reimbursement or target-cost contracts for major projects, involving limited risk transfer to the supply chain. The Authority has approved Sellafield Limited's decision to re-compete the contract for the single largest project at Sellafield – the silos direct encapsulation project. This is an attempt to transfer some risk to the supply chain. However, it has the potential to introduce further risk to achieving an already uncertain timetable for this project.
- d The Authority should routinely report externally on its major projects, with performance information against original schedules and budgeted costs.** This will enable Parliament and the public better to hold the Authority to account for important work which is at considerable cost to the taxpayer.

Part One

The Sellafield site

1.1 This part of the report provides an overview of the Sellafield site, covering:

- roles and responsibilities;
- the site and its hazards; and
- the costs and funding arrangements.

Roles and responsibilities

1.2 Sellafield is owned by the Nuclear Decommissioning Authority, which since April 2005 has been responsible for the decommissioning and clean-up of the UK's 19 civil public sector nuclear sites. As at 31 March 2012, the Authority had 276 permanent full-time equivalent employees. In April 2012, the Authority increased the direct involvement of its Chief Operating Officer in overseeing Sellafield.

1.3 The Authority is an arm's-length body sponsored by the Department of Energy and Climate Change. The Shareholder Executive, which is part of the Department for Business, Innovation and Skills, oversees the Authority's governance and performance for the Department. The Department reviewed existing accountability and governance arrangements for Sellafield in May 2011 and since then the frequency of contact between its senior management and the Authority has increased.

1.4 The Authority contracts with Sellafield Limited to manage and operate the Sellafield site. The contract sets out Sellafield Limited's obligations, procedural requirements, and funding arrangements including fees and minimum performance standards. Following a competition, in November 2008, the Authority appointed Nuclear Management Partners Limited, a private sector consortium of URS, AMEC and AREVA, as 'parent body' owners of Sellafield Limited for up to 17 years. The Authority appointed Nuclear Management Partners Limited to strengthen Sellafield Limited's strategic management of the site while avoiding the potentially lengthy and complex process of licensing a new site operator. Nuclear Management Partners Limited appoints Sellafield Limited's executive team. It also seconds staff, through a separate process known as 'reachback', to fill specific skills gaps at Sellafield Limited. Nuclear Management Partners Limited owns the shares of Sellafield Limited and receives dividends from the fees Sellafield Limited makes through its contract with the Authority. The Authority regains ownership of Sellafield Limited when the agreement ends.

1.5 Sellafield Limited is licensed to operate the site by the Office for Nuclear Regulation, which is part of the Health and Safety Executive, under the Nuclear Installations Act 1965 (as amended). The regulator sets principles for safely operating the site and can place specific and legally binding requirements on Sellafield Limited to complete or stop certain activities by particular dates. Sellafield Limited must also comply with permit requirements set by the Environment Agency, for example to minimise radioactive discharges and disposals. Neither the Authority nor Nuclear Management Partners Limited can take operational decisions about managing the site. Only Sellafield Limited is licensed and permitted to operate it. **Figure 1** overleaf summarises the responsibilities and relationships between the organisations involved.

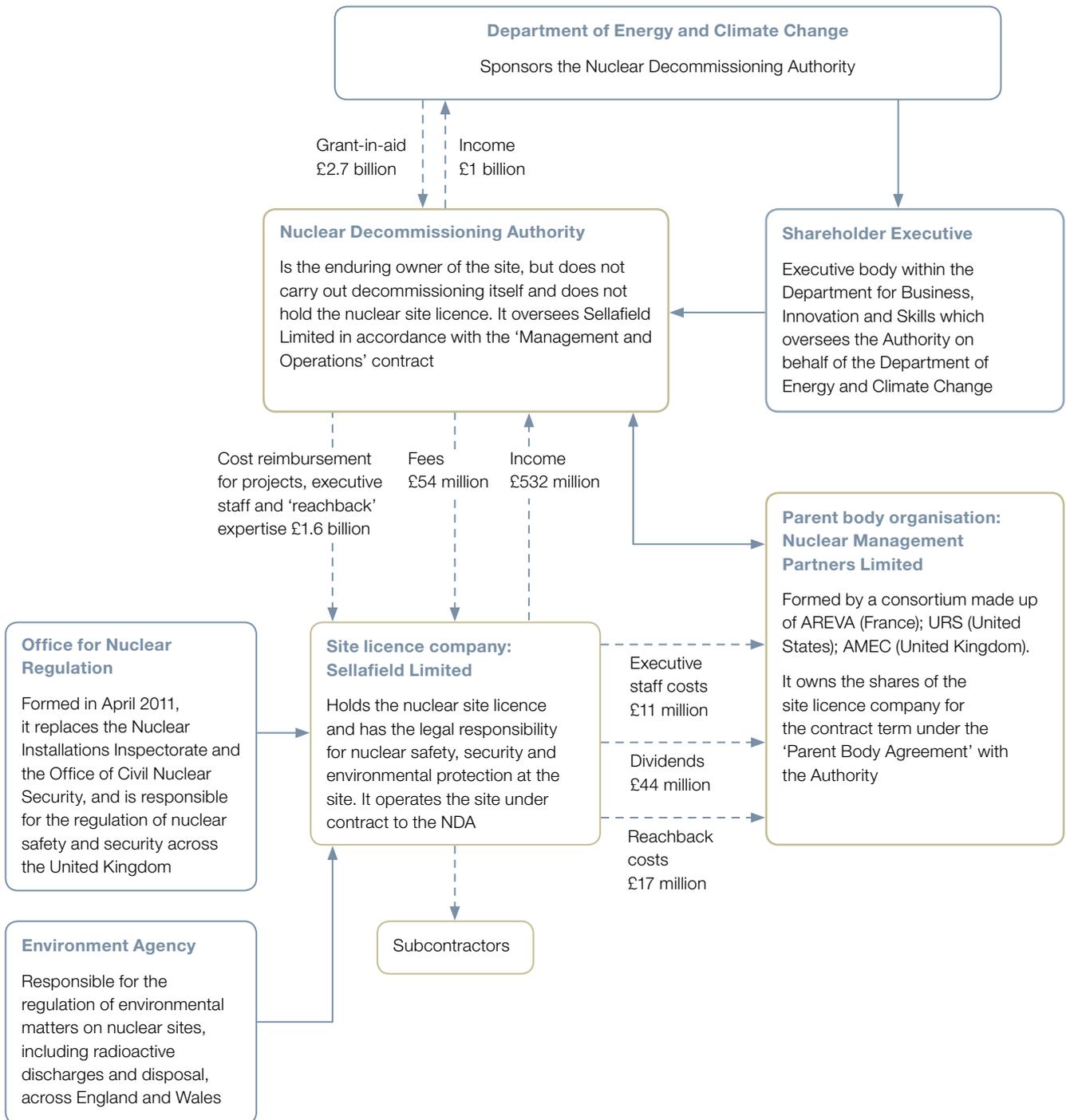
The site and its hazards

1.6 Sellafield has evolved since the 1940s to become the largest nuclear site in the UK and one of the most complex and hazardous nuclear sites in the world. It contains around 1,400 buildings, of which 240 are nuclear facilities, concentrated in a 2.62 square kilometre site. Key activities include: retrieving waste from and decommissioning old facilities; commercial reprocessing operations and nuclear waste management; and storage (**Figure 2** on page 15).

Decommissioning and clean-up

1.7 To date, 55 buildings on the site have been decommissioned and removed. Limited progress has been made in removing hazardous waste and reducing the risk posed by legacy facilities. Sellafield Limited undertakes major repairs, for example to a crack in the side of a storage pond. It also carries out routine care and maintenance to minimise risks in line with regulatory requirements. The Authority's ultimate objective is to complete the clean-up of the site and release it for alternative uses by 2120.

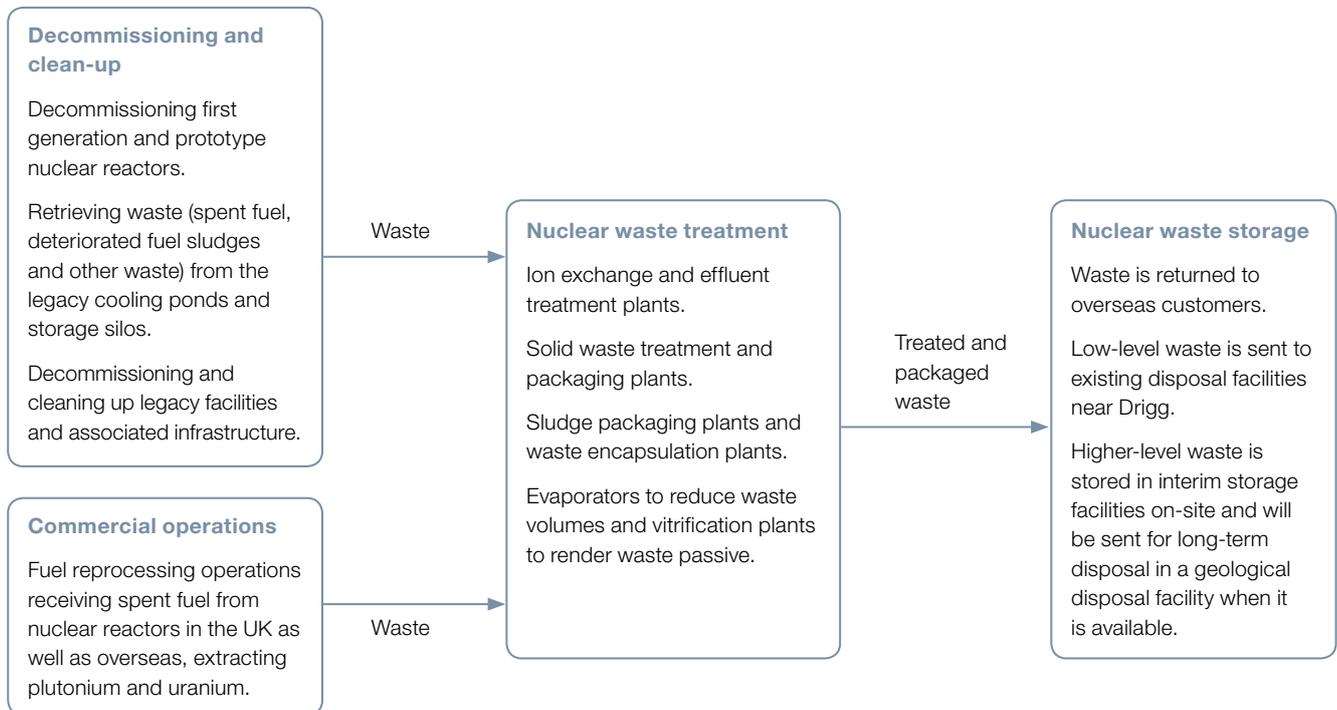
Figure 1
Roles, responsibilities and finance flows in 2011-12



Source: National Audit Office

Figure 2

Key activities and processes at Sellafield



Source: National Audit Office

Commercial operations

1.8 Since the Authority appointed Nuclear Management Partners Limited, Sellafield Limited's performance in carrying out ongoing commercial operations, mainly fuel processing, has improved but not fully met planned levels of performance. In 2011-12, Sellafield Limited vitrified⁵ over 2,300 tonnes equivalent of uranium, which was a 131 per cent increase on the previous year, and removed the outer casing of over 600 tonnes of spent fuel in preparation for reprocessing, an increase of 159 per cent (**Figure 3** overleaf).

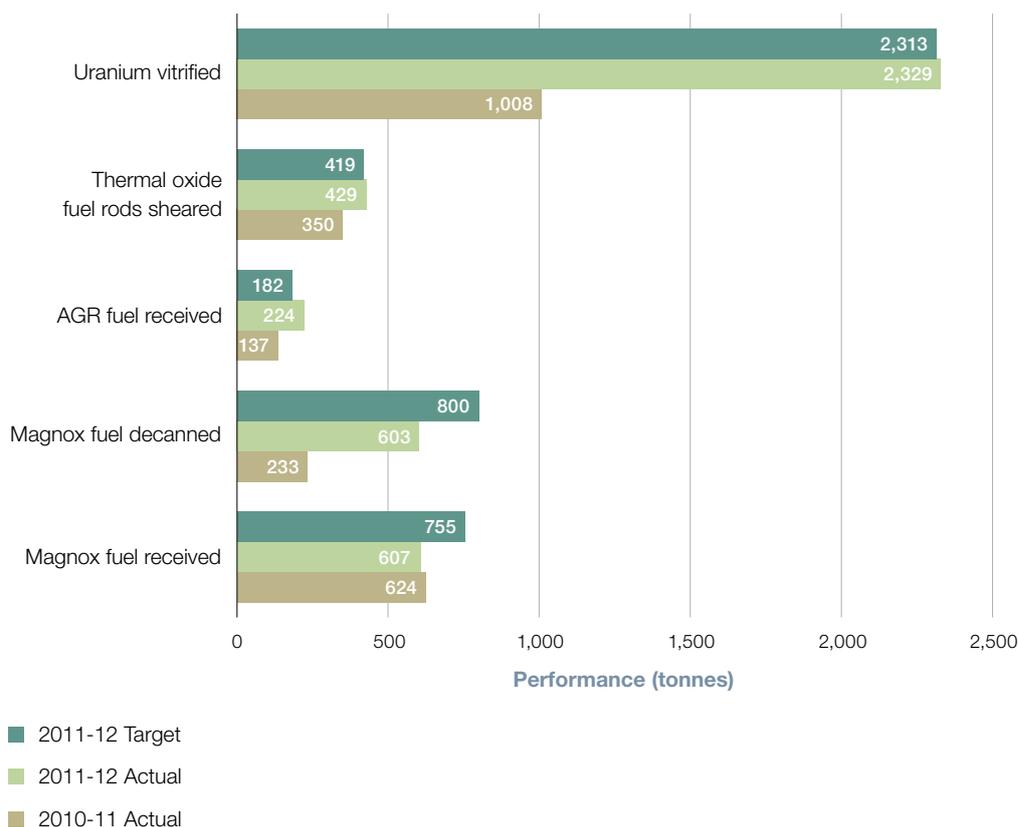
Waste management and storage

1.9 Sellafield holds 95 per cent of the UK's nuclear waste as measured by radioactivity. The total volume of high- and intermediate-level radioactive waste stored on the site is 68,000 m³, which would fill 27 Olympic-sized swimming pools. It will be held in interim storage (defined as up to 100 years) until a long-term disposal solution is developed. The government's current plan for long-term storage is to build a geological disposal facility, which it plans will be available by 2040.

⁵ Vitrification is a process for transforming substances, including radioactive material, into glass.

Figure 3
Sellafield Limited's operations

Sellafield Limited's performance in ongoing operations is improving



Source: National Audit Office analysis of data supplied by the Authority

1.10 Successive site operators developed Sellafield without sufficient thought to decommissioning or retrieving and disposing of radioactive waste. Some of the older facilities at Sellafield containing highly hazardous radioactive waste have deteriorated so much that their contents pose significant risks to people and the environment. The highest risks are posed by the ponds and silos built during the 1950s and 1960s to store fuel for early reprocessing operations and radioactive waste. The Committee of Public Accounts noted in 2008 that the Authority was dealing with a legacy of deferred decision-making in the UK's nuclear programme going back over 50 years. This was made more complex because the exact quantity and type of hazardous material on the site had yet to be fully investigated.⁶

6 HC Committee of Public Accounts, *Nuclear Decommissioning Authority – Taking Forward Decommissioning*, Thirty-eighth Report of Session 2008-09, HC 370, July 2008.

Costs and funding arrangements

1.11 Sellafield Limited employed an average of 9,231 staff at the site and spent £1.6 billion in 2011-12, with approximately a quarter of this spent on programmes to deal with waste retrieval and clean-up of high hazard legacy ponds and silos (**Figure 4**).⁷

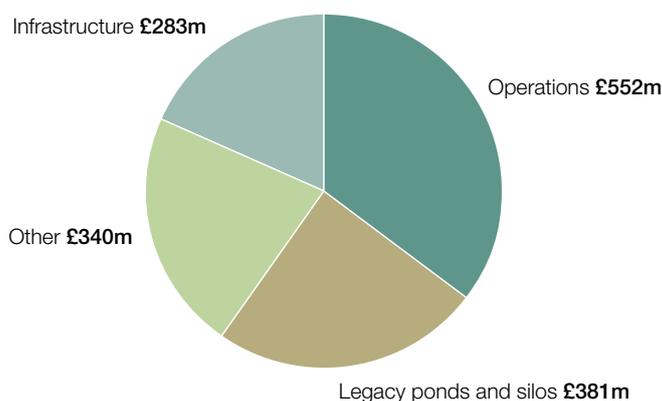
1.12 Sellafield Limited spent £986 million on subcontractors in 2011-12. Just under half of this was on professional services such as technical design and modelling used in the development of specialist equipment and facilities (**Figure 5** overleaf). Six per cent of Sellafield Limited's spending on subcontractors in 2011-12 was with the companies of the parent body, Nuclear Management Partners Limited.⁸ The Authority plans to review Sellafield Limited's subcontracting with its parent body's companies in 2012-13.

1.13 The Authority funds the site from grant-in-aid that it receives from the Department of Energy and Climate Change. The Authority reimburses Sellafield Limited for all allowable costs that it incurs, including the cost of the executives and 'reachback' staff from Nuclear Management Partners Limited. It pays Sellafield Limited fees according to performance in making efficiencies and achieving milestones. The Authority pays the income that Sellafield generates from commercial activities to the Department.

Figure 4

Sellafield Limited's spending in 2011-12

A quarter of Sellafield Limited's annual spending is on waste retrieval and clean-up of high hazard legacy ponds and silos



NOTE

1 Other includes spending on site-wide support functions and management of the Windscale site.

Source: National Audit Office analysis of the Authority's data

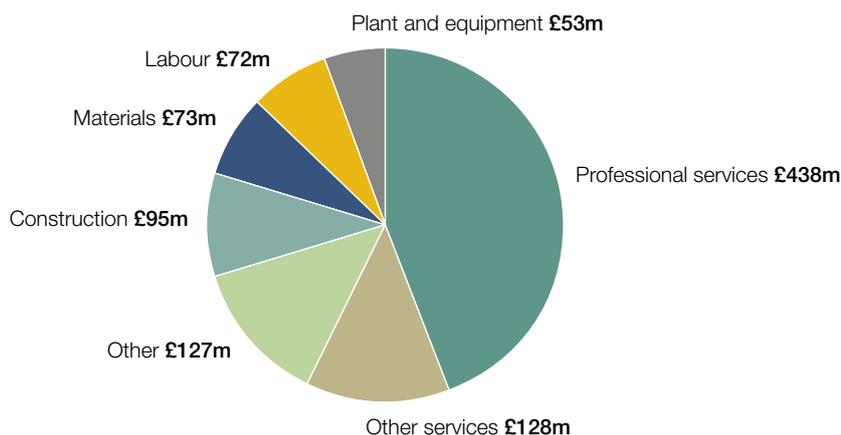
7 These and subsequent figures exclude the much smaller Capenhurst site, which is also operated by Sellafield Limited.

8 Sellafield Limited, *Directors' report and financial statements*, 31 March 2012. Available at sellafielddesites.com/wp-content/uploads/2012/08/2011_12_signed_Sellafield_accounts.pdf. Sellafield Limited disclosed in its financial statements transactions with the parent companies of Nuclear Management Partners, AMEC, URS and AREVA resulting in purchases of £54.4 million.

Figure 5

Products and services procured by Sellafield in 2011-12

Just under half of Sellafield Limited's spending on subcontractors in 2011-12 was for professional services



Source: Sellafield Limited, Procurement Plan 2012-13

1.14 The Authority's provision for the cost of decommissioning and cleaning-up Sellafield, before discounting future cash flows to their present values, was £67.5 billion as at 31 March 2012 (£36.6 billion discounted). This accounted for 67 per cent of the provision for cleaning-up the Authority's entire estate. The provision is based on the 'lifetime plan' that Sellafield Limited developed and the Authority accepted. The plan sets out work schedules and associated costs over the entire life of the site up to 2120. In 2008, the Committee of Public Accounts noted that the estimated lifetime cost of decommissioning all the Authority's sites had risen each time the lifetime plans were reviewed by the Authority. The Authority told the Committee in 2008 that it expected UK experience to reflect experience in the United States, where lifetime costs rose initially, as uncertainties in plans were addressed, then plateaued, and finally declined as the decommissioning process was better managed. Since 2008, the estimated cost of decommissioning Sellafield has continued to rise. The Authority expects this trend to continue and does not know when the cost will plateau then decline.

Scope of this report

1.15 This report examines whether the Authority is cost-effectively reducing risks on the Sellafield site through its major projects. In Part Two we examine how well Sellafield Limited developed and the Authority assured the lifetime plan. In Part Three we examine the performance of the Authority's 14 major projects, which account for 26 per cent of annual site spend.

1.16 Our analytical framework and the methods we used to collect evidence are in Appendices One and Two.

Part Two

Developing the lifetime plan

2.1 The Authority sets the strategy for its estate, which site operators implement by developing and implementing prioritised lifetime plans for their sites. Sellafield Limited, under the management of British Nuclear Fuels Limited, developed a lifetime plan for the site in 2007, to meet the Nuclear Installations Inspectorate's specifications set in 2000 for treating and storing hazardous material. The Authority did not accept the 2007 plan was achievable or affordable. Due to its concerns about the existing management team at Sellafield, the Authority ran a competition to appoint a new parent body before securing a better delivery plan for the site. The Authority concluded that developing the plan further would be a core requirement for Sellafield Limited after it transferred to its new parent body, Nuclear Management Partners Limited, in November 2008.

2.2 In July 2008, before Nuclear Management Partners Limited was appointed, the Committee of Public Accounts (the Committee) noted that the legacy of poor management and the challenge of cleaning-up the Authority's sites meant that the estimated cost of decommissioning was uncertain. It expressed concern, however, about how well the Authority scrutinised lifetime plans across its estate. Of particular concern was the Authority's focus on compliance with procedures, rather than the nature or cost of proposed work, and the lack of benchmark data.⁹

2.3 In this part of the report we examine:

- the Authority's assurance of the lifetime plan;
- the costs and schedules in the plan;
- the ongoing development of the plan; and
- performance against the plan.

⁹ HC Committee of Public Accounts, *Nuclear Decommissioning Authority – Taking Forward Decommissioning*, Thirty-eighth Report of Session 2008-09, HC 370, July 2008.

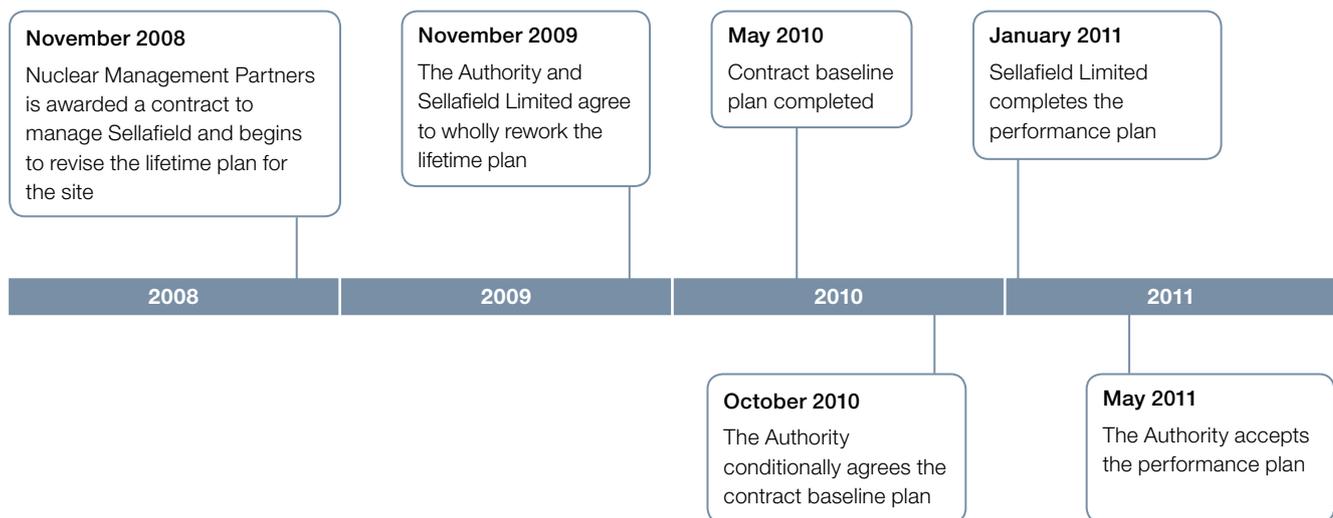
Assuring the lifetime plan

2.4 The Authority agreed a new lifetime plan with Sellafield Limited in May 2011, two and a half years after Nuclear Management Partners Limited was appointed as parent body (**Figure 6**). The Authority aimed to agree a revised plan with Sellafield Limited by April 2010. The Authority assumed that this would involve the new parent body adjusting the inherited 2007 plan and incorporating its proposed efficiencies. In November 2009, the Authority agreed with Sellafield Limited that a more fundamental reworking of the plan was required. This involved Sellafield Limited developing and the Authority agreeing the following:

- The ‘contract baseline’, which is only used to give a baseline against which performance improvements are measured to calculate fees. The costs and schedules in the baseline were based on assessing Sellafield Limited’s past performance and working practices before appointing the new parent body. The Authority agreed the contract baseline in October 2010.
- The ‘performance plan’, which sets out what Sellafield Limited expects to achieve each year, showing how it would outperform the contract baseline. This plan forms the basis of the Authority’s budgeting and its estimate of the lifetime cost of cleaning-up the site. The Authority accepted the performance plan in May 2011.

Figure 6

Timeline for developing the Sellafield lifetime plan



Source: National Audit Office

2.5 The May 2011 plan was a significant advance on the 2007 plan. It reflected the Authority's strategic priorities to address the highest risks on the site as quickly as possible. It was also aligned with the funding settlement that the Authority agreed with HM Treasury up to 2014-15 and the Authority's agreed corporate plan to 2031. Before the 2010 spending review, the Authority reviewed a range of scenarios for spending across its estate. It also decided the funding requirement for Sellafield in consultation with the regulatory authorities, the Department and HM Treasury. HM Treasury agreed that spending on tackling the highest hazards at Sellafield should be protected. The Office for Nuclear Regulation and the Environment Agency worked with the Authority to challenge and amend the timescales in the proposed plan, as it developed. The regulatory authorities accepted the decommissioning milestones in the lifetime plan but continue to press for the hazards to be addressed more quickly, subject to meeting safety requirements.

2.6 The Authority accepted the revised lifetime plan after completing assurance reviews of the contract baseline and the performance plan, supported by consultants. For its assurance, the Authority focused on plans up to 2026 and did the following:

- Examined whether each programme in the plan was aligned with its strategy and carried out detailed reviews of high hazard projects and checklist-based reviews of large sections of the remainder of the plan. The reviews covered 75 per cent of planned spending in the contract baseline and 49 per cent of planned spending in the performance plan up to 2026.
- Obtained a reconciliation from Sellafield Limited between the performance plan, contract baseline and 2007 lifetime plan to 2026, to identify and challenge key changes in schedules and costs.

2.7 The Authority's assurance was extensive. We found that it had challenged the nature of the work set out in the plan and budgeted costs and timescales. However, it did not have clear evidence on how Sellafield Limited estimated costs and schedules. The Authority also had no benchmarks to judge proposed levels of performance, the scope for acceleration, or the potential for efficiencies. It made minimal comparisons with nuclear projects elsewhere in the UK or internationally to check the validity of the estimates.

2.8 The Authority accepted the revised plan in May 2011 as a reasonable basis for performance management, following its assurance reviews. However, it recognised that the estimates in the plan were uncertain, both in the medium term up to 2026, and in the long term up to 2120:

- Sellafield Limited lacked information on some of the materials and facilities on the site. The exact nature of some of the materials has not been fully characterised as access to some locations, for example the legacy ponds and silos, is not yet feasible. Sellafield Limited is working to understand fully the assets and the condition of the infrastructure on the site, and to bring its asset management plans into line with industry good practice.
- The plan includes outline estimates for cost and schedules for key projects where there is not yet sufficient supporting data to provide reliable estimates. The Authority found a lack of consistency in the contingency contained within project cost estimates. It noted too that some entries in the plan were yet to be properly substantiated, for example estimates for some savings projects.
- The Authority could not determine whether critical paths for completing programmes and projects were correctly identified, as the plan did not clearly show dependencies between them. Some tasks aimed at reducing the highest risks could be delayed by up to three years without affecting Sellafield Limited's ability to meet key risk reduction milestones. As at September 2012, the Authority was in the process of reviewing programme business cases to identify cost and scheduling risks and opportunities.

Delivery schedules in the plan

2.9 In 2008, the Nuclear Installations Inspectorate recognised that the licence specifications it had set in 2000 could not be met by Sellafield Limited. The Inspectorate deferred enforcement action until Sellafield Limited produced a new plan. The contract baseline agreed in 2010, based on past norms, deferred schedules for addressing the highest risks between 10 and 28 years. The May 2011 performance plan set Sellafield Limited more challenging schedules, which brought forward retrieving waste from legacy ponds and silos by between 3 and 18 years compared with the contract baseline (**Figure 7**). However, the performance plan's estimated dates still defer achieving the regulatory specifications (**Figure 8**).

Figure 7

Estimated completion dates for legacy ponds and silos

Completion dates were significantly extended in the 2010 contract baseline but brought forward in the 2011 performance plan

Programme	Lifetime plan 2007	Contract baseline plan 2010	Performance plan 2011
First generation magnox storage pond: completion of retrievals	2015	2043	2034
Pile fuel storage pond: all intermediate-level waste removed and treated	2021	2042	2024
Pile fuel cladding silo: bulk retrievals complete	2016	2026	2023
Magnox swarf storage silo: residual retrievals complete	2029	2045	2036

NOTE

1 The Authority did not accept the 2007 lifetime plan as it considered the plan undeliverable.

Source: National Audit Office based on Authority data

Figure 8

Regulatory specifications on intermediate-level waste in legacy ponds and silos set by the Nuclear Installations Inspectorate

Extant specifications	Prescribed completion date as at 2000	Forecast completion date as at 2012
324 (d) – the licensee shall not accumulate the contents of the pile fuel cladding silo except in an approved place and manner.	2016	2023
325 (a) – At least 90 per cent of intermediate-level waste sludge in the pile fuel storage ponds shall be stored within modern standard stainless steel containment.	2009	2016
325 (b) – At least 90 per cent of intermediate-level waste sludge in first generation magnox storage pond and bays shall be stored within modern standard stainless steel containment.	2010	2023
326 (a) – At least 80 per cent of intermediate-level waste sludges originating prior to 1 August 2000 shall be stored in a safe passive form.	2020	2031

NOTES

1 These specifications are still in force but the Office for Nuclear Regulation has chosen not to prosecute Sellafield for non-compliance. It is instead working with Sellafield Limited to ensure that all necessary steps are taken to minimise hazard levels as soon as reasonably practicable.

2 The full specifications are available at www.wcsg.co.uk/documentstore/NII%20Report.pdf

Source: Office for Nuclear Regulation and National Audit Office examination of Authority data

Cost of the plan

2.10 The May 2011 plan estimated the undiscounted cost of decommissioning and clean-up at the site up to March 2026 at £24.3 billion. This was an increase of £6.1 billion above the estimated cost over the same period in the 2007 plan which the Authority considered undeliverable (**Figure 9**). This includes increased spend on maintaining hazardous legacy facilities in as safe a condition as practicable over a longer period than previously planned. The May 2011 plan contributed to an increase in the total undiscounted provision for decommissioning the site from £46.6 billion as at March 2009 (in 2011-12 prices) to £67.5 billion as at March 2012. The estimates in the 2010 contract baseline are higher as they are based on Sellafield Limited's performance under previous management. The May 2011 plan set out how Sellafield Limited intended to improve on past performance. It included efficiency commitments totalling £1.4 billion over the first contract term to end March 2014 and increased spending on retrieving waste from legacy ponds and silos to meet strategic priorities.

2.11 The lifetime plan includes outline estimates for eight projects with uncertain costs, some of which were excluded from the previous plan due to the level of uncertainty. As there are no certain baseline cost estimates against which Sellafield can earn efficiency fees, the Authority pays Sellafield Limited a fixed fee of 3 per cent of the value of work carried out on these projects each year. Total spending on these projects in 2011-12 was £151 million, with future costs estimated at a further £1.7 billion (undiscounted).

Ongoing development of the plan

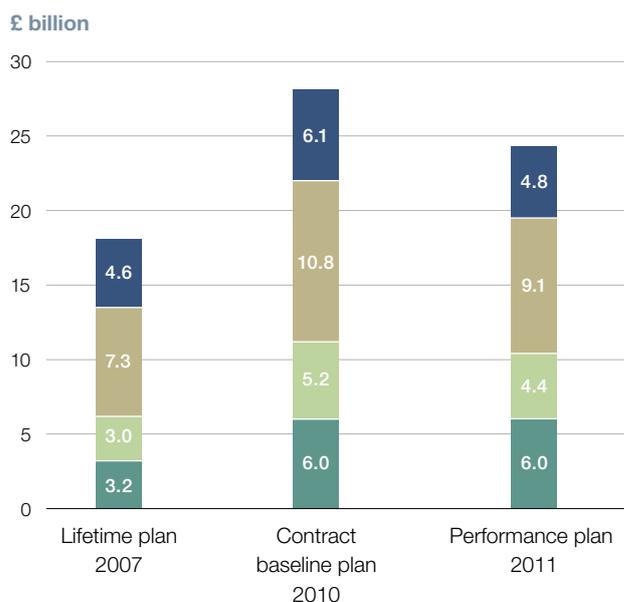
2.12 The lifetime plan will continue to evolve as strategic priorities develop. The Authority will also require Sellafield Limited to use updated performance norms to revise the plan after the initial term of the parent body agreement ends in 2014.

2.13 The Authority tracks and approves changes to the plan with a cost impact of greater than £1 million through a change control process. Since the revised lifetime plan was agreed, the Authority took a strategic decision to halt reprocessing operations at the thermal oxide reprocessing plant in 2018. This enabled Sellafield Limited in May 2012, to cancel a project with estimated future costs of over £400 million to build tanks to store waste from that plant, following the Office for Nuclear Regulation's agreement on cancelling the project. Other strategic decisions with consequences for the plan include decisions on plutonium management.

2.14 Performance against the plan will affect revisions to the plan and whether the Authority will renew the parent body agreement in 2014. The Authority can choose to renew its agreement automatically if Sellafield Limited meets predetermined minimum performance standards. The minimum performance standards include achieving at least 80 per cent of the £1.4 billion efficiency target set against the contract baseline over the agreement period to March 2014. The savings are based on Nuclear Management Partners Limited's bid for the agreement. They will come from organisational change initiatives to improve the running of the site, for example through better managing site-wide support services and maintenance work and better use of technology.

Figure 9
Estimated costs, 2009 to 2026

Costs increased significantly between the 2007 plan and the 2010 plan but then reduced by a smaller amount in the 2011 plan



- Other
- Operations
- Infrastructure
- Legacy ponds and silos

NOTES

- 1 Costs expressed in 2011-12 values but not discounted to a net present value.
- 2 Spending beyond 2026 is not included and so the figures do not consider the impact of extending completion dates beyond 2026.
- 3 The Authority did not accept the 2007 lifetime plan as it considered the plan undeliverable.

Source: National Audit Office based on Authority data

2.15 The Authority tracks savings by comparing the cost of work carried out with the estimate in the contract baseline, adjusted to remove savings not made by Sellafield Limited. Sellafield Limited forecast in September 2012 that it could exceed the minimum performance standard of 80 per cent of planned efficiency savings by £24 million during the five years to 2014. However, it expects to fall £250 million short of its £1.4 billion target for this period. As at September 2012, Sellafield Limited reported savings of £695 million as measured against the contract baseline. The Authority had verified £425 million of these savings but had not yet verified the £270 million from 2011-12.

2.16 Nuclear Management Partners Limited's primary means of improving performance at Sellafield is through deploying staff on short- or long-term secondments from its parent companies, URS, AREVA and AMEC:

- In 2011-12, Sellafield Limited had 16 executives supplied by the parent body. The Authority reimburses their salaries and other costs, such as relocation packages, which totalled £32 million between November 2008 and March 2012.
- Nuclear Management Partners also seconds specialists, known as 'reachback', partly to manage critical projects and programmes better. The Authority reimburses the cost, plus an additional 10 per cent contribution to the parent companies' overheads. Reachback costs totalled £44 million between November 2008 and March 2012. The cost in 2011-12 was £17 million, for 63 full-time equivalent secondees, against a forecast of £12 million. In February 2012, the Authority identified a lack of evidence to support using reachback resources. In response, Sellafield Limited has taken steps to improve its governance arrangements and in August 2012 produced a reachback deployment strategy.

2.17 Sellafield Limited is currently developing a comprehensive benefits tracker to evaluate the impact of its organisational change initiatives. To meet efficiency targets against the contract baseline, Sellafield Limited must increase the rate of work and address issues that have created cost overruns on individual projects. The Authority also monitors Sellafield Limited's progress against the performance plan. In 2011-12, Sellafield Limited completed £92 million less scope by value than in the performance plan for the year. The net cost of the work it undertook was slightly higher than budgeted, with overspends totalling £263 million and outweighing underspends of £248 million.

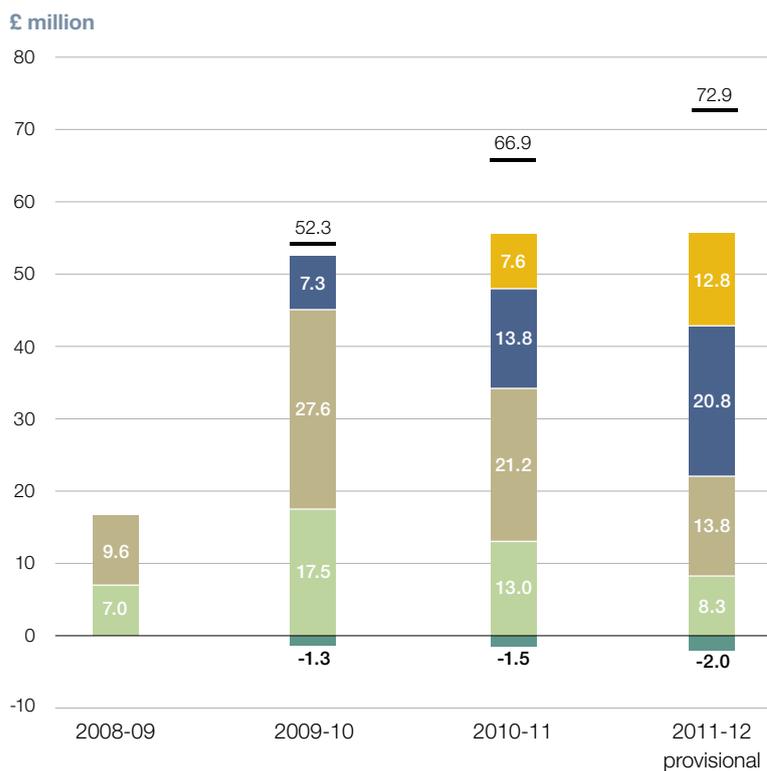
2.18 The Authority aims to incentivise Sellafield Limited by paying fees for improved performance compared to the contract baseline. The Authority estimates that Sellafield Limited will receive £54 million in fees for 2011-12.¹⁰ This is £19 million lower than the Authority's estimate of the maximum potential fee, largely as a result of poor performance on major projects (**Figure 10**). The Authority is considering alternative incentives to balance rewarding operational and decommissioning outcomes and cost efficiency. Project performance and incentives are addressed further in Part Three.

¹⁰ The Authority and Sellafield Limited have yet to finally agree the level of fee to be paid relating to 2011-12.

Figure 10

Fee payments, 2008-09 to 2011-12

The gap between the Authority's estimate of the maximum potential fee and actual fees has widened over the last three years



- The Authority's estimate of maximum potential fee.
- Other fees: for example, payments for identifying work that can be removed from the plan without affecting the achievement of objectives.
- Efficiency fee: earned for outperforming the contract baseline and achieving project and operational efficiency milestones.
- Performance based incentive fee: earned on achievement of specific project milestones. The Authority has withdrawn these incentives for the remainder of the contract period.
- Base fee: a predetermined amount earned regardless of performance.
- Abatement: a reduction applied by the Authority based on its assessment of overall performance at the site.

NOTE

1 The Authority's estimate of fees for 2011-12 is provisional and has yet to be finally agreed with Sellafield Limited.

Source: National Audit Office using Authority data

Part Three

Major project performance

3.1 The Authority has defined 16 of the 119 capital projects across its estate as 'major projects' by virtue of their size or strategic importance. Fourteen of these projects are at Sellafield and are critical to risk reduction. They provide equipment, buildings and systems to remove, treat, package and store waste contained in the highest-hazard legacy facilities or created through reprocessing spent nuclear fuels. As at March 2012, Sellafield Limited estimated the lifetime cost of completing the 14 major projects at Sellafield at £4.6 billion, of which £1.6 billion had already been spent by 31 March 2012. In 2011-12, these projects accounted for 26 per cent (£411 million) of expenditure on the site.

3.2 Sellafield Limited manages the major projects. The Authority's role is to help create the conditions for successful delivery by:

- communicating clear requirements;
- incentivising delivery;
- reviewing proposals before funds are committed at key stages in the project life cycle;
- monitoring performance; and
- intervening to ensure Sellafield Limited takes appropriate steps to address underperformance.

3.3 This part of the report examines performance on major projects at Sellafield, including the period before the Authority was established in 2005 and Nuclear Management Partners Limited was appointed in 2008. It covers:

- Sellafield Limited's performance against time and cost estimates at the start of the design and construction phases and in-year performance during 2011-12;
- factors affecting performance; and
- the impact of delays and cost overruns on some major projects on meeting the lifetime plan.

Performance against time and cost estimates

3.4 As at March 2012, Sellafield Limited estimated that the seven major projects at Sellafield that were in the planning or design phase would be completed by March 2018 and cost £2.8 billion. Between May 2011 and March 2012, the estimated completion date for the silos direct encapsulation plant project was put back by four months, the silos maintenance facility project was accelerated by three months and the dates for the rest remained unchanged (**Figure 11** on pages 30 and 31). Overall, since the projects were first initiated, their schedules have been put back by a total of 57 months, with three projects having been brought forward and two put back. The total estimated cost for the seven projects increased by £614 million between May 2011 and March 2012, almost entirely as a result of the 92 per cent increase in the cost estimate for the silos direct encapsulation plant to £1.3 billion. The increase was due to Sellafield Limited not making sufficient provision for risk and uncertainty in the earlier estimate that it prepared before it had assessed the full cost implications of the design.

3.5 Sellafield Limited estimates that the seven major projects that were in the construction phase at March 2012 will be completed by June 2023 and cost £1.76 billion in total. The estimated time to complete six of these projects was extended by between 2 and 19 months between May 2011 and March 2012 (**Figure 12** on pages 32 and 33). Estimates for the total cost of these projects increased during this period by £294 million. Eighty-three per cent of the increase was due to cost escalation in the evaporator D project. Overall, since the projects started construction, their schedules have been put back by a total of 284 months, with one project brought forward by 20 months.

Performance during 2011-12

3.6 The Authority measures in-year progress of major projects against budgeted time and cost using schedule and cost performance indices. Our analysis of these indices shows that 12 of the 14 projects delivered less than the planned scope of work during 2011-12, with five delivering less than 90 per cent of the planned scope. Five projects overran the budgeted cost of work completed, of which three exceeded it by more than 10 per cent. Eight delivered the work completed for less than the budgeted cost (**Figure 13** on page 34).

Factors affecting performance

3.7 We carried out a high-level review of 10 of the 14 major projects and more detailed case studies of the remaining four to identify the reasons for underperformance. We identified five factors that led to cost escalation and delays:

- The uncertainties involved in these projects require taxpayers to bear the impact of delay and cost increases, and limits risk sharing.
- Gaps in the capability of Sellafield Limited's subcontractors.
- Construction proceeded before design risks were sufficiently addressed.
- Weaknesses in cost and schedule estimation.
- Weaknesses in project reporting and monitoring.

Figure 11

The performance of projects in the planning and design phase

Estimated costs for projects at the design and planning stage have increased by 55 per cent compared to initial estimates or 35 per cent excluding the highly active liquor storage tanks project

Project	Description	Year project initiated	Years in planning/design stage	Estimated cost at initiation (£m)	Estimated cost in performance plan May 2011 (£m)	Estimated cost as at March 2012 (£m)	Variance against original upper estimate (£m)	Variance against upper estimate at initiation (%)	Variance against performance plan estimated cost (£m)	Total spend to March 2012 (£m)	Planned delivery date when initiated	Planned delivery date in 2011 performance plan	Estimated delivery date as at March 2012	Variance against delivery date when initiated (months)	Variance against delivery date in 2011 performance plan (months)
Bulk sludge and fuel retrievals ³	Provide assets needed to support the export of ponds solids, wet bay solids and sludge	2004	8	73–229	227	233	4	2	6	132	December 2012	November 2016	November 2016	47	0
Pile fuel cladding silo ³	Design and build a new waste retrieval plant	2005	7	150–495	342	341	-154	-31	-1	117	October 2019	August 2017	August 2017	-26	0
Box encapsulation plant product stores comprehensive import/export facility ³	Design and build a store with an import/export facility for containerised intermediate-level waste	2006	6	108–119	277	281	162	136	4	43	January 2019	October 2017	October 2017	-15	0
Silos maintenance facility ³	Build a high contamination workshop to keep machines functional or permit their replacement during retrieval operations	2006	5	49–180	165	165	-15	-8	0	21	October 2011	May 2017	February 2017	64	-3
Highly active liquor storage tanks ³	Build replacement tanks to hold highly active liquid waste from reprocessing	2007	5	83	474	474	391	471	0	39	March 2013	March 2018	Cancelled	0	0
Silos direct encapsulation plant ³	Build a treatment plant to deal with hazardous legacy waste	2010	2	560–669	668	1,281	612	91	613	207	November 2018	June 2017	October 2017	-13	4
Ponds solid treatment plant technical underpinning project	Complete a series of studies to define solutions for the management of ponds solids	2010	2	29	29	21	-8	-28	-8	3	March 2015	March 2015	March 2015	0	0
Total				1,052–1,804	2,182	2,796	992	55	614	562				57	1
Total (excluding highly active liquor storage tanks)				969–1,721	1,708	2,322	601	35	614	523				57	1

NOTES

- 1 The cost estimates at initiation are the ranges based on historic data used in the business cases for each project.
- 2 The costs in this table are 'P50' estimates (meaning there is a 50 per cent probability of the projects being delivered either under or over budget), which include allowances for risk and uncertainty.
- 3 Cost and schedule estimates are provisional due to high levels of uncertainty.
- 4 Figures quoted are undiscounted and have been adjusted for inflation.
- 5 The Authority took a strategic decision to cancel the highly active storage tanks project in May 2012.
- 6 Five of these projects were initiated before Nuclear Management Partners Limited was appointed.

Source: National Audit Office analysis of Authority data

Figure 12

The performance of projects in the construction phase

Total costs have increased by 51 per cent compared to the estimate when construction started

Project	Description	Date passed design gate	Estimated cost at design gate	Estimated cost in performance plan May 2011	Estimated cost as at March 2012	Variance against design gate estimate	Variance against design gate estimate	Variance against the performance plan estimated cost (£m)	Total spend to March 2012 (£m)	Planned delivery date at design gate	Planned delivery date in 2011 performance plan	Estimated delivery date as at March 2012	Variance against delivery date at design gate (months)	Variance against delivery date in 2011 performance plan (months)	PBI fees paid in 2011-12 (£000s)
			(£m)	(£m)	(£m)	(£m)	(%)								
Local sludge treatment plant	Construct storage tanks to hold radioactive sludge and a building to house them with settling plant, utilities and ventilation equipment.	May 2006 ³	32	63	63	31	97	0	63	March 2008	January 2012	Delivered March 2012	48	2	570
Buffer sludge packaging plant ¹	Construct storage capability for radioactive sludge until it can be processed into a suitable waste form for final disposal.	September 2006 ³	108	202	234	126	117	32	172	June 2008	October 2013	March 2014	69	5	700
Encapsulated product store ³	Construct new store for intermediate-level radioactive waste from reprocessing and future hazard reduction programmes.	October 2006 ³	94	103	103	9	10	0	99	September 2010	August 2012	November 2012	26	3	0
Magnox swarf storage silos retrievals	Construct equipment and systems that can safely remove radioactive waste from a storage silo.	March 2007 ³	243	421	387	144	59	-34	167	April 2015	June 2023	June 2023	98	0	700
Separation area ventilation	Construct a 120 metre high chimney with associated plant room, monitoring room and substation.	August 2008 ³	144	120	138	-6	-4	18	106	August 2011	January 2013	November 2013	27	10	700
Evaporator D	Construct a new evaporator to reduce the volume of highly active liquors (a by-product of reprocessing).	April 2009	397	398	641	244	61	243	375	July 2014	May 2014	December 2015	16	19	375
Box transfer facility	Construct a tunnel and associated mechanical devices to transport processed waste contained inside of 3m ³ boxes.	December 2011	148	158	193	45	30	35	40	November 2018	January 2017	March 2017	-20	2	0
Total			1,166	1,465	1,759	593	51	294	1,022				264	41	3,045

NOTES

1 The costs in this table are 'P50' estimates that include allowances for risk and uncertainty. This means there is a 50 per cent probability of the projects being delivered either under or over budget.

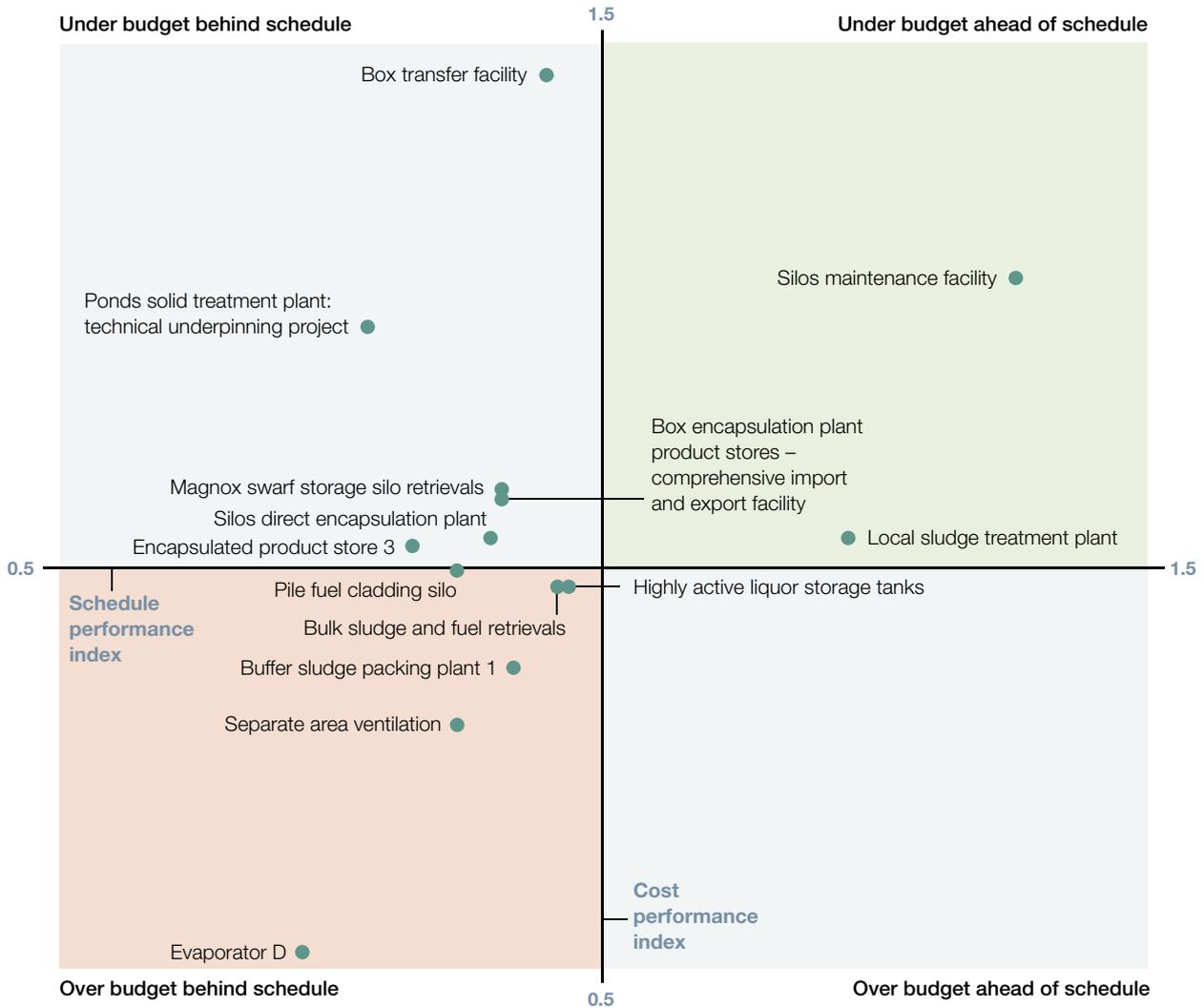
2 Figures quoted are undiscounted and have been adjusted for inflation.

3 Five of these projects passed the design gate before the appointment of Nuclear Management Partners Limited.

Source: National Audit Office based on data supplied by the Authority

Figure 13
Major projects performance in 2011-12

Twelve projects delivered less than the planned scope of work and for five projects the cost of work completed was more than budgeted



NOTES

- 1 Schedule performance index is the ratio of budgeted cost of work performed to budgeted cost of work scheduled. A ratio greater than 1 means that the project is running ahead of schedule and less than 1 is running behind schedule.
- 2 Cost performance index is the ratio of budgeted cost of work performed to actual cost of work performed. A ratio greater than 1 means that the project is running under budget and less than 1 is running over budget.

Source: National Audit Office based on Authority data

Risk transfer

3.8 The uncertainties involved in assessing the risks at Sellafield and potential technical solutions means that the Authority has had to adopt a contract that involves it reimbursing Sellafield Limited for all allowable costs, with very limited risk sharing. The taxpayer therefore bears the impact of delays and cost increases rather than Sellafield Limited and its subcontractors. The Authority reimburses Sellafield Limited for all allowable costs incurred in doing the work agreed in the lifetime plan up to an agreed site funding limit. The Authority sets the funding limit at the start of the year, but can amend it within its budget allocation for its whole estate.

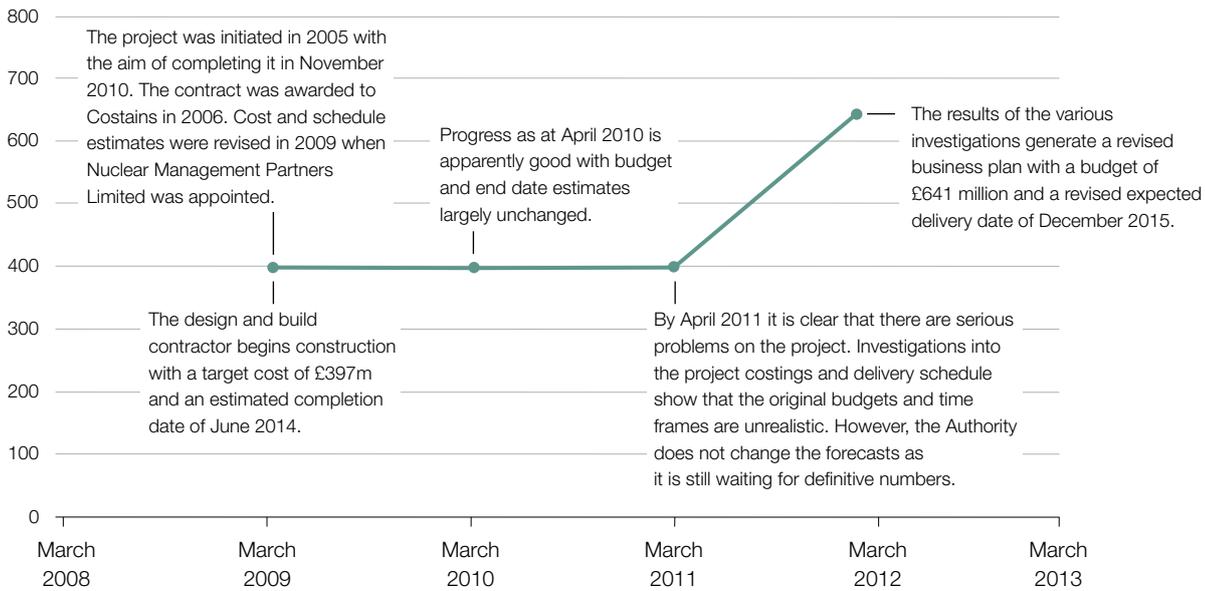
3.9 The fees regime incentivises Sellafield Limited to keep costs down but results in little risk sharing. Sellafield Limited can claim an efficiency fee of up to 25 per cent of savings against the contract baseline. Where a project overspends, the amount of available efficiency fee that it can claim is reduced by up to 25 per cent of overspends. However, fee reductions caused by increased project costs are small relative to the additional costs borne by the Authority (**Case example 1** overleaf). The Authority continues to apply fees to projects where schedules and costs have slipped as an ongoing incentive. The Authority is considering how the existing incentive framework could be strengthened if it chooses to renew the parent body agreement in 2014.

3.10 Sellafield Limited's contracts with its subcontractors generally involve very little risk transfer. Eleven of its major projects are managed by subcontractors through reimbursement contracts. Two are target cost contracts involving limited risk transfer, where the subcontractor shares savings if actual costs are lower than the target, and one is through a fixed price contract. This reflects the difficulty of passing the risk of cost increases or delays in complex nuclear projects at Sellafield on to the supply chain. Rising costs and the impact of delays are therefore borne by Sellafield Limited and then passed on to the Authority. In the project using a fixed price contract, the subcontractor has borne most of the impact of cost escalation (**Case example 2** on page 37).

Case example 1

A project in the construction phase: evaporator D

Estimated cost (£m)



In 2005, the Authority approved work to start developing plans for a new evaporator to reduce the volume of highly active liquor created by reprocessing spent nuclear fuel. Two of the existing three evaporators were approaching the end of their lives and a new evaporator was needed to avoid a build-up of stocks of highly active liquor and to ensure that Sellafield could meet contractual commitments to reprocess fuel.

In April 2009, the Authority approved Sellafield Limited, and its design and build subcontractor Costain Oil and Gas, to begin construction, before all design issues had been fully resolved. The design was based on requirements for withstanding earthquakes that Sellafield Limited later found, in 2010, used a conservative interpretation of standards that far exceeded what was necessary. Subsequent changes in design and construction requirements contributed to cost increases and delays. Reworking that was needed due to weld quality of components provided by subcontractors not meeting nuclear standards caused further delays and cost increases.

By the end of 2010, the Authority knew that the project was in distress, but firm figures for cost increases and schedule delays were not available to include them in the May 2011 plan.

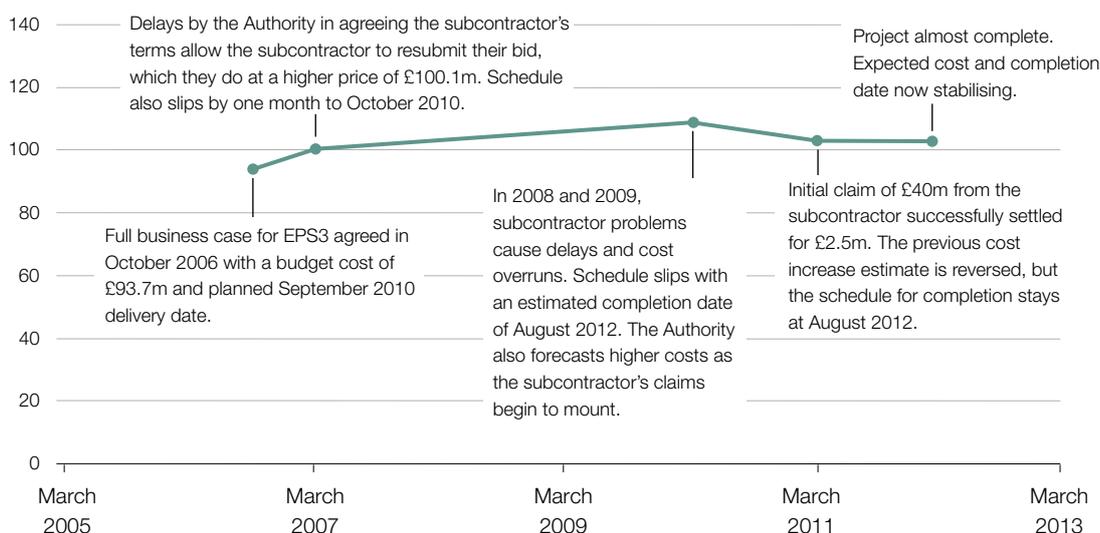
The significant cost overruns on the project could reduce the total of available fees for Sellafield Limited by up to £40 million over the project’s life. However, the Authority and hence taxpayers will bear the full increase in the total cost of the project of £244 million.

Source: National Audit Office analysis of Authority data

Case example 2

Encapsulated product store 3

Estimated cost (£m)



Constructing a new interim storage facility, for intermediate level radioactive waste arising from spent fuel reprocessing, is required as existing stores are nearing their capacity. If storage space runs out, Sellafield could not deliver the magnox hazard reduction programme or meet contractual commitments to reprocess fuel. The Authority approved Sellafield Limited's proposal to award a fixed-price contract to design and build the new store to Laing O'Rourke in April 2007. The risks were relatively low as it was similar in design to two existing stores. Construction costs started to increase during 2009 as a result of difficulties experienced by the subcontractor, which included the insolvency of one its main suppliers. The Authority was closely involved in discussions with Sellafield Limited about its response to compensation claims raised by Laing O'Rourke. Although the cost for the Authority of this project has increased by £9 million, it could have been some £40 million higher had Sellafield Limited used a cost-reimbursement contract. The subcontractor's difficulties and the contractual dispute also caused delays in construction of 17 months.

Sellafield Limited has, since 2009, earned £400,000 in performance-based incentives on this project out of total potential performance based incentive fees of £800,000.

Source: National Audit Office analysis of Authority data

Supply chain capability

3.11 Gaps in the capability of subcontractors in the supply chain to undertake work to the standards required for nuclear installations have had direct consequences for the speed and efficiency of project delivery. For example, the Authority estimates that £50 million of the £244 million increase in the cost of evaporator D and part of the 18-month delay since 2009 is because the subcontractor lacked experience in welding to the necessary nuclear quality standards. The Authority was aware of these risks when it approved the start of construction. It relied on Sellafield Limited's assurances that its subcontractor could manage the risks. The Authority did not obtain assurance from Sellafield Limited that it had put in place appropriate quality assurance and training.

3.12 The Authority is working with Sellafield Limited to develop its procurement strategy and identify how to build up the supply chain to meet the needs of the site. It is developing its own commercial assurance plan to review progress in these areas across its estate.

Construction began before design requirements were fully understood

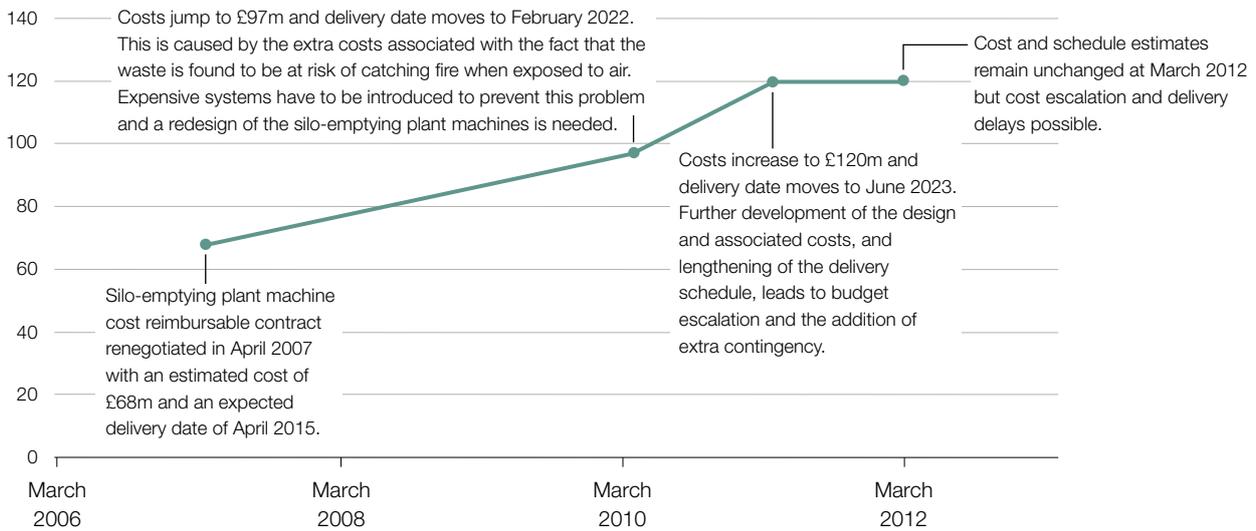
3.13 Pressure to show progress in risk reduction has sometimes resulted in Sellafield Limited starting construction before design issues were resolved and technical solutions tested. This has been a cause of some cost overruns and delays across major projects (Case example 1). Past decisions to start construction early continue to impact on delivery.

3.14 Uncertainties about the characteristics of waste and therefore design requirements have posed particular problems in projects set up by Sellafield Limited to remove waste from legacy ponds and silos. This has been a key factor behind the protracted delays in building machines to extract waste from silos used to store intermediate level waste (Case example 3). It has also had significant financial impacts. For example, some £400 million was spent between 1994 and 2002 on an aborted project to build a plant to treat waste extracted from silos before the Authority took ownership of Sellafield. The Authority approved a further £128 million between 2006 and 2008 on a second aborted attempt to build this plant. In both cases, the chosen design and technology could not deal with the waste the facility was supposed to treat. The silos direct encapsulation plant project is the third attempt to build this facility, at an estimated cost of nearly £1.3 billion (Case example 4 on page 40).

Case example 3

Silo-emptying plant machines

Estimated cost (£m)



This is a highly complex sub-project within the magnox swarf storage silos retrievals project. It involves designing and constructing machines to remove corroding waste from the silos using remotely controlled devices. The project has experienced protracted delays and cost escalation since construction of the silo-emptying machines started in the late 1990s. Work was suspended from 2002 to 2007 after the risk of a hydrogen explosion was identified. Work restarted in 2007 but was delayed again after Sellafield Limited identified that the revised design could result in waste catching fire.

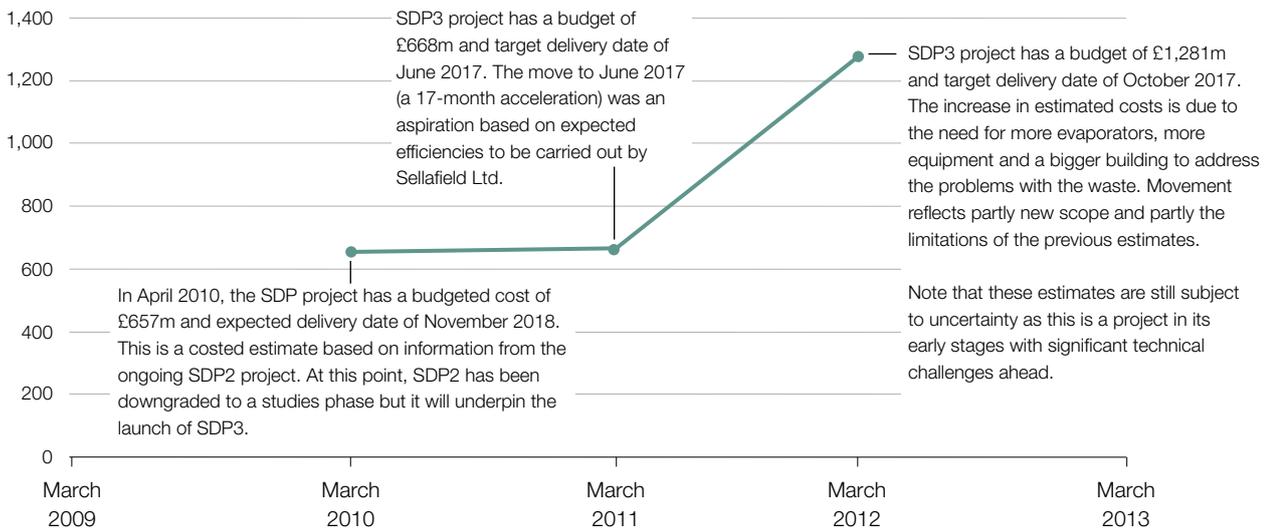
Sellafield Limited has, since April 2009, met one of the two fee milestones set for this sub-project and earned £500,000 performance-based incentive fees from potential total in-year fees of £1.07 million. Since April 2007, the estimated lifetime cost of this project has increased by £52 million and the schedule has slipped by eight years, including cost increases of £23 million since April 2010.

Source: National Audit Office analysis of Authority data

Case example 4

Project in the design phase: silos direct encapsulation plant

Estimated cost (£m)



In the early 1990s, the site operator at Sellafield developed plans to build a new treatment plant to receive, treat and immobilise waste material removed from the magnox swarf storage silos. Although the characteristics of the waste and therefore design requirements were uncertain, construction of the facility proceeded. The first attempt was abandoned in 2002 and the second was put on hold in 2008.

Sellafield Limited's current project, with design and development support from Nuvia/Vinci Construction UK, is the highest value major project in the Authority's estate. It had an estimated cost of nearly £1.3 billion (additional to the £528 million already spent).

There has been progress in developing and checking the technical process. The business case that Sellafield submitted to the Authority in January 2011 contained a lower-range estimate of £560 million and an upper-range estimate of £669 million. This range did not adequately reflect the level of uncertainty. The subsequent July 2011 business case contained a lower-range estimate of £800 million and upper-range estimate of £1,600 million, with a central estimate of £1,281 million. The increase was due to Sellafield Limited carrying out further work to properly reflect the costs for the design needed to address the risk of waste catching fire when exposed to air and to manage higher than expected volumes of effluent. Subsequent Authority and Sellafield Limited reviews concluded that Sellafield Limited's project management capability needed to be strengthened and it has implemented improved governance procedures.

Sellafield Limited plans to re-compete the project and is considering awarding a new target cost contract. It aims to transfer risks to the supply chain by introducing competitive pressure on costs and schedules, accessing the most competent subcontractor and soliciting ideas to improve the design, construction, procurement and commissioning. Sellafield Limited plans to progress detailed design with the existing subcontractor in parallel with re-competing the contract. Although this increases the risk of design issues and cost increases arising after the new contract is awarded, Sellafield Limited considers that this is necessary to fast-track the project.

The project plan assumes completion during 2018-19. Sellafield Limited is aiming to complete this project earlier in October 2017, to allow waste retrieval from the magnox swarf storage silo to start, but has not yet identified how it will achieve this.

Source: National Audit Office analysis of Authority data

3.15 Sellafield Limited changed its approvals processes in 2010, with the aim of ensuring that construction would not start until design requirements and the underpinning technology reach an appropriate level of development. Under the revised approach, endorsed by the Authority, a technical readiness board reviews the proposals. For example, Sellafield Limited and the Authority will not approve the silos direct encapsulation plant project to proceed to construction until proposed solutions have been proven.

3.16 A significant feature of major projects at Sellafield is the extended timescales for planning and design. The Authority attributes this to the particularly complex nature of Sellafield projects and the potential for very significant consequences from accidents, but recognises that further work is needed to understand the reasons.

Cost and schedule estimation

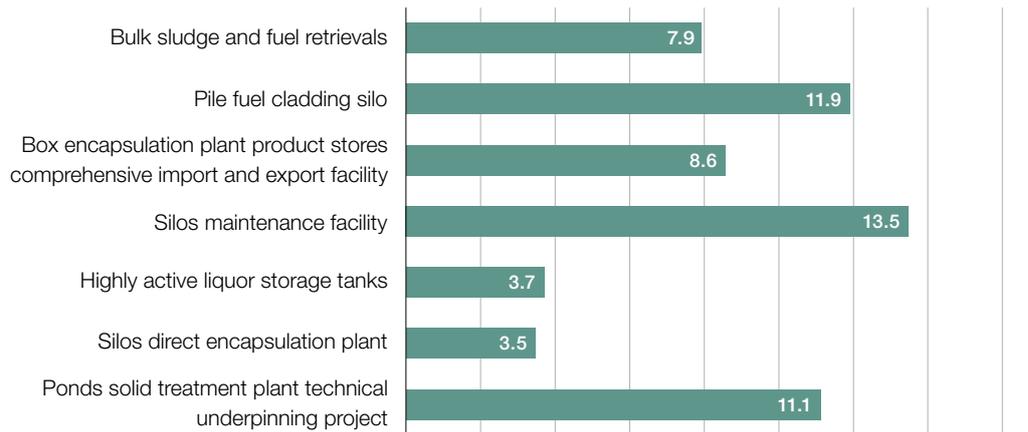
3.17 Most of the major projects at Sellafield are complex and unique nuclear chemical engineering projects. Cost estimation is difficult and there is considerable uncertainty in Sellafield Limited's estimates through the design stage. For example, a significant increase on the silos direct encapsulation plant during 2011 was largely due to Sellafield Limited having made insufficient allowance for risk and uncertainty in the earlier estimate that it had prepared before the full cost implication of the design had been assessed (case example 4). The increase in estimated costs could have resulted in needing additional government funding or the future deferral of other projects. However, it was offset by the Authority's strategic decision to cancel the highly active storage tanks project.

3.18 HM Treasury guidance expects government to allow for optimism bias in business cases. Its recommended adjustment range for the generic project types we examined at Sellafield is between 6 and 200 per cent, based on assessing cost and schedule increases in past government projects. Sellafield Limited holds allowances for risk and uncertainty, which are reflected in the cost estimates in the lifetime plan. As at March 2012, the allowances for major projects ranged from 0.9 per cent to 13.5 per cent of the total estimated costs (**Figure 14** overleaf). Our findings show that Sellafield major projects in construction have increased in cost by up to 117 per cent. This suggests that risks have not been fully reflected in contingency allowances and the provision may give insufficient allowance for optimism bias. The Authority is piloting a benchmarking tool, which includes benchmarking contingency provisions. The Authority intends to roll it out at Sellafield.

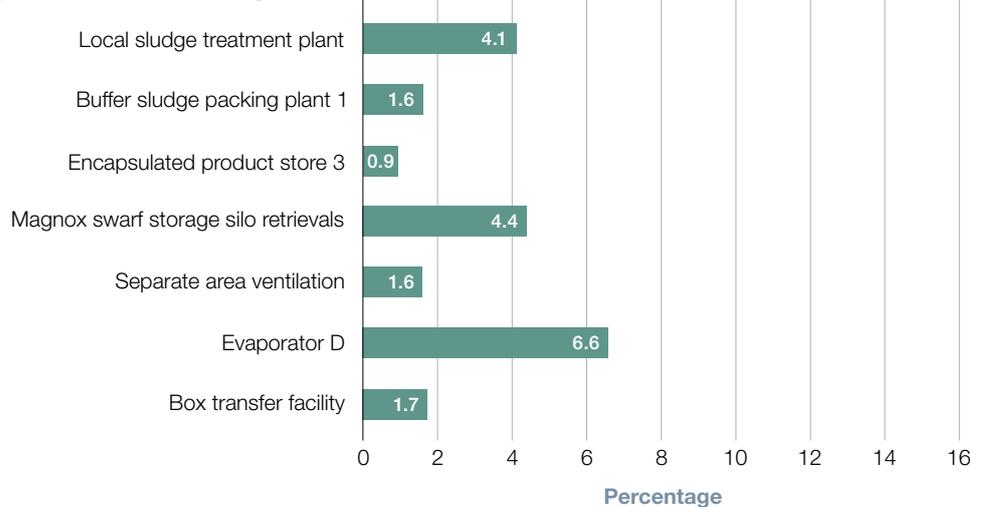
Figure 14
Contingency allowances

Contingency allowances range from 0.9 to 13.5 per cent

Projects at planning stage



Projects at construction stage



NOTE

1 Figures show contingency as a percentage of the 'p50' total cost estimates as at March 2012, which include allowances for contingency and have a 50 per cent probability of the projects being delivered either under or over that estimate.

Source: National Audit Office based on Authority data

Weaknesses in project reporting and monitoring

3.19 Identifying emerging issues early on depends on accurate and timely reporting and monitoring of progress and risks to delivery. We found evidence of gaps in information the Authority collected from Sellafield Limited on project estimates and risks. There were also weaknesses in communication between Sellafield Limited and the Authority on some projects. For example, until mid 2011 the Authority did not monitor the use of contingency, which would have given it a much earlier warning of emerging problems on evaporator D. On that project the use of project contingency started to accelerate from March 2010 onwards and by May 2011 the entire allowance of £36 million had been used. The Authority also collected insufficient information on time and cost variances to give early warnings of poor progress.

3.20 The emerging issues in the silos direct encapsulation plant and evaporator D projects prompted the Authority to introduce a new reporting framework for major projects in May 2011. This has significantly strengthened the Authority's understanding of performance. There are, however, still some issues in the quality and presentation of information that the Authority and Sellafield Limited are seeking to address. In September 2011, the Authority also created a project and programme review group to review its main programmes and projects and appointed business intervention leads to address underperformance with Sellafield Limited. By September 2012, the group had reviewed 5 of the 14 major projects.

3.21 The improved information that the Authority is collecting could increase transparent external reporting on performance. The Authority only selectively refers to project performance in external reporting and during 2012 its reporting on the performance of the evaporator D project was not kept up to date. The Authority routinely reports on performance to the Department of Energy and Climate Change, including on individual projects. It is working with the Shareholder Executive to ensure that the indicators cover the full range of issues. Most major projects require approval from the Department of Energy and Climate Change, but are currently outside the scope of the external assurance for major government projects provided by the Major Projects Authority.

Impact of delays and cost overruns

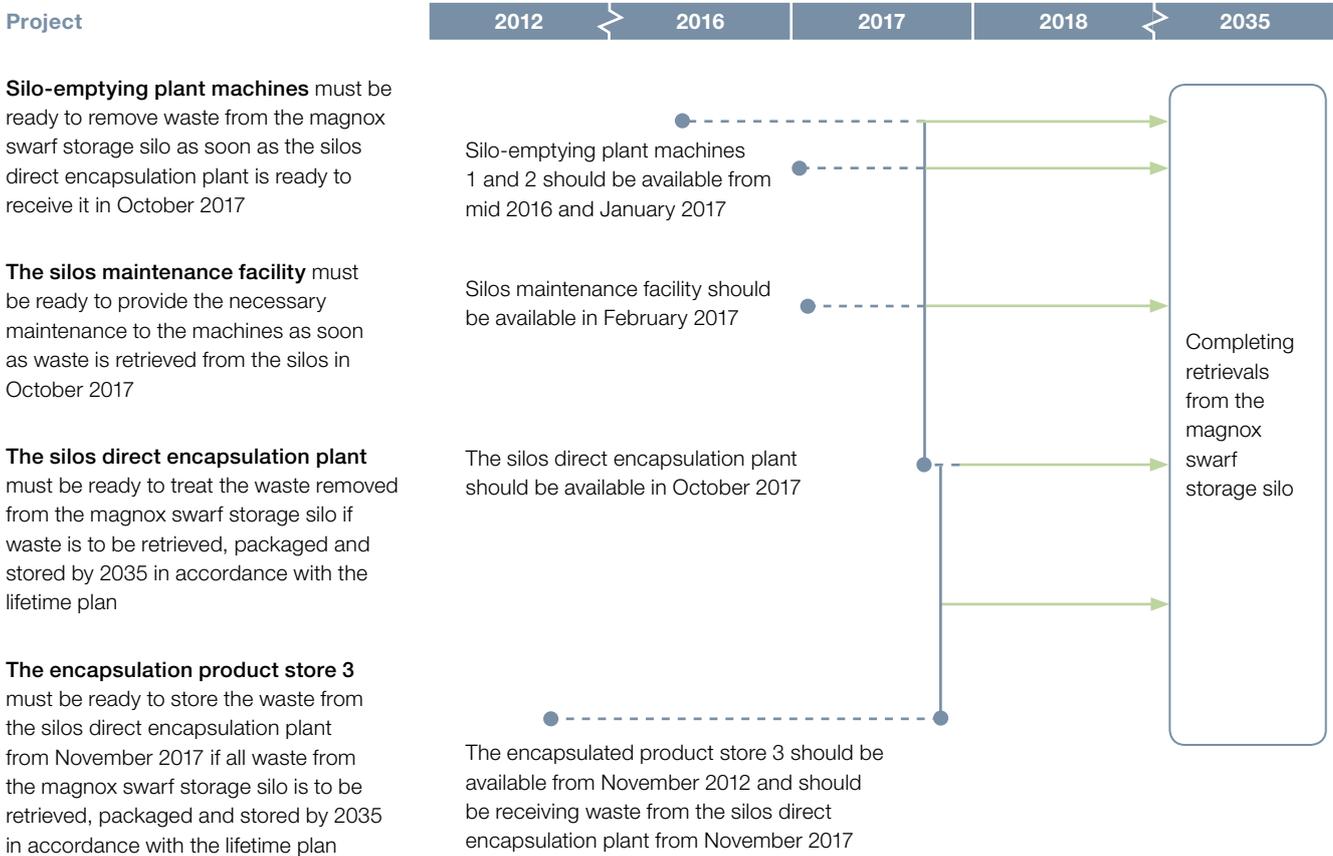
3.22 Cost increases have not affected the affordability of tackling the highest hazards, as HM Treasury has agreed that spending on them should be protected. Recent cost escalation in major projects has been offset by savings and scope deletion elsewhere in the plans. For example, the Authority decided to cancel the construction of highly active storage tanks, which reduced budgeted costs between 2012 and 2015 by £181 million.

3.23 The extensions to the forecast duration of some major projects have also been offset by changes in other parts of the site so overall operations and schedules have not been affected. For example, the delay in completing evaporator D should not impact on operations, partly because fuel reprocessing operations have been slower than originally expected. Similarly, the two-year delay in the encapsulated product store construction schedule has not had any impact on delivery as existing stores have been used at a slower rate than planned because of the intermediate level waste volumes being lower than forecast. The delayed completion date for the store is November 2012 and it is expected to be needed from July 2013 at the earliest. If waste volumes had been in line with original forecasts, the delay could have interrupted operations.

3.24 Delays on some projects could put at risk completing high hazard reduction. For example, forecast timescales for retrieving waste from the magnox swarf storage silo depends on completing a number of linked projects. If the silos direct encapsulation plant project is not completed as planned in October 2017, this could delay the retrieval, and hence the treatment and safe storage, of the hazardous material in the silo (Figure 15).

Figure 15
The magnox swarf storage silos programme

Delays in completing individual projects could delay hazard reduction



Source: National Audit Office

Appendix One

Our audit approach

1 This study examined the Nuclear Decommissioning Authority's approach to managing risk and the progress in decommissioning and cleaning-up the site, reviewing in detail the Authority's major projects at Sellafield. We reviewed the following:

- The development of the lifetime plan to reduce risks, the assurance the Authority has conducted and the remaining areas of uncertainty in the plan's costs and schedules.
- Key shifts in costs and schedules in the plan as it developed since 2007 and the potential for developing the plan further.
- Progress in achieving the major projects, common causes of delay and cost increases and the Authority's work to improve value for money.

2 We applied an analytical framework to assess the Authority's approach to risk and prioritisation through developing a strategy and revising plans for decommissioning and clean-up.

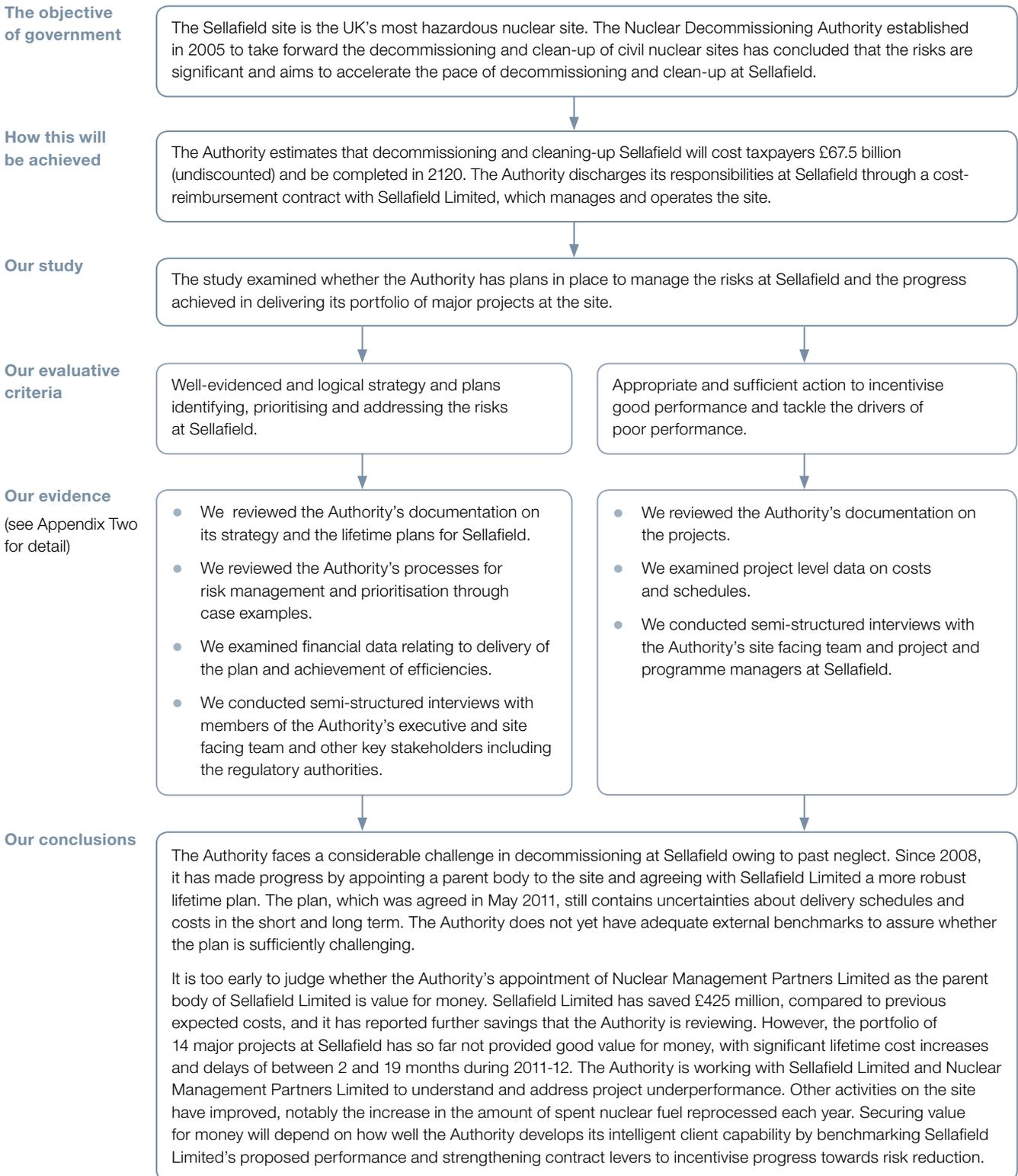
3 We reviewed key planning documents about the development and assurance of the lifetime plan and identified the progress in achieving the plan, highlighting changes to costs and schedules.

4 We established the progress in achieving major projects, identifying shifts in lifetime cost estimates and delivery milestones on individual projects. We also investigated the reasons for significant cost and schedule variances, using the National Audit Office's analytical framework, *Initiating successful projects*.¹¹

5 Our audit approach is summarised in **Figure 16** overleaf. Our evidence base is described in Appendix Two.

¹¹ National Audit Office, *Initiating successful projects*, December 2011. Available at: www.nao.org.uk/publications/1012/initiating_successful_projects.aspx

Figure 16
Our audit approach



Appendix Two

Our evidence base

1 We reached our independent conclusions on the value for money of the Authority's management of risk and of the progress made in achieving its portfolio of major projects. We did so by analysing the data we collected on developing and assuring the lifetime plans for the site, and on the progress of the major projects against budgets and plans.

2 We reviewed documents to understand how the Authority planned and prioritised and deployed resources including reviews of:

- the Authority's strategy documents and minutes of relevant strategy meetings;
- the Authority's and Sellafield Limited's documents about developing the contract baseline and performance plan including process guidance on methods to assess and prioritise hazards and risks;
- regulatory assessments of planning and prioritisation;
- the Authority's assurance assessments of the lifetime plans and relevant internal audit reports and reconciliations of programme and project schedules in the lifetime plans;
- the Authority's process for undertaking change controls to the plan;
- the Authority's assessment together with Sellafield Limited of resources required to take forward decommissioning and align the plan with affordability constraints;
- the Authority's reviews of programme business cases;
- the Authority's ongoing assurance programme; and
- the Authority's commercial reviews.

3 We reviewed processes using case examples of projects not defined as major projects to test the Authority's strategic alignment, prioritisation and change control processes.

4 We collected high-level data for ten of the major projects, covering overall performance, and more detailed evidence on the remaining four projects to identify the key performance drivers. Our reviews included examining:

- historic and current project business cases;
- safety cases;
- risk registers;
- performance reports;
- cost and time estimating reports; and
- contingency management reports.

5 We undertook some 50 semi-structured interviews with members of the Authority's executive and Sellafield based 'site facing' team, including:

- the Chief Executive; Chief Financial Officer; Commercial Director; Communications Director; Strategy Director and Chief Operating Officer; and
- the Authority's head office functions (business planning, financial management, risk, commercial, projects and programmes, and asset management).

6 We also interviewed key officials from Sellafield Limited including:

- the Deputy Managing Director;
- officials from the major projects directorate; and
- key programme managers.

7 We also interviewed other stakeholders including key subcontractors to Sellafield Limited, HM Treasury, the Shareholder Executive, the Department of Energy and Climate Change, the Office for Nuclear Regulation and the Environment Agency.

8 We sought expert input from the consultants AD Little.

9 We held seminars with members of the Royal Academy of Engineers.

Note on financial data

10 All financial data is presented undiscounted, unless otherwise stated, and adjusted for inflation to 2011-12 prices. The value of the provision is adjusted for inflation using the retail price index in accordance with agreed accounting practices. To enable comparability, we adjusted estimates of plan costs to 2026 on the same basis. Project costs have been adjusted for inflation using the Authority's own inflation index based on materials and labour specific to the nuclear industry. The costs are therefore not directly comparable, but the impact of the different inflationary indices is not significant.



Design and Production by
NAO Communications
DP Ref: 009991-001

This report has been printed on Consort 155 and contains material sourced from responsibly managed and sustainable forests certified in accordance with the FSC (Forest Stewardship Council).

The wood pulp is totally recyclable and acid-free. Our printers also have full ISO 14001 environmental accreditation, which ensures that they have effective procedures in place to manage waste and practices that may affect the environment.



National Audit Office

Published by TSO (The Stationery Office) and available from:

Online

www.tsoshop.co.uk

Mail, telephone, fax and email

TSO

PO Box 29, Norwich NR3 1GN

Telephone orders/general enquiries: 0870 600 5522

Order through the Parliamentary Hotline

Lo-Call 0845 7 023474

Fax orders: 0870 600 5533

Email: customer.services@tso.co.uk

Textphone: 0870 240 3701

The Houses of Parliament Shop

12 Bridge Street, Parliament Square,

London SW1A 2JX

Telephone orders/general enquiries: 020 7219 3890

Fax orders: 020 7219 3866

Email: shop@parliament.uk

Internet: <http://www.shop.parliament.uk>

TSO@Blackwell and other accredited agents

£16.00

ISBN 978-0-10-298045-5



9 780102 980455