



National Audit Office

## **THE NUCLEAR DECOMMISSIONING AUTHORITY** Taking forward decommissioning

REPORT BY THE COMPTROLLER AND AUDITOR GENERAL | HC 238 Session 2007-2008 | 30 January 2008

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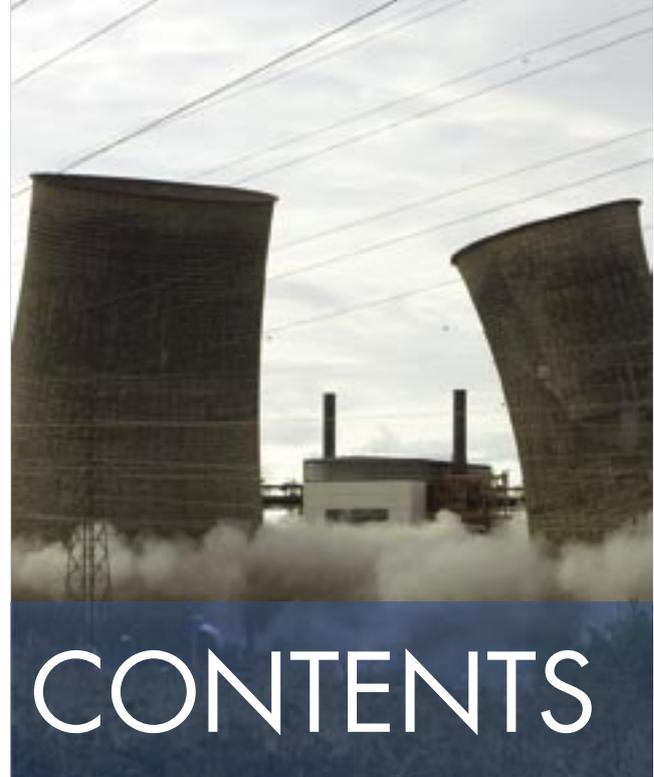


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**THE NUCLEAR DECOMMISSIONING AUTHORITY**  
Taking forward decommissioning

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**24 January 2008**

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# SUMMARY

**1** A growing proportion of the UK's civil public sector nuclear facilities have reached, or are nearing, the end of their operational life. By December 2007, 14 facilities had already shut down and were in the process of being decommissioned, which includes cleaning-up the sites.<sup>1</sup> Parts of Sellafield – the UK's largest civil nuclear site – were also being decommissioned and cleaned-up. Current plans envisage that most of these sites will be cleared over a 100-year period. The current best estimate puts the undiscounted future costs of decommissioning sites at around £61 billion at 2007 prices.

**2** The Nuclear Decommissioning Authority (the Authority) was established on 1 April 2005 to ensure the safe and efficient clean-up of the UK's first generation of civil public sector nuclear facilities. It owns a varied and ageing portfolio of 19 sites.<sup>2</sup> The sites include: Magnox nuclear power stations; research sites, including Dounreay; and the fuel handling, recycling and production facilities at Sellafield. The Authority is a non-departmental public body sponsored by the Department for Business, Enterprise and Regulatory Reform (the Department), which approves its strategy,

<sup>1</sup> In this report we use the term decommissioning in a broad sense to cover the range of activities required to take a facility which has ceased operating to its end state.

<sup>2</sup> The Authority has full ownership of 18 sites and has a lease agreement with the United Kingdom Atomic Energy Authority for that part of the Harwell site which was designated to it under the Energy Act 2004 and requires decommissioning and clean-up.

plans and budget. The Authority also reports to the Scottish Ministers who agree its strategy and plans for Scottish sites, and thus the Department and the Scottish Government are involved in the Authority's governance.

**3** The Authority discharges its responsibilities for decommissioning through management and operation contracts with licensed operators at each site. These site licensees manage sites, including preparing site plans, performing and sub-contracting work. The site licensees are, in turn, owned by parent bodies. The relationship between the Authority and the parent body is governed by a parent body agreement. At December 2007 the parent bodies comprised: the United Kingdom Atomic Energy Authority, a non-departmental public body; British Nuclear Group Limited (part of British Nuclear Fuels Limited, a company wholly owned by government); Reactor Sites Management Company Ltd, part of the private company EnergySolutions; and Westinghouse Electric Company, part of the Toshiba Group.

**4** The UK Government set out, in broad terms, the structure for taking forward decommissioning in the 2002 White Paper *Managing the Nuclear Legacy* Cm 5552. The structure is intended to allow the Authority to put the right to be the parent body out to competition whilst retaining the skills and or knowledge of staff within the site licensees. This avoids the need to license a new operator after each competition. The Government believes competition will stimulate innovation and bring strengthened management to the decommissioning process. The first of these competitions, to become the parent body for the Low Level Waste Repository near Drigg, is expected to be concluded by the end of February 2008 subject to Government approval. The competition to become the parent body for the Sellafield group of sites<sup>3</sup> is underway and due to be concluded by the end of 2008. The contracts are expected to run for an initial period of five years, extendable for a total of 12 further years over three periods, subject to performance.

**5** The Energy Act 2004 imposed a duty on the Authority to safeguard the environment; maintain health and safety; and preserve nuclear security. The Act left the statutory responsibilities of site operators, and their relationship with health, safety, security and environmental protection regulators, unchanged. Ultimate legal responsibility for determining how to comply with regulatory requirements remains with the site licensees. As such there are limits on the extent to which the Authority or the parent body can

influence how the site licensee delivers the work paid for by the Authority. **Figure 1 overleaf** summarises the relationship between the different parties.

**6** The Authority's income comes from a mix of grant-in-aid from the Department (expected to be £1,420 million in 2007-08) and revenue generated from commercial activities (budgeted to be £1,370 million in 2007-08), including power generation and fuel processing, that are centred on four of its sites. In 2006-07, the Authority spent around £690 million on project work at decommissioning sites, of which 40 per cent was spent at Sellafield (see paragraphs 1.13 and 3.2).

**7** This report examines the Authority's performance in using its contracts to take forward the decommissioning of sites since April 2005, and the lessons it can learn for contracting as it takes forward its competitions. The Authority's management of the competition process will be considered in future reports.

## Overall conclusions and assessment of value for money

**8** The nature and scale of the decommissioning task inherited by the Authority was highly uncertain. Many of the Authority's sites had not been designed with decommissioning in mind, and record-keeping – particularly in the early days of nuclear development – had not always been sufficiently detailed to inform decommissioning several decades later. Since its creation, the Authority has invested significant effort in determining the scale of the task it faces in decommissioning the UK's first generation of civil nuclear facilities. The Authority has produced, for the first time in the UK, a unified strategy for decommissioning the UK's legacy nuclear sites.

**9** The Department and Authority envisaged that better definition of the decommissioning task would see estimates of remaining lifetime costs grow in the short-term, but stabilise by 2008 and fall thereafter. The most recent iterations of the Authority's plans have continued to produce large increases in estimates, including the cost of the work programme over the next five years which might have been expected to have stabilised by now. The continuing instability in these costings reduces their value during the parent body competitions, making it difficult for the Authority to judge the cost and price element of bidders' proposals.

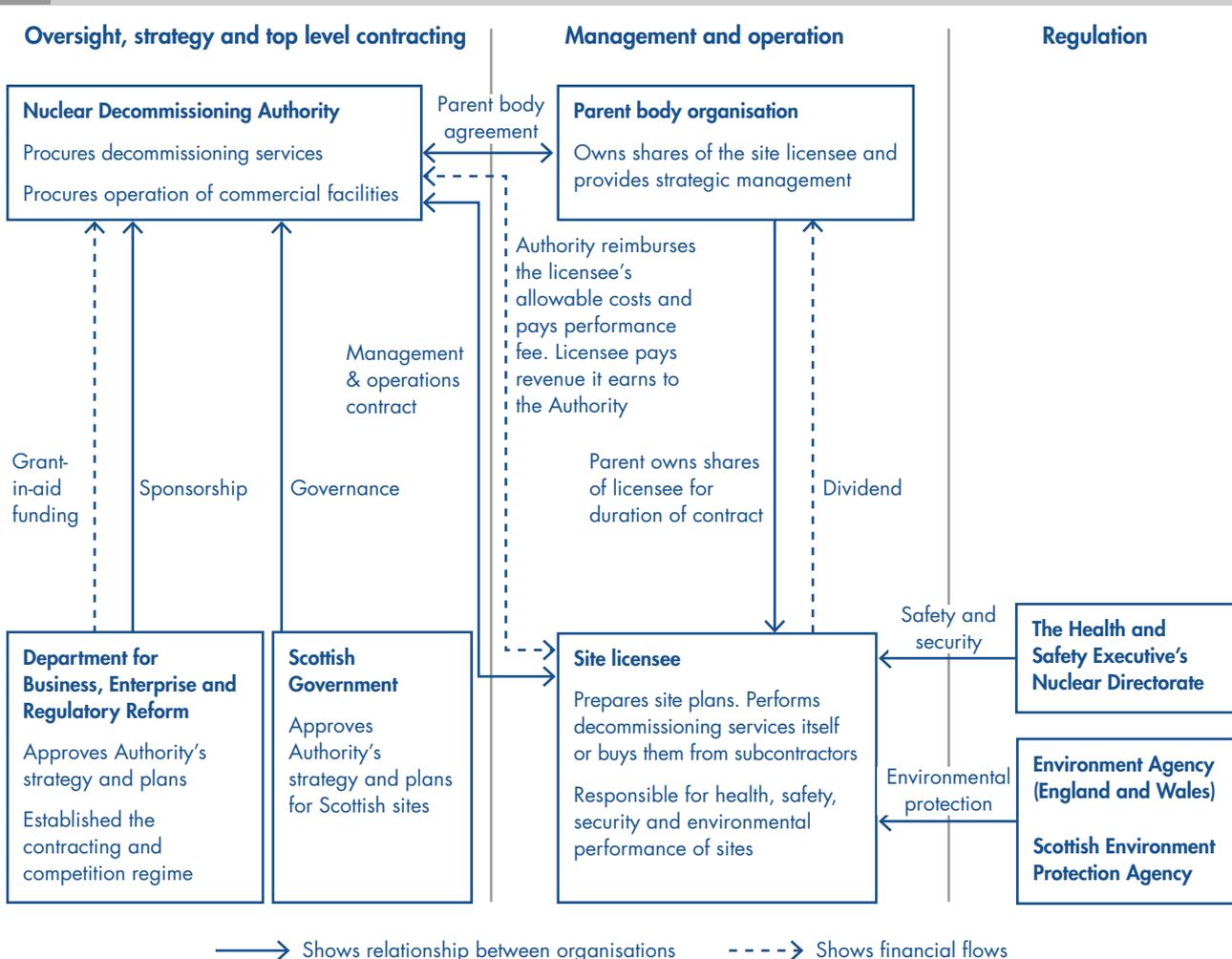
<sup>3</sup> The parent body will own the shares in the site licensee for Sellafield, Capenhurst, Calder Hall and Windscale.

**10** Significant resources have been allocated to the decommissioning programme. But the progress made by the Authority in decommissioning non-operational Magnox and research sites has been hampered by emerging pressures on its financial position. Due to the need to fulfil additional urgent expenditure commitments, particularly at Sellafield, and the uncertainty of commercial income from its ageing and unreliable facilities, the Authority has had to make changes at short notice to some sites' funding levels for the last quarter of 2006-07 and for 2007-08 to meet its priorities within budget. These changes have created significant uncertainty for both site licensees, in planning and delivering their long-term decommissioning programmes, and their

contractors, and have led to additional costs for the taxpayer which lessen the value for money derived from the decommissioning programme.

**11** The Authority's use of cost reimbursement management and operation contracts with site operators has been a sensible approach to adopt whilst establishing its role as a purchaser of decommissioning services. But these contracts require reliance on detailed short-term annual work programmes, which change frequently and make it difficult for the Authority to maintain a sufficiently testing incentive regime. In our view, in their current form, the contracts are unlikely to encourage sites to deliver long-term value for money as they do

**1** The key responsibilities of the main organisations which oversee, manage and regulate the decommissioning of civil public sector nuclear sites



Source: National Audit Office

**NOTE**

The diagram does not show the relationship at December 2007 between the Department and two of the parent bodies. The Department sponsors the United Kingdom Atomic Energy Authority, which is the parent body and site licensee for Dounreay and the other research sites. The Department owns British Nuclear Fuels Limited which includes the parent body for the Sellafield site licensee. British Nuclear Fuels Limited is not competing to remain the parent body of Sellafield.

not provide strong incentives to contractors to control lifetime costs through, for example, innovation and efficiency improvements. Other forms of contract, better adapted to the circumstances of particular sites and work streams, and the long-term nature of the work, need to be adopted if the potential value for money benefits of competitive contracting for decommissioning work are to be fully realised. The Authority has indicated its intention to move towards more testing contract forms where this is appropriate. It will need to have a clear view of how to achieve this if it is to use the competition process effectively to deliver benefit for the taxpayer.

## Our main findings

**i** The Authority has developed a comprehensive and consistent framework for drawing up decommissioning plans, known as lifetime plans, at site level. The quality of the plans has improved over a number of iterations particularly in setting out what needs to be done and, in broad terms, how it might be done and when (see paragraphs 2.2 and 2.3).

**ii** The Authority's 2007 estimate of the undiscounted future costs of sites over their remaining lifetime (£73 billion<sup>4</sup>) was almost £17 billion (30 per cent) higher than the estimate made by the Department in 2003.<sup>5</sup> Between 2005 and 2007 lifetime costs increased by some 18 per cent (£11.7 billion), after adjusting for inflation and the Authority's expenditure at its sites since it was established in 2005. In part, this increase reflects a more complete assessment of the range of work that needs to be taken forward, including the action necessary to address hazard at some of the legacy facilities at Sellafield. Our analysis of the plans also indicates, however, that cost estimates on work expected to be undertaken in the near to medium-term, which might be expected to have stabilised by now, have risen significantly over successive iterations. Between 2005 and 2007, the estimate of likely costs for the first five year period covered by those plans in a consistent manner<sup>6</sup> – April 2008 to March 2013 – rose by 41 per cent (see paragraphs 2.4 to 2.8 and Figure 8 on page 18).

**iii** In deriving cost estimates from the site licensees, the Authority has obtained most of its assurance about the validity of budgets by specifying the costing procedures sites should adopt and reviewing compliance with those

procedures. The Authority's staff, including its engineers, review project budgets included by sites in lifetime plans. The degree of scrutiny has been limited, however, as the Authority does not, for example, routinely employ its own professional cost advisers to review estimates. The Authority has previously recognised the need to strengthen the scrutiny of costs and is intending to commission a validation of the costs being submitted by sites in the lifetime plans to be finalised in 2008 (see paragraphs 2.9 to 2.11 and Figure 9 on page 20).

**iv** The Authority reports annually on performance at each of its sites by providing data on the value and cost of work completed against budget and assessing progress against key milestones and deliverables, for example expressed in terms of the demolition of buildings on site. These measures do not convey clearly to the lay reader how far decommissioning has progressed down the path from waste characterisation, through retrieval and containment, to hazard removal and eventual site clearance. The Authority has set itself a target for 2007-08 to develop, for all potentially mobile radioactive wastes, a hazard baseline that will cover the amount of waste, its activity, location, condition and the percentage of waste that is passively safe.<sup>7</sup> If robust hazard baselines can be developed, it is possible that these might provide one basis for reporting progress on decommissioning. At present, in the absence of appropriate measures of progress, the focus of external parties monitoring the Authority's performance is likely to be skewed towards levels of spend rather than its outputs and outcomes (see paragraphs 3.3 to 3.5 and Figure 10 on page 22).

**v** It is still too early to judge the impact of the contracting regime on health, safety, security and environmental performance. Since 2000-01, there has been a general reduction in the number of reported nuclear safety events at the sites now falling within the Authority's responsibility. Site by site performance against a wider series of metrics developed by the Authority was reported, for the first time, in its 2006-07 Health, Safety, Security and Environmental Report. The Authority can expand the range of metrics it uses and reports on so it can, for example, assess the overall environmental impact of its sites (see paragraphs 3.7 to 3.8 and Figure 11 on page 23).

4 This figure, at 2007 prices, comprises £61 billion for decommissioning (mentioned at paragraph 1) and around £12 billion to cover the cost of running the remaining operational facilities to the end of their commercial life, but does not reflect the anticipated revenue from these sites.

5 Estimated cost had increased partly as a result of inflationary pressures (which have added approximately £2 billion per annum, the equivalent of £8 billion over the period 2003 to 2007), and even though resources have been spent on operating and decommissioning sites during the intervening period.

6 Although all three plans covered 2007-08, the basis for treating the costs of contingency for that year varied.

7 Waste which is passively safe includes: waste which is in a form which is chemically and physically stable and is stored in a manner that minimises the need for safety mechanisms, maintenance, monitoring and human intervention.

8 The Authority's Draft Business Plan for 2008-11 was put out to public consultation.

- vi** The Authority has not had sufficient flexibility in its budget to cope with the level of volatility and uncertainty it has faced with its commercial income, and urgent expenditure commitments, in particular at Sellafield. As a result, a pattern of “start and stop” on some non-operational Magnox and research sites has incurred extra costs for the taxpayer. In November 2007 the Authority consulted on its plan to increasingly focus its decommissioning resources over the next three years on the high hazard facilities at Sellafield and Dounreay. The speed with which the Authority can move resources between sites depends on factors such as: the potential socio-economic impact on those areas around smaller research and Magnox sites; having funds to cover transition costs such as redundancy; and the ability of Sellafield and Dounreay to make effective use of new money (see paragraphs 3.11 to 3.17 and Figure 12 on page 25).
- vii** The Authority has lacked an established mechanism, developed and applied in consultation with stakeholders, for deciding priorities against different resource assumptions. As at Autumn 2007, the Authority was in the early stages of developing a framework to demonstrate the overall value of decommissioning work, for example, on levels of hazard, environmental performance and its socio-economic impact on local communities. It plans to use this framework in comparing different decommissioning scenarios (see paragraphs 3.5 and 3.23 to 3.24).
- viii** The Authority has had to strike a balance between encouraging sites to take forward decommissioning in a cost effective way and not cutting across site licensees’ legal responsibility for all site activities. The appointment of new parent bodies, drawn from the private sector, is creating a new set of relationships to manage. The Authority, the Health and Safety Executive’s Nuclear Directorate, the site licensees and existing parent bodies, have sought to clarify the roles of the different parties but this framework remains relatively new and untested. The effectiveness of this framework in helping the Authority take forward the decommissioning task will rely heavily on the ability of all parties to work in partnership towards common shared goals, with incentives in place that reflect those goals, and management teams with the skills to work constructively with their partners (paragraphs 4.3 to 4.5).
- ix** The use of a common cost reimbursable management and operation contract across all sites has provided a stable framework upon which the Authority and its sites have been able to establish consistent industry-wide planning and contract control procedures. The use of these contracts has, however, meant that increases in site licensees’ costs are borne by the taxpayer.

And because of the difficulties of using short-term incentive regimes noted at paragraph 11, the contracts are not well suited to the delivery of decommissioning activities that generally run to longer timescales. There is scope for the Authority to make greater use of fixed cost, or longer-term target cost plus fee arrangements to cover support services and those decommissioning activities, such as demolition or deplanting of non-radioactive buildings, that do not entail substantial risk or uncertainty and, in doing so, deliver better value for money. The Authority is considering, through the competition process, how it can use more commercial payment and reward mechanisms, including the use of multi-year performance incentives (see paragraphs 4.6 to 4.29).

## Recommendations

- i** The Authority should develop its current contract incentives by:
- incorporating elements of fixed price, or longer-term target cost plus fee, for work streams or sites where analysis of risks – including awareness of experience abroad – indicates that work scope and cost are sufficiently well defined;
  - reviewing intellectual property provisions to maximise the Authority’s share of the benefits of innovation while providing sufficient incentive for site licensees and their parent bodies; and
  - moving to multi-year performance milestones aligned with project timetables where financial flexibility permits.
- ii** The Authority should strengthen its capacity to scrutinise the cost estimates put forward in the lifetime plans submitted by sites. The Authority has recognised the need to strengthen its scrutiny of costs and is intending to commission a validation of sites’ 2008 plans.
- iii** The Authority should determine the reasons for the continuing increases in cost estimates submitted by sites, particularly on those elements of work which by now should have been reliably costed. The analysis could break down cost increases into those driven by: changes in the Authority’s policy or guidance; better understanding of work required to achieve regulatory compliance; changes in the volume or characterisation of waste; and changes in the strategy, costs or scope of the work proposed by the site licensee. The Authority should seek to quantify uncertainties associated with the lifetime cost estimates that it intends to publish, and then present a cost range within which the final figure is likely to fall.

- iv** In the absence of stable cost baselines the Authority must consider how:
- it will compare the likely cost outcomes of bidders' proposals against each other and against the probable cost under the current incumbents;
  - it can subsequently lock successful parent bodies, and their site licensees, into price and incentive regimes which will provide the taxpayer with good value, once work scope has been adequately defined but where the successful bidder may already have been appointed.
- v** The Authority should evaluate the risks from more commercial management of its sites following competitions and ensure that its contract management staff are equipped to mitigate those risks.
- vi** The Authority should develop clear and transparent measures of the progress being made against the objective of decommissioning sites and present these in public documents in a way which is comprehensible to the layman. Its current work on developing a hazard baseline could provide a possible means of developing such measures. It should also continue to develop, by working with the regulators, the metrics its uses to monitor and report on the health, safety, security and environmental performance of its sites.
- vii** The Authority should require site licensees to prepare lifetime plans on the basis of the most realistic available funding assumptions and reject plans that exceed those limits unless the sites are able to demonstrate to the Authority they are the minimum necessary to meet their obligations.
- viii** The Authority should require lifetime plans to be prepared in a form which enables sites to assess the impact of differing funding assumptions for the near term. Sites would then be well-placed to provide the Authority with the information it needs to assess priorities should funding levels change.
- ix** The Authority should work with parent bodies, site licensees and regulators to develop a shared and documented understanding of their roles and responsibilities given the complexity of the contracting regime and the need to agree, prioritise and meet regulatory requirements as they arise.
- x** At the end of 2007 the Department transferred responsibility for governance of the Authority to its Shareholder Executive, which is responsible for improving the way Government manages public sector businesses. The Department should ensure these new arrangements enable it to be fully aware of developing financial and other major issues affecting the decommissioning programme and enable it to assess key risks to the Authority's programme.
- xi** The Department, working with HM Treasury and the Authority, should ensure that decisions on the use of funding flexibilities available to the Authority are made promptly in response to unanticipated changes in commercial income or commitments, to minimise their adverse impact on the value for money of the decommissioning programme and the confidence of the supply chain.
- xii** The Department should ensure that the targets which will underpin the 2008-11 Departmental Service Objective – to manage energy liabilities effectively and efficiently – provide incentives for the Authority to bear down upon and control lifetime costs.



# PART ONE

## Background

### The Authority aims to deliver a programme of safe, sustainable, publicly acceptable and cost-effective decommissioning

**1.1** In April 2005, the Government established the Nuclear Decommissioning Authority (the Authority), under the Energy Act 2004, to take forward the decommissioning and clean up of the UK's civil public sector nuclear sites. It is a non-departmental public body sponsored by the Department for Business, Enterprise and Regulatory Reform (the Department), with the Scottish Parliament and Executive having important roles in approving strategy and plans for Scottish sites.<sup>9</sup> The Authority's mission is: "to deliver safe, sustainable and publicly acceptable solutions to the challenge of nuclear clean-up and waste management. This means never compromising on safety, or security, taking full account of our social and environmental responsibilities, always seeking value for money for the tax payer, and actively engaging with stakeholders."<sup>10</sup>

**1.2** The Authority is responsible for 19 civil nuclear sites<sup>11</sup> (Figure 2) comprising:

- facilities at Dounreay (Caithness), Windscale (Cumbria), Harwell (Oxfordshire) and Winfrith (Dorset) which were developed in the 1940s, 1950s and 1960s to support the Governments' research programmes and had been owned by the United Kingdom Atomic Energy Authority, a non-departmental public body;
- a fleet of 11 Magnox nuclear power stations designed and built during the 1950s, and 1960s. Most of these stations had been owned by the Central Electricity Generating Board before being

transferred to a number of public sector companies. British Nuclear Fuels Limited, a company wholly owned by Government, took ownership of the reactors in 1998; and

- four sites with facilities designed to manufacture fuel or treat or store the wastes, materials and spent fuel produced by nuclear programmes. These sites, including Sellafield (Cumbria) and Springfields (Lancashire), were owned by British Nuclear Fuels Limited until March 2005. The operations at Sellafield include recycling fuel used in the Magnox reactors.

Of the 19 sites, 12 were no longer operating and were being decommissioned when the Authority took responsibility in April 2005, and parts of the Sellafield site were being cleaned-up. Two more sites – Dungeness A and Sizewell A – ceased operating at the end of 2006. The transfer of ownership of the 15 British Nuclear Fuels Limited sites to the Authority led to the Company releasing the £3.75 billion in its Nuclear Liabilities Investment Portfolio to the Consolidated Fund.<sup>12</sup>

**1.3** The Authority's current best estimate of the undiscounted future cost of its 19 sites over their remaining life is around £73 billion at 2007 prices. This comprises around £61 billion for the cost of decommissioning and around £12 billion to cover the cost of running operational facilities to the end of their commercial life but does not reflect the anticipated revenue from these sites. Sellafield is expected to cost around £46 billion (63 per cent of total lifetime costs) with Dounreay expected to be the next largest at around £4 billion (5 per cent) (Figure 3 on page 12). Appendix 2 details the forecast lifetime cost for each site.

<sup>9</sup> Under the Energy Act 2004 the Authority is a cross border public authority and thus it reports to Scottish Ministers who agree its strategy and annual plans as regards Scottish sites.

<sup>10</sup> Page 2 of the Authority's Annual Report and Accounts 2006-07.

<sup>11</sup> The Authority owns 18 sites and leases part of the Harwell site (see footnote 2 on page 4). British Energy plc, a company wholly owned by private shareholders, is separately responsible for eight operating nuclear power stations. British Energy's decommissioning liabilities are to be met from the Nuclear Liabilities Fund. The Company contributes to the Nuclear Liabilities Fund (see paragraph 1.15 and Figure 8 of the C&AG's Report *The restructuring of British Energy*, HC 943 Session 2005-06).

<sup>12</sup> Up to 2005, the Company had used income from the Portfolio to offset spending on its liabilities.

## The Authority contracts with site licensees to take forward the decommissioning task

**1.4** The Authority discharges its responsibilities for decommissioning its sites through managing contracts with independent site operators, known as site licensees. In April 2005, it entered into management and operations contracts and parent body agreements covering each of its 19 sites. Appendix 3 lists the current site licensees and their parent bodies.

**1.5** The site licensees are reimbursed for the actual costs of work performed against a work plan they draw up with the Authority – this is a form of cost reimbursement contract. The site licensee uses its own staff, or uses sub-contractors, to deliver work. The Authority agrees performance based incentives with each site licensee to deliver priority areas for their work plan, achieve reductions on the costs appearing in that plan and contribute to the Authority's strategic improvement programmes. The Authority is able to withhold or deduct fee if the performance of the site licensee has not been satisfactory.

## 2 Nature, location and parent body of the Authority's sites at December 2007



### Research sites no longer operating

- 1 Dounreay, United Kingdom Atomic Energy Authority
- 2 Windscale, United Kingdom Atomic Energy Authority
- 3 Harwell, United Kingdom Atomic Energy Authority
- 4 Winfrith, United Kingdom Atomic Energy Authority

### Magnox power stations no longer operating

- 5 Hunterston A, Reactor Sites Management Company Ltd<sup>1</sup>
- 6 Chapelcross, Reactor Sites Management Company Ltd
- 7 Calder Hall, British Nuclear Group Limited part of British Nuclear Fuels Limited
- 8 Trawsfynydd, Reactor Sites Management Company Ltd
- 9 Berkeley, Reactor Sites Management Company Ltd
- 10 Hinkley Point A, Reactor Sites Management Company Ltd
- 11 Sizewell A, Reactor Sites Management Company Ltd
- 12 Bradwell, Reactor Sites Management Company Ltd
- 13 Dungeness A, Reactor Sites Management Company Ltd

### Operating Magnox power stations

- 14 Wylfa, Reactor Sites Management Company Ltd
- 15 Oldbury, Reactor Sites Management Company Ltd

### Low-level Waste Repository

- 16 Low Level Waste Repository, British Nuclear Group Limited part of British Nuclear Fuels Limited

### Operating fuel facilities

- 17 Sellafield, British Nuclear Group Limited part of British Nuclear Fuels Limited
- 18 Springfields, Westinghouse Electric Company<sup>1</sup>

### Fuel facilities no longer operating

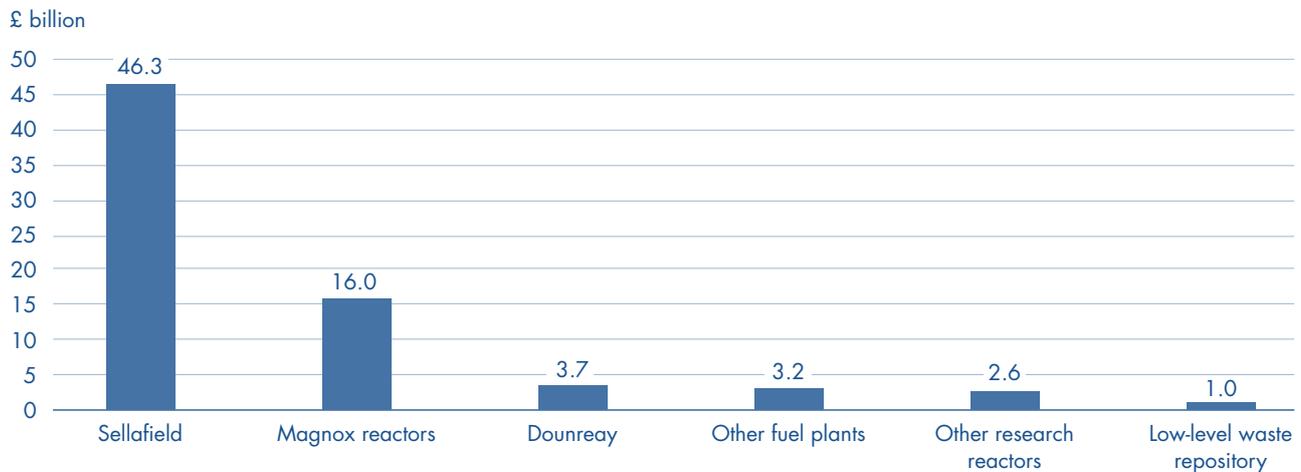
- 19 Capenhurst, British Nuclear Group Limited part of British Nuclear Fuels Limited

Source: National Audit Office analysis of site locations, type and owner

### NOTE

<sup>1</sup> Prior to the Authority's creation all research sites and their operators were owned by UKAEA and all other facilities and their operators were owned by British Nuclear Fuels Limited. By December 2007, the ownership of 18 sites had passed to the Authority and it leased part of the Harwell site which had been designated to it under the Energy Act 2004. Also by December 2007, the parent body for the majority of the Magnox reactors – Reactor Sites Management Company Limited – had been sold to the private company EnergySolutions and the parent body for the Springfields site licensee – Westinghouse Electric Company – had been sold to the Toshiba Group, also a private company.

### 3 Total estimated lifetime cost by main site and type of site



Source: National Audit Office analysis of the Authority's lifetime plans prepared in 2007

#### NOTE

The figure for other research reactors includes £204 million for the costs of the Joint European Torus at Culham, a facility the Authority will become responsible for decommissioning at the end of its operation, currently planned for 2011. All figures are undiscounted and use 2007 prices.

## Current plans envisage that the decommissioning and clearance of most sites will take around 100 years

**1.6** The decommissioning and clean-up programme will tackle a range of radiological and non-radiological hazards at each of the sites. The operation of nuclear sites produces a range of waste much of which is radioactive or has been exposed to radiological or radiochemical contamination and thus has to be stored or disposed of in safe and secure conditions. Some waste, such as protective equipment and effluent at a Magnox reactor, can be treated and processed as it arises during the facility's operational phase. Other waste, such as fuel element debris accumulated in storage vaults, will only be recovered after a facility has ceased operating. Spent fuel from nuclear reactors, and the uranium and plutonium produced from fuel reprocessing, have to be stored safely and securely until they can be processed, utilised or disposed of. When they reach the end of their working lives, buildings and facilities at nuclear sites need to be decontaminated and, over time, dismantled. The decommissioning process also involves tackling varying degrees of land contamination.

**1.7** The latest plans prepared by site licensees finalised in March 2007 proposed that most of the Authority's sites will not be cleared for at least another 80 years. Decommissioning strategies differ from site

to site. The Magnox operator has adopted a deferred decommissioning strategy allowing a long period for radioactivity in the reactors to decay before dismantling them. **Figure 4** sets out how at March 2007 the main stages of the Magnox decommissioning strategy were due to be applied to the Oldbury reactor and **Figure 5 on page 14** shows the potential profile of spend over the decommissioning period.

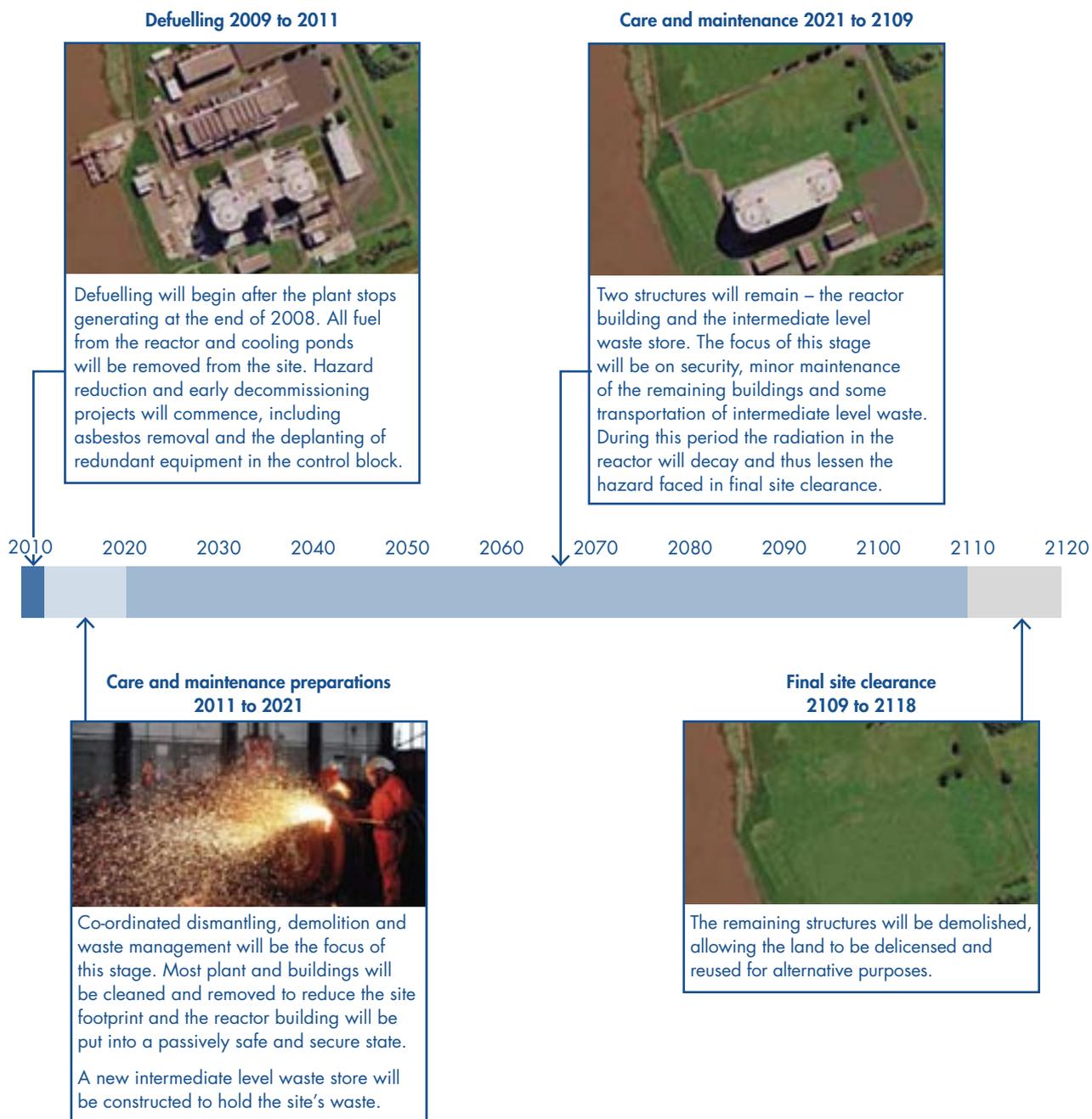
**1.8** The sites at Harwell and Winfrith<sup>13</sup> could be cleared within the next 20 years. The operator of these research reactors – the United Kingdom Atomic Energy Authority – had originally proposed a deferred decommissioning strategy but proposed a change to an accelerated strategy following the 2002 White Paper *Managing the Nuclear Legacy Cm 5552*<sup>14</sup> with the encouragement of the Department. Acceleration has a number of potential advantages, including making better use of the existing workforce's knowledge of the site, reducing lifetime costs, earlier release of sites for alternative use and meeting the wishes of some local communities but usually incurs higher expenditure in the short-term. The Nuclear Decommissioning Authority's Strategy agreed in 2006 specified a wish to accelerate the decommissioning of Magnox and research reactor sites, if that were supported by a sound business case.<sup>15</sup> That business case has not been prepared to date because acceleration would not have been affordable in the near-term. Acceleration is not explicitly referred to in the latest statement of the Authority's mission prepared in 2007 (see paragraph 1.1).

<sup>13</sup> At December 2007, the Authority did not have the resources to fund the latest plans for these sites.

<sup>14</sup> This White Paper proceeded the 2004 Energy Act.

<sup>15</sup> Nuclear Decommissioning Authority Strategy, March 2006.

## 4 The main stages in decommissioning the Oldbury Magnox reactor

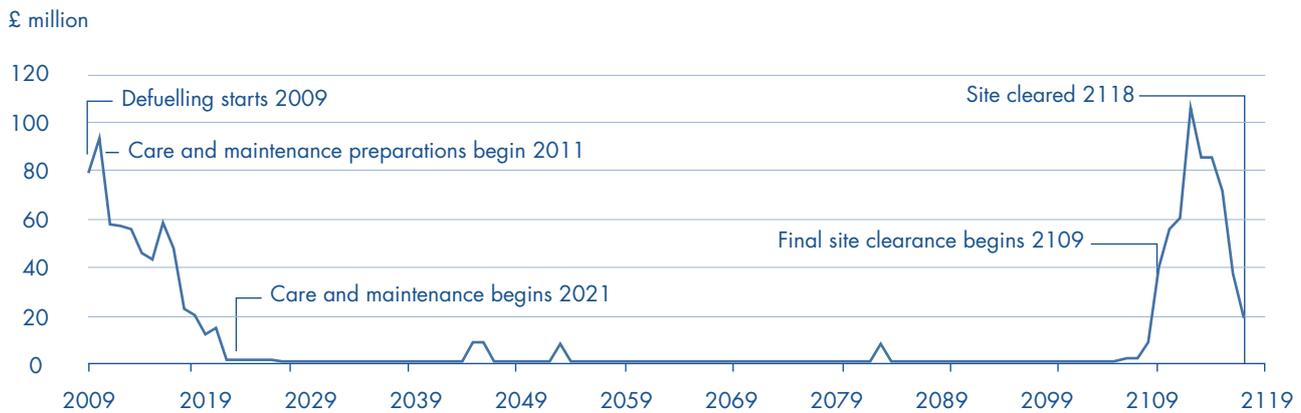


Source: National Audit Office summary of Oldbury lifetime plan, March 2007

### NOTE

The site licensee will submit a revised plan in March 2008. This will take account of developments over the previous 12 months. These will include on-going difficulties at Sellafield with the plant which reprocesses spent Magnox fuel. This is likely to push back the date for completing defuelling at Oldbury and thus may impact on subsequent dates.

## 5 Planned profile of expenditure at the Oldbury Magnox reactor, 2009 to 2119



Source: National Audit Office presentation of data in Oldbury lifetime plan, March 2007

### NOTE

Plant is due to cease operations at the end of 2008. Costs are undiscounted and at 2007 prices. See note to Figure 4: key dates and the expenditure profile will be revisited by the site licensee when new plans are submitted in March 2008.

**1.9** High level waste, from reprocessing spent nuclear fuel, is currently stored at Sellafield. There is as yet no location for long-term disposal of either high level or intermediate level waste which impacts on the timetables and decommissioning strategies for clearing sites. Both the research sites and Magnox sites in England and Wales are currently planning to build their own stores to hold intermediate level waste, such as fuel element debris, before it is transferred to a national repository when available. The Scottish Government's policy is to support interim near-site surface storage of higher activity radioactive wastes. There is a repository for disposing of low level waste, such as protective clothing, near Drigg, Cumbria and there are plans for a facility at Dounreay to take low level waste from the Dounreay site.

**1.10** Other countries have been taking forward their own decommissioning programmes. **Figure 6** shows the stages reached in the process for closed commercial reactors in the United States, Germany, France and the UK.

## Primary responsibility for health and safety and environmental performance remains with site licensees

**1.11** The Energy Act 2004 imposed a duty on the Authority to: safeguard the environment; protect persons from risks to their health and safety from activities involving the use, treatment, storage, transportation and disposal of hazardous material; and preserve nuclear

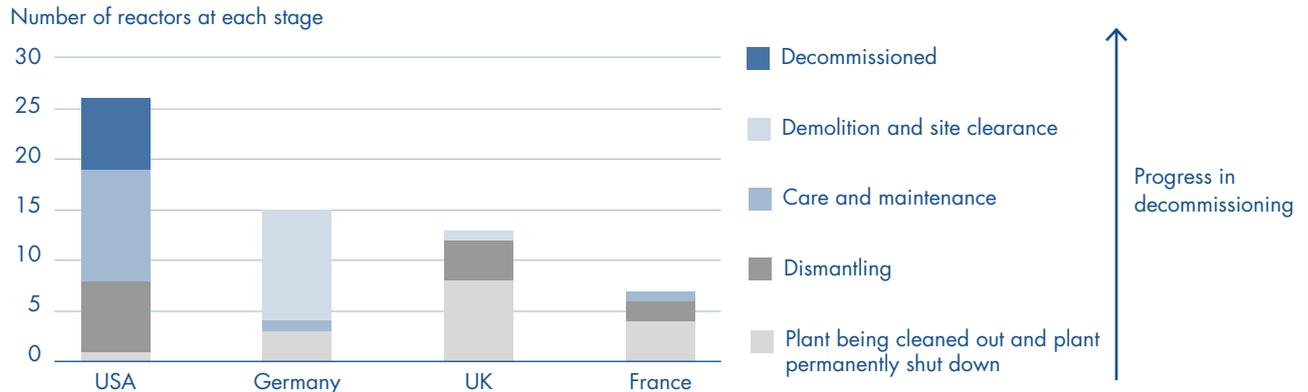
security. The Authority seeks to use its contracts to further these aims. The 2004 Act did not alter other relevant legislation governing the operation of nuclear sites and thus the statutory relationship between the operators of sites and the regulators has not changed (**Figure 7**). Each site licensee is licensed to operate by the safety regulator, the Health and Safety Executive's Nuclear Directorate. Sites' security arrangements are also overseen by the Nuclear Directorate whose responsibilities for security include designating sites which must have an on-site armed response capability from the Civil Nuclear Constabulary. Sites hold required licences from environmental regulators including authorisations to dispose of radioactive waste. It is the site licensees therefore which are responsible for determining how to comply with regulatory requirements and ensuring the safe, secure and environmentally responsible operation of sites. As a consequence there are limits on the degree to which the Authority, or a site's parent body, can influence how the site licensee delivers the work paid for by the Authority under its contracts.

## The Authority is funded by grant-in-aid and commercial income

**1.12** The Authority's budget for 2005-06 was £2,262 million. For 2007-08, its budget is set at £2,790 million, of which £2,590 million<sup>16</sup> is expected to be spent on its sites, including continuing commercial operations. The remaining £200 million covers a range

<sup>16</sup> This figure includes £2,472 million to reimburse sites for the cost of work performed and £118 million to pay fees to the site licensees (see paragraphs 4.11 to 4.18).

## 6 Shut down commercial reactors by stage of decommissioning at 2004

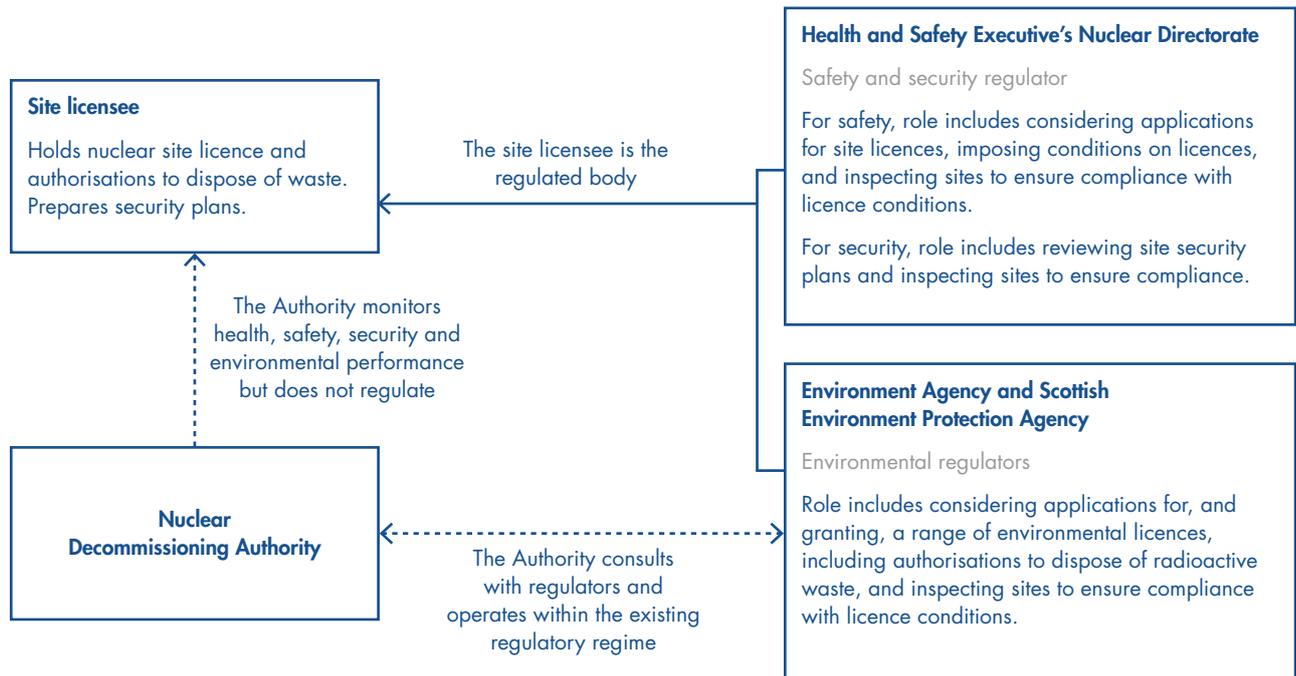


Source: World Nuclear Association reactor decommissioning database

### NOTES

- Decommissioning stages are those used in the database. Not all reactors pass through each of the decommissioning stages. See Appendix 5 for an explanation of the stages of the decommissioning process.
- The Windscale WAGR reactor was the only UK reactor classified as a commercial reactor and in "demolition and site clearance".

## 7 The regulation of nuclear safety, security and environmental performance



Source: National Audit Office

### NOTE

This figure identifies those regulators with a key interest in the decommissioning of sites. In addition to the bodies above, the Department for Transport regulates the transportation of radioactive materials within Great Britain. The Department for the Environment, Food and Rural Affairs has UK government policy responsibility for the management of radioactive waste substances in England and the Welsh Assembly has similar responsibility in Wales, with regulation of radioactive discharges undertaken by the Environment Agency. In Scotland these roles are undertaken by the Scottish Government and the Scottish Environment Protection Agency.

of items. These include £60 million for the Authority's headquarters operations, including the cost of its 230 staff based at its offices and at its sites. The Authority also plans to spend £17 million on initiatives to aid the development of a skilled workforce and £43 million on research and development.<sup>17</sup> Both of these programmes are regarded by the Authority as important for delivering decommissioning in the long run. It has also been responsible for introducing in 2006 the Combined Nuclear Pension Plan with the aim of ensuring that the nuclear decommissioning workforce continues to receive high quality pension provision. The Authority's management team is drawn from a range of backgrounds, including the nuclear industry, the wider energy sector, defence and transport, and a range of disciplines, including programme and project management, contracting, engineering and finance.

**1.13** The Authority is funded by a combination of grant-in-aid from the Department and the income it achieves from its commercial activities. In 2007-08, its ring fenced<sup>18</sup> grant-in-aid is £1,420 million and revenue generated from commercial activities was budgeted to be £1,370 million. Commercial income arises mainly from power generated from the Authority's two remaining operational Magnox reactors, the production and reprocessing of fuel for British Energy and overseas customers and the international transport of nuclear materials. Many of its operational facilities are old and unreliable which increases the volatility of the Authority's commercial income. To help it manage this, the Department and HM Treasury have established a budget framework which gives the Authority flexibility to make use of higher than expected levels of income. Subject to Departmental and HM Treasury oversight, the Authority can either use such income as it arises to bring planned work forward from future years, or it can carry over year-end surpluses which remain ring fenced to meet the Authority's spending in future years.

**1.14** The Authority generated £1.21 billion of commercial income in 2005-06 and incurred a similar level of expenditure on its commercial operations. The Authority's 2007-08 annual plan shows that it plans to spend a similar sum on operating commercial facilities as it receives in income. If commercial operations were to cease, however, the Authority would continue to bear substantial fixed costs of security, monitoring and maintenance associated with these sites and plants. The two operational Magnox reactors, Oldbury and Wyfla are due to cease operating in 2008 and 2010 respectively.

The main commercial activities at Sellafield are due to be completed around 2020 and at Springfields around 2022. The Authority's commercial activities will therefore decline over time to the point where it is wholly dependent on grant-in-aid.

## The Authority is competing the right to own shares of site licensees

**1.15** The Authority has a duty under the Energy Act 2004 to promote effective competition for contracts to provide it with services. The model for introducing competition – through competing the parent body rights to site licensees – was set out in broad terms in the 2002 White Paper *Managing the Nuclear Legacy* Cm5552. It enables the Authority to change the strategic management of site operators by a competitive process, whilst maintaining the skills and experience of a single enduring site licensee and avoiding the need to license a new site operator after each competition. Through the competition process, the Authority intends to appoint parent bodies that have the expertise and resources necessary to provide the leadership, innovation and management support to enable site licensees to deliver value for money whilst maintaining high safety, security and environmental standards. By April 2007, the Authority had launched three competitions. The parent body for the Low Level Waste Repository near Drigg, Cumbria is due to be selected in early 2008 and the parent body for Sellafield by the end 2008.<sup>19</sup> In October 2007, the Authority halted the third competition for the five reactor sites covered by Magnox South<sup>20</sup> as a result of limited market interest.

## Scope of report

**1.16** This report examines the Authority's performance in taking forward the decommissioning of its sites through contract arrangements since April 2005, and the lessons it can learn for contracting as it takes forward its parent body competitions. It examines, in particular, how the Authority:

- has planned the decommissioning of the UK's first generation of civil nuclear facilities (Part 2);
- has delivered its planned decommissioning programme (Part 3); and
- has developed the contracting framework (Part 4).

The study methods are summarised at Appendix 1.

<sup>17</sup> Licensees received the majority of research and development funding in 2006-07.

<sup>18</sup> The Authority's grant-in-aid cannot be accessed to ease spending pressures elsewhere in the Department.

<sup>19</sup> The parent body for Sellafield will own the shares of the site licensee for Sellafield, Capenhurst, Calder Hall and Windscale.

<sup>20</sup> The sites are Berkeley, Bradwell, Dungeness A, Hinkley Point A and Sizewell A.



## PART TWO

## Estimating the scale of the decommissioning task

**2.1** This Part examines the work undertaken by the Nuclear Decommissioning Authority to assess the scale and likely cost of the decommissioning task.

### The Authority has put significant effort into identifying the scale of the decommissioning task

**2.2** Since 2003, the Department and subsequently the Authority have invested significant effort into developing lifetime plans which cover all future activities to be undertaken on the sites. As part of the process, the Authority has required site licensees to draw up plans, in consultation with the regulators and other stakeholders, for decommissioning individual sites. The plans include an assessment of the scope of work to be performed at each site, a schedule of when the work is to be performed and an estimate of the likely lifetime costs. The plans have been refined over five successive iterations and another is scheduled for 2008. Thereafter the Authority is considering different options for updating lifetime plans including maintaining a live baseline programme.

**2.3** The process has allowed information to be gathered on a consistent basis across the sites, although as we will describe further refinements need to be made. In broad terms, the process has generated significant information on the scale of the task; allowed decommissioning plans to be compared between sites; and helped develop a degree of commonality in the underlying systems used to develop the plans. For the first time there are consistently prepared and presented plans for the decommissioning of the UK's first generation of civil nuclear facilities. These plans are intended to help the Authority to manage its programme, and make that programme more transparent to external stakeholders. Our consultation with site licensees and parent bodies suggested that the development of the planning framework, with its emphasis

on developing longer-term plans, had been welcomed although some expressed concern that the process was overly costly. Our consultation with representatives of site stakeholder groups indicated the Authority's efforts had made plans and strategy more visible to local communities, accompanied in some cases by raised expectations of what might be achieved and when.

### Successive iterations of lifetime plans have seen the estimated cost of decommissioning grow at a rapid rate

**2.4** The 2002 White Paper *Managing the Nuclear Legacy* Cm 5552, prior to the establishment of the lifetime planning process, included an undiscounted cost estimate of £48 billion at 2002 prices for dealing with the liabilities at civil nuclear facilities. The White Paper stated that the figure was subject to uncertainty and that in the short-term better definition of the task would almost certainly mean that estimates would rise.

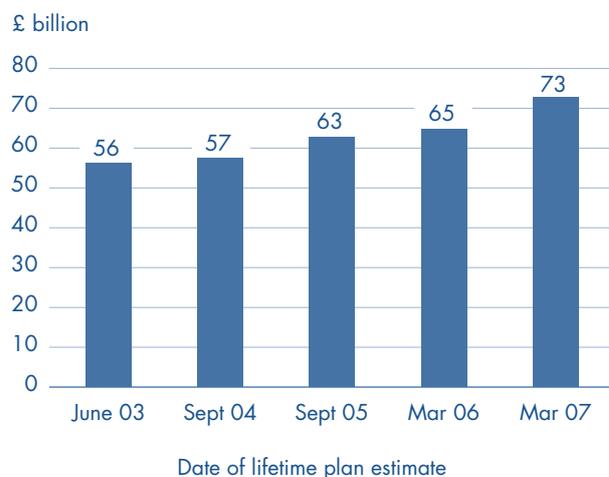
**2.5** Point estimates of decommissioning costs must be interpreted with caution, and in the knowledge that confidence bands will tend to be wider for the more distant tasks. Estimates of decommissioning costs cover work to be undertaken up to 120 years in the future. For distant years in particular the estimates require significant assumptions to be made, for example about the nature and disposition of wastes, the technology available and the likely regulatory regime, all of which will be uncertain. For the more immediate tasks, survey work, sampling and modelling can help define the nature of the hazard to be addressed, but the actual nature of waste once retrieval and treatment begins may nevertheless differ from that expected and require changes to decommissioning plans. On many sites, however, a significant proportion of the most imminent tasks either do not involve radioactive material or involve well characterised radioactive material.

**2.6** The first aggregate lifetime plan initiated by the Department was prepared in 2003. It estimated that the undiscounted future costs of sites over their remaining life, including the costs of running those facilities still operating, were around £56 billion at 2003 prices. Since then, successive iterations have produced further increases, with the 2007 estimate of remaining costs representing an increase of almost £17 billion (30 per cent) over the first lifetime plan (**Figure 8**). The estimates have increased partly as a result of inflationary pressures (which have added approximately £2 billion per annum, the equivalent of £8 billion over the period 2003 to 2007), and even though resources have been spent on operating and decommissioning sites during the intervening period.

**2.7** The Authority reported in its 2006-07 Annual Report and Accounts that there remained a significant degree of uncertainty in the latest cost estimate.<sup>21</sup> It identified a number of specific uncertainties including, for example: the volume of contaminated land, and methods of treatment; the quantities and composition of historical waste in legacy facilities at Sellafield and methods of treatment; and, the Authority's funding profile. As yet, the Authority has not been able to support the cost estimate it presents in its Annual Report and Accounts with a cost range within which the final figure is likely to fall.

**2.8** Our examination of lifetime plans indicated that some of the increases to date were attributable, for example, to the inclusion of items previously not costed such as work on Sellafield's legacy ponds and silos and therefore represented a clear improvement on previous estimates. Our work also suggested, however, that there had been significant increases on items already included in previous estimates and which might have been expected to be more stable because they were near-term, because they were on the less hazardous reactor sites, or because they involved site support activities less sensitive to the type of waste generated than direct decommissioning work. Our analysis was based on the estimates supporting the three lifetime plans prepared since the Authority was established, and which had produced the equivalent of a £11.7 billion (18 per cent) like-for-like increase in cost after adjusting for the effects of inflation and expenditure undertaken at the sites since 2005. This analysis had indicated that:

## 8 Growth in estimated remaining lifetime costs of the Authority's sites



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

### NOTE

Estimates are for the future undiscounted costs of sites over their remaining life. Estimates are based on the prices at the time the lifetime plans were prepared.

- A variety of factors had contributed to the cost increases, not just the completeness of the initial estimates. The cost estimate for Sellafield had grown by 14 per cent, with the site accounting for £6 billion (51 per cent) of the total increase across the Authority's portfolio. As part of its 2007 lifetime plan the site licensee prepared a summary which showed the main reasons for the £4 billion added since its previous plan. These reasons were: removing gaps in the 2006 plan such as work required on Sellafield's legacy ponds and silos (15 per cent); revisions to decommissioning strategies, including a move from manual to remote decommissioning of a major facility to reduce risks to staff (25 per cent); revisions to the scope of projects (29 per cent); and, revisions to cost estimates including contaminated land (31 per cent);<sup>22</sup>
- Costs had increased across most of the sites. Costs had increased, for example, at 17 of the Authority's 19 sites (see Appendix 2 for details). Across the Magnox fleet, costs had increased by 21 per cent, and at the research sites<sup>23</sup> by 14 per cent.

21 Lifetime plan costs are the main determinant of the nuclear provision in the Authority's financial statements. The provision at March 2007 was £37 billion. The provision excludes the cost of commercial activities, which are included in lifetime plans, and discounts future costs at a rate of 2.2 per cent per annum in line with Treasury guidance.

22 A reconciliation of the movement between Sellafield's 2005 and 2006 lifetime plan was undertaken, as were reconciliations in the movements in lifetime plans at other sites, but these were in a different format and are not therefore directly comparable.

23 Excludes Windscale which is expected to be part of the Sellafield group of sites from April 2008.

- The increase in site support service costs was lower than for other costs but was still significant. The forecast cost of these services – which include procurement services, engineering support, human resources and financial services – rose by 9 per cent between 2005 and 2007. In 2007 they totalled £20 billion – the equivalent of 28 per cent of total lifetime costs.
- Costs expected to be incurred in the near-term had been subject to significant revision. We compared the size of the 2005, 2006 and 2007 lifetime plans over the first five-year period covered by each of those plans – April 2008 to March 2013.<sup>24</sup> For this period, the latest lifetime plan had aggregate costs 41 per cent higher than the 2005 plan and 24 per cent higher than the 2006 plan. The level of variation at the Sellafield group of sites (Sellafield, Windscale, Calder Hall and Capenhurst) whose ownership was being competed during Autumn 2007 were of a similar magnitude, with costs increasing by 21 per cent between the 2006 and 2007 plans. Across the Magnox fleet of reactors – of which the Authority had planned<sup>25</sup> to compete parent body rights to five sites in 2007 and 2008 – costs increased by 23 per cent over the same period.

## The Authority has sought to strengthen the planning and estimation process but further improvements are needed

**2.9** The robustness of the lifetime plans has practical implications for the Authority in enabling it to prioritise projects, identify the likely funding needed and communicate the nature of the task to potential bidders. Continuing instability in the lifetime plan costs in general, and the degree of variation in the first five years of plans, in particular, could reduce the value of plans to the Authority as it seeks to compete the ownership of parent body rights. The instability will make it more difficult to judge the cost and price elements of bidders' proposals. The instability also impacts on external stakeholders, such as regulators, who both input into the planning process and use the final plans to inform their work. We therefore examined the efforts being made by the Authority to refine the plans.

**2.10** The Authority had expected that it would take time to develop robust plans and estimates. Since 2005, it has therefore sought to improve the planning process over successive iterations. Our work, based on a review of lifetime plans submitted in March 2007, suggested that the improvement programme had resulted in an overall increase in the quality of lifetime plans, for example, in the consideration of risk and contingency although further training and improvements were required to gain a consistent level of treatment of risk assessment across all sites.<sup>26</sup> The integration of lifetime plans has also been improved with, for example, those sites intending to transfer waste having to demonstrate that another site had agreed to receive it. Our findings echo similar conclusions from a review by Arthur D. Little, engineering consultants. It was part of a team commissioned by the Authority to conduct an assurance review of the Authority's Comprehensive Spending Review bid to the Department and HM Treasury for resources, which had been based on the 2007 lifetime plans. In its report, Arthur D. Little concluded that the 2007 lifetime plans had been much more robust than previous iterations although further refinements were needed.

## Examination of cost estimates

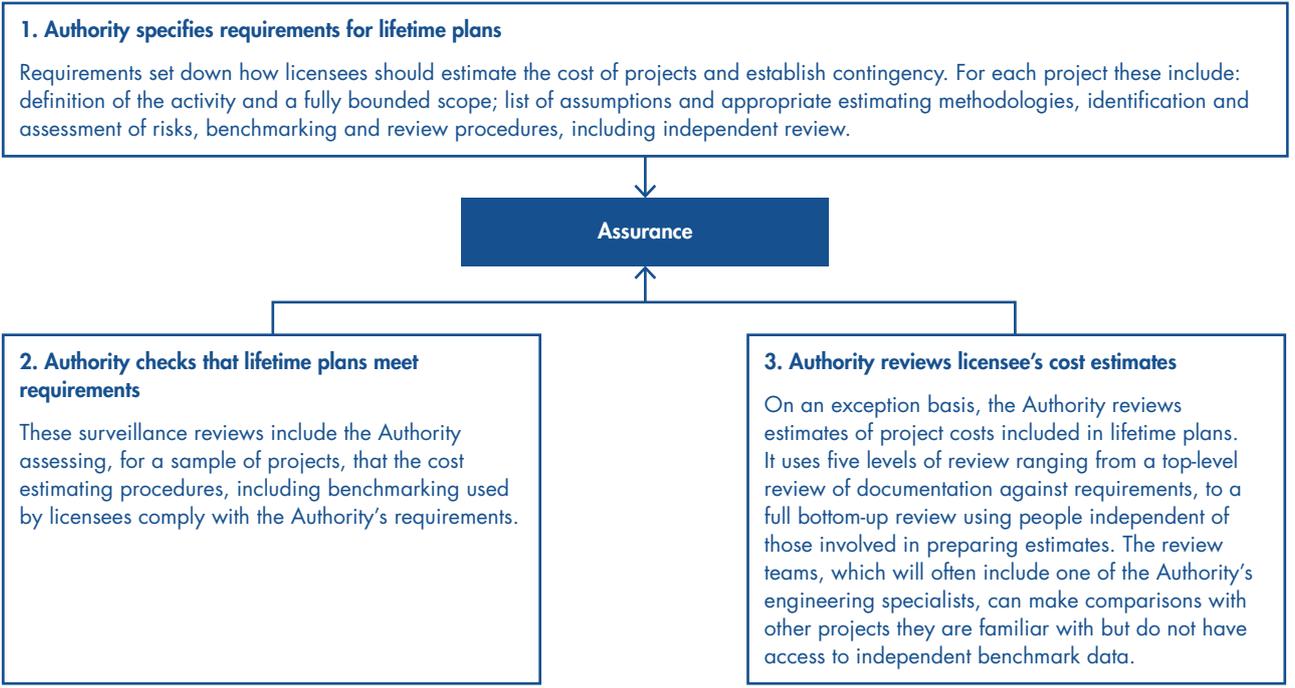
**2.11** The lifetime plans submitted by site licensees are scrutinised and challenged by the Authority before being finalised and incorporated into its own plans and programmes. Our review of this process indicated that, to date, the Authority's efforts had been directed primarily at ensuring the submissions are compiled in accordance with procedural guidance and that work elements are consistently categorised and comprehensively captured. We found less evidence of challenge to the nature of the work content or the cost estimates associated with each component of work. The Authority does not routinely employ its own professional cost advisers to review the budgets submitted by sites in lifetime plans (**Figure 9 overleaf**).

<sup>24</sup> Although all three plans covered 2007-08, the basis for treating the costs of contingency for that year varied.

<sup>25</sup> See paragraph 1.15.

<sup>26</sup> We reviewed lifetime plans as part of this study and also as part of our audit of the Authority's 2006-07 financial statements. The Authority's financial statements include a provision for the cost of nuclear liabilities. As part of our review of this balance, we assess the robustness of systems in place to generate lifetime plan estimates as these underpin the Authority's calculation of nuclear liabilities.

**9** Overview of the Authority’s arrangements for obtaining assurance on the costs included by licensees in lifetime plans



Source: National Audit Office

**2.12** The targets initially set for the Authority by the Department have, arguably, not incentivised it to constrain the growth in estimates of lifetime costs. The Authority’s 2005-08 Public Service Agreement target, introduced in the 2004 Spending Review, required it to reduce the size of the UK’s civil nuclear liabilities by 10 per cent by 2010, against a baseline to be established in 2008. Arguably, the bigger the baseline set in 2008, the easier it would be for the Authority to achieve a reduction by 2010. The Department considers that this target will be difficult to measure against a background of uncertainty in the estimates of lifetime costs, and questions whether it will be a meaningful measure of progress against the objective of decommissioning.

**2.13** The government-wide review of objectives and targets as part of the 2007 Comprehensive Spending Review established a Strategic Objective for the Department to manage energy liabilities effectively and responsibly. This Objective will be supported by a number of indicators, including “a reduction in UK civil nuclear liabilities”. The Authority, in consultation with the Department, is required to develop targets to enable its progress on indicators to be assessed although it is not yet clear whether these will cover the Authority’s performance in managing lifetime costs. HM Treasury expects the targets to be in place by March 2008 and published. If the targets do not include those used for the 2005-08 Public Service Agreement target HM Treasury guidelines will require the Department to explain the change.



## Progress in delivering the decommissioning programme

**3.1** This Part considers the progress made by the Nuclear Decommissioning Authority in implementing the plans for decommissioning its sites.

The Authority has devoted around 41 per cent of its resources to sites which have begun decommissioning, including the cost of support services at these sites

**3.2** In 2006-07 the Authority spent some £2,200 million on work undertaken at its 19 sites. Of this, £905 million supported decommissioning, including the clean-up of sites:

- Some £611 million was spent at the 12 sites no longer operating at April 2006, and £29 million on work to dispose of waste at the Low Level Waste Repository near Drigg in Cumbria. Of this, some £421 million was spent on project work at the 12 sites and the Low Level Waste Repository. This work included defuelling reactors, decommissioning buildings, treating and disposing of waste. Support costs – including items such as facilities management, engineering services, security and the costs of transition – accounted for the remainder of the expenditure.
- Around £265 million was spent by the Authority on project work to decommission and clean-up parts of the Sellafield site.

The Authority is seeking to develop better measures of the progress being made towards decommissioning

**3.3** The Authority reports annually on the value and cost of work undertaken against budget at each site. It also reports on the progress being made at each of its sites against key milestones and deliverables specified in its annual plan, for example expressed in terms of the demolition of buildings. The Authority's 2006-07 Annual Report and Accounts shows that across the 12 sites which were being decommissioned throughout the year, some 78 per cent of milestones and deliverables were achieved or were on track to be achieved (see Figure 10 overleaf). Appendix 4 lists the individual milestones and deliverables for each decommissioning site.

**3.4** Whilst reporting progress against milestones assists the monitoring of individual projects, it does not convey to the lay reader how far hazard reduction has progressed. The main distinct hazards in nuclear decommissioning – as opposed to the decommissioning of non-nuclear installations – are the risks of excessive radiation dosage for workers or the release of radioactivity to the environment with consequent excessive dosages for the wider population or natural environment. Hence it is not solely the amount, or radioactivity, of material which constitutes a nuclear hazard, but the level of risk inherent in its current condition or future handling requirement. As the amounts spent on decommissioning begin to accumulate it will become more important for the Authority to demonstrate real progress down the path from waste characterisation, through retrieval and containment, to hazard removal and eventual site clearance. In the absence of such hazard reduction measures stakeholders will be left to rely on levels of spend as a measure of progress rather than outputs and outcomes.

**3.5** The Authority has set itself a corporate target for 2007-08 to develop, for all potentially mobile radioactive wastes, a hazard baseline which will cover the amount of waste, its activity, location, condition and the percentage of waste that is passively safe. The Authority plans that the hazard baseline will be underpinned by information which sites will submit as part of lifetime plans due in March 2008. If robust hazard baselines can be developed, it is possible that in time these might help the Authority to monitor and communicate its progress in reducing hazard. Such metrics could also help the Authority to both assess the impact of differing levels of resourcing on the future level of hazard, and demonstrate that impact when presenting its bids for funding. Ahead of the next government-wide Spending Review expected in 2009 the Authority is intending to develop a broader framework for demonstrating the value of its work and comparing different decommissioning scenarios. In addition to hazard reduction, the framework would reflect other factors, for example, the socio-economic impact on local communities and environmental performance.

## The Authority has improved the consistency of information it collects and reports on nuclear safety

**3.6** The Authority's contracts set down the minimum performance obligations of each site licensee. These include: operating in a safe, secure, efficient and cost effective manner; acting transparently and co-operating with the Authority and the regulators; and fulfilling its obligations under its nuclear site license. The Authority can set out what outcomes it wants contractors to achieve, but each site licensee must have freedom to determine how it will deliver its various statutory obligations. The Authority's five nuclear safety assurance managers assess sites' health, safety, security and environmental protection performance, identify immediate performance issues and discuss with sites how to develop that performance. The assurance managers, who generally have a nuclear safety background, visit sites, meet with regulators, review data collected by

### 10 Reported achievements against sites' milestones and deliverables, 2006-07

Site	Achieved	On track	Behind schedule	Not achieved	Total set	% achieved or on track
Calder Hall		1		2	3	33
Capenhurst	5	1			6	100
Berkeley	1	4			5	100
Bradwell	3	2			5	100
Chapelcross	1	2	1		4	75
Hinkley Point A	1	3			4	100
Hunterston A	3	2			5	100
Trawsfynydd			5		5	0
Downreay	1	6	1		8	88
Harwell	5	1			6	100
Windscale (see Note)	3	1	2		6	67
Winfrith		1	1	1	3	33
<b>Sub total for decommissioning sites</b>	<b>23</b>	<b>24</b>	<b>10</b>	<b>3</b>	<b>60</b>	<b>78</b>
Low Level Waste Repository	1		1	2	4	25
Sellafield (see Note)	2	1		3	6	50
Other operating sites	19	2		5	26	81
<b>Total</b>	<b>45</b>	<b>27</b>	<b>11</b>	<b>13</b>	<b>96</b>	<b>75</b>

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

#### NOTE

Figures for Windscale exclude one target that was revised during the year. The Sellafield milestones included the site's on-going commercial activities.

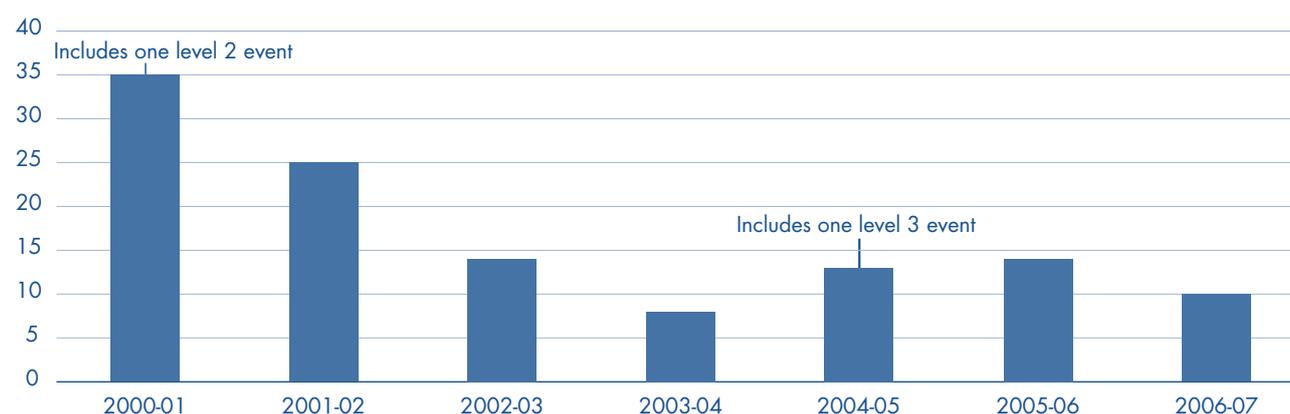
sites and participate in site safety reviews. The Authority has few staff with substantial skills and experience in environmental protection. The environmental regulators have encouraged the Authority to develop their in-house capability in this field.

**3.7** It is too early to say what impact, if any, the Authority has had on site performance since it was established in April 2005. The Authority developed, in its first year, and in conjunction with site licensees, a consistent but partial set of safety and environmental performance metrics. These metrics include, for example, dosage levels received by those working on the Authority's sites, and the number of events reported under the "Reporting of Injuries, Diseases and Dangerous Occurrences Regulations". Site by site performance against these metrics was reported, for the first time, in the Authority's 2006-07 Health, Safety, Security and Environment Report published in October 2007. The Authority's Report was able to present data on nuclear safety events at the Authority's sites over the last seven years. This data showed a general reduction in the number of events since 2000-01 (**Figure 11**).

**3.8** There remains scope for the Authority to develop the range of metrics it both uses and includes within its publicly available reports on performance. The Authority can draw on the work of the regulators, as well as refer to data already collected and available from site licensees. Trends in the number of safety events provide a blunt measure of performance, and thus the Health and Safety Executive's Nuclear Directorate are currently developing a broader set of measures covering site operations, control of hazards and safety culture. The Authority could also supplement existing data on the numbers of environmental events and non-compliances at its sites so that it can assess their overall environmental impact. This impact is dependent in part on how sites manage resources, such as energy and water, as well as their management of wastes, including non-radioactive wastes some of which, such as asbestos, are hazardous.

**3.9** The Authority can withhold or deduct performance fee earned by a site in a year if it considers that the site has not performed its minimum performance obligations. The Authority has, on two occasions, withheld substantial sums from a site's performance fee for weaknesses in health, safety, security and environmental performance. The Authority explained in its 2005-06 Annual Report and Accounts (published October 2006) that it had advised the site licensees which operate Sellafield and Dounreay<sup>27</sup> that it was making a fee deduction of £2 million for each of the following events:

**11** Number of nuclear safety events (level 1 and above) at the Authority's sites, 2000-01 to 2006-07



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

#### NOTE

The Authority and its sites measure nuclear events using the International Nuclear Event Scale. This Scale was devised to communicate a common understanding of the severity of any event connected with radiation or radioactive materials. The Scale has ranges from level 1 "anomaly", level 2 "incident", level 3 "serious incident" – through to the level 7 – "major accident". All but two of the 119 events in the period April 2000 to March 2007 were categorised as level 1.

<sup>27</sup> In 2005-06, some £38.1million of fee was payable to Sellafield for its achievements against performance based incentives and some £5.6 million was payable to Dounreay before any fee deductions.

- The Thermal Oxide Reprocessing Plant (THORP) at Sellafield was shut down in April 2005 after identification of a pipe work leak that had begun in 2004 and thus prior to the Authority being established. The site received permission from the Health and Safety Executive's Nuclear Directorate to restart the facility in January 2007 but the facility did not begin operations, and then only at a limited scale, until July 2007. The delay in the restart was in part due to problems with other plant at the Sellafield site which support the operation of THORP;
- The Dounreay Cementation Plant was shutdown in September 2005 after there was a spillage of cement powder and radioactive liquid. The plant is due to be re-opened in Spring 2008.

**3.10** In its 2006-07 Annual Report and Accounts (published October 2007), the Authority reported that the shortcomings in management, training and culture that were identified in relation to the two incidents had been addressed vigorously, and that the sites had been able to earn back the fee deduction. At Dounreay, the Authority had agreed an additional six performance based incentives in 2006-07 for the recoverable fee of £2 million. These included £1 million for effecting a cultural change on the Dounreay site. This covered, amongst other things, the development and delivery of safety leadership workshops. The site earned £1.95 million of the £2 million fee on these additional incentives. At Sellafield no additional performance based incentives were set and thus its £2 million of recoverable fee was used to increase the value of each of the site's incentives agreed at the start of 2006-07. Performance on these incentives enabled Sellafield to earn around £1.8 million of the fee deducted in 2005-06.

## Significant resources have been allocated to decommissioning. But the progress at some sites has been hampered by emerging pressures on the Authority's financial position

**3.11** Between 2005-06 and 2007-08 the Authority's budgeted grant-in-aid increased from £1,178 million to £1,420 million. This has helped the Authority to increase its net expenditure at some sites including the overall financial resources it has devoted to decommissioning, particularly at Sellafield. The progress made to date,

however, by the Authority on decommissioning at Magnox sites and research sites has been hampered by emerging pressures on the Authority's budget:

- In 2005-06, the Authority spent, in line with projections, some £593 million (the equivalent of £612 million at 2006-07 prices) on decommissioning projects at the 12 non-operating sites, the Low Level Waste Repository and at Sellafield.
- In 2006-07, the Authority had increased project expenditure at these sites to £686 million. The Authority had, however, to ask its 19 sites to remove in total some £50 million from their work programmes<sup>28</sup> in the last three months of the year, about a tenth of planned spend in that period, primarily in response to a shortfall in commercial income. This action enabled the Authority to live within budget but resulted in expenditure at the non-operating sites and on Sellafield decommissioning and clean-up being reduced by approximately £30 million.
- In planning for 2007-08, the Authority has had to cope with uncertainty over the receipt of around £400 million in forecast commercial income from Sellafield's waste substitution activities.<sup>29</sup> In addition, sites submitted expenditure plans for 2007-08 which were in excess of the funding levels proposed to sites by the Authority in Autumn 2006. In aggregate, across all the Authority's 19 sites, the plans were £185 million (8 per cent) higher than the proposed funding levels for 2007-08 and over £400 million (18 per cent) higher for 2008-09. In part, the excess arose from additional work to meet regulatory requirements at Sellafield but also from three sites – Dounreay, Harwell and Winfrith – proposing to accelerate their decommissioning programmes. The twin pressures on the Authority of a possible reduction in expected income from waste substitution and the higher than expected lifetime plans resulted, after allowing for efficiency savings, in agreed work programmes across all 19 sites which were £200 million lower than set out in those plans for 2007-08.

**3.12** Changes made by the Authority to sites' funding at short notice have created uncertainty for some licensees, their contractors and incurred extra costs for the taxpayer. The Authority wishes to support its commercial operations and support priority clean-up work at Sellafield where total expenditure on decommissioning is expected to

<sup>28</sup> Including operating sites.

<sup>29</sup> Contracts with overseas customers for reprocessing spent nuclear fuel require that waste products are returned to the country of origin. One approach to delivering this requirement is for the UK to dispose of all the customers' intermediate level waste in this country and return an additional volume of higher level waste to the country of origin. This minimises the volumes of waste to be transported and thus increases the volume (but not the radiological content) of waste to be stored in the UK.

rise from just over £200 million in 2005-06 to around £315 million in 2007-08. It must do this within its overall budget, so to the extent reductions are required these tend to fall on the decommissioning Magnox and research reactor sites and, in particular, the planned project work taking forward decommissioning activities at those sites, as they have limited opportunity to cut their site support service costs in the short-run.

**3.13** Figure 12 shows, that at the start of 2007, the Authority responded to its financial pressures by cutting the provisional 2007-08 funding levels provided (in October 2006) to the 14 sites no longer operating by £65 million (9 per cent). The reduction in funding, coupled by three sites preparing plans proposing accelerated decommissioning (see paragraph 3.11), which would have required resources in excess of their provisional funding levels, resulted in a gap between available resources and sites' 2007-08 work programmes as set out in their lifetime plans. To close the gap sites have

had to reduce their planned 2007-08 project expenditure by deferring work. Across the 14 sites some £120 million (20 per cent) was removed from planned project work for 2007-08. Some of this work would have been undertaken by tier 2 contractors. Consequently, some contracts have been halted at short notice and this has brought some additional costs for the taxpayer, for example, as in-house and contractor teams have been demobilised (**Box 1 overleaf**).

**3.14** Harwell and Winfrith's funding for 2007-08 was reduced by £19.0 million (18 per cent) to £84.6 million between October 2006 and February 2007 (see Figure 12). A further reduction in the sites' funding levels to £60 million is expected for 2008-09. In response the sites reduced decommissioning work on facilities and buildings which were in a stable condition, with Winfrith entering a care and maintenance phase. The sites also planned to cut in-house staff numbers by around 25 per cent.

**12** The provisional 2007-08 funding levels for most decommissioning Magnox and research sites were subsequently cut in February 2007

	Provisional funding levels set in October 2006 <sup>1</sup> (£ million)	Funding levels finalised in February 2007 (£ million)	Percentage change
Bradwell	51.5	31.2	-39.4
Dungeness A	56.2	42.0	-25.3
Hinkley Point A	45.8	36.1	-21.2
Berkeley	57.0	46.0	-19.3
Harwell/Winfrith	103.6	84.6	-18.3
Sizewell A	47.0	39.0	-17.0
Hunterston A	41.8	37.2	-11.0
Windscale	34.7	34.2	-1.4
Chapelcross	55.2	56.6	2.5
Capenhurst	21.2	22.0	3.8
Downreay	139.4	150.1	7.7
Trawsfynydd	46.2	50.7	9.7
Calder Hall	32.4	36.1	11.4
<b>Total for 14 sites</b>	<b>732.0</b>	<b>665.8</b>	<b>-9.0</b>

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

#### NOTES

- For Hinkley Point A, Berkeley and Chapelcross the October values are approximates agreed with the Authority.
- The Authority provided provisional funding levels in October 2006 so that sites could plan their near term work programme which was included in their overall lifetime plan submitted in March 2007.
- The number of sites no longer operating increased from 12 (see paragraph 3.2) to 14 when Dungeness A and Sizewell A ceased generating at the end of 2006. Other than Capenhurst, all sites listed above are Magnox or research reactor sites.

## BOX 1

**Examples of contracts halted at the Authority's sites**

**Hinkley Point A.** At the start of 2006-07 the site and the Authority agreed that the project to build an Intermediate Level Waste Store should be accelerated. Planned work on the project during 2006-07 was therefore increased from £2.1 million to £7.9 million. By the end of the year, however, the site had to cut back expenditure on the project. Work with a budget of £0.4 million was removed from the 2006-07 programme and planned expenditure for 2007-08 was cut from £6.0 million to £0.5 million. These cuts required the site to halt its contract for the store after the contractor had prepared the base for the store but had not started to construct its shell. Halting the contract was expected to bring demobilisation costs of some £0.2million and a similar level of cost is expected to be incurred in restarting the project.

**Bradwell, Sizewell A and Dungeness A.** The removal of plant and demolition of the turbine halls at these three reactor sites had been packaged together, to deliver economies of scale, and put out to tender in 2006. The price offered by the bidders was some 30 per cent below baseline provision and had been influenced by the relatively strong scrap values present at the time of tendering. The competition was aborted, however, at the start of 2007 because the sites had to cut their 2007-08 programmes.

**3.15** To help the transition of those sites bearing the largest reductions in planned programmes, the Authority established a “break through” fund totalling £31.6 million in 2007-08. Sites can apply for “break through” support to meet the costs of contract closure as well as staff training, relocation and what can be substantial redundancy costs. These costs make it difficult for sites to reduce their overall spending in the near term through reducing in-house staff numbers.

**3.16** The tier 2 contractors we interviewed suggested that uncertainties over the size and composition of the Authority's programme might make them more wary of investing in the decommissioning market. They also reported that uncertainty could also make it difficult for them to retain staff with skills which are in demand elsewhere.

**3.17** In November 2007 the Authority started a consultation on its Business Plan for 2008-11. The Authority intends to focus its decommissioning resources increasingly on the high hazard facilities at Sellafield and Dounreay. The speed with which the Authority can transfer resources will depend on factors such as: the potential socio-economic impact on those areas around the smaller research and Magnox sites; having funds to cover costs of transition such as redundancy; and the ability of Sellafield and Dounreay to make effective use of new money.

30 As at December 2007, the Authority had submitted a request to HM Treasury (via the Department) to draw upon all of its built up end-year flexibility in order to guard against possible pressures on its 2007-08 budget. At the time of finalising this report the Treasury had not yet concluded its discussions with the Department on the end-year flexibility.

## The challenges faced by the Authority reflect, in part, uncertainties inherent in its reliance on commercial income earned from ageing and unreliable facilities

**3.18** In 2005-06, the Authority's commercial income was £1,211 million, broadly in line with budget. In 2006-07, commercial income of £1,206 million was some £112 million less than budget. The shortfall was due to a number of factors including lower electricity prices, a reduction in the fuel required by customers and the on-going shut down of the Thermal Oxide Reprocessing Plant (THORP) which reprocesses spent nuclear fuel. In Spring 2006 the Authority established its initial budget for 2007-08. Based upon advice from the Sellafield site licensee, the Authority assumed that some customers would take-up the waste substitution service in 2007-08 (see paragraph 3.11). The Authority therefore judged that it would receive income of around £400 million for waste substitution activities in 2007-08. By Autumn 2006, the Authority considered that there was a significant risk that waste substitution income might not be received in 2007-08.

**3.19** In addition, the Authority was also aware that during 2007-08 it would have to fund urgent work on Sellafield's legacy ponds and silos. These are high hazard facilities, which are covered by licensed specifications, issued by the Health and Safety Executive's Nuclear Directorate, which set down requirements which must be achieved by dates between 2009 and 2020. It had taken time to determine the nature and scale of work to be undertaken on these facilities. Expenditure on legacy ponds and silos was £183 million in 2006-07, with a budget of £263 million in 2007-08 and forecast to rise to around £375 million in 2008-09.

**3.20** Coping with uncertainties on this scale was a major challenge for the Authority. It had some flexibility in its 2007-08 spending plans, through its scope to reprioritise activity across sites, and its end-year flexibility to draw on unused resources from past years, subject to Department and HM Treasury approval (see paragraph 1.13). The Authority decided to commit in full its unused resources<sup>30</sup> to 2007-08 but judged that this would probably be insufficient to balance its books given the uncertainties in its commercial income and the additional expenditure required for urgent work. It therefore approached the Department for an increase in its grant-in-aid for 2007-08.

**3.21** The uncertainties in 2007-08 were exacerbated by the fact that the Authority's final 2007-08 budget was not set until February 2007, albeit that it was informed of its provisional financing position in December 2006.<sup>31</sup> Initially the Department had an incomplete understanding of the Authority's financial position for 2007-08. The scale of the Authority's potential additional claim on the public finances was not apparent to the Department until November 2006. Our work suggested that a lack of effective communication between the two parties on the Authority's 2007-08 budget, in particular on the scale of the extra expenditure required at Sellafield and the uncertainties over commercial income, had delayed action to bridge the funding gap and had added to the uncertainties facing the Authority's sites.

**3.22** During 2007, the Department has increased the number, and breadth of skills, of its staff who work with the Authority. Input, for example, has been provided by the Department's Shareholder Executive<sup>32</sup> who have commercial and financial expertise. In October 2007, the Department transferred overall responsibility for overseeing the Authority to the Shareholder Executive. The Department consider that these developments will ensure that it is well placed to carry out its governance function and to oversee the full range of issues facing the Authority.

## The Authority is developing mechanisms to help it prioritise between competing demands for decommissioning resources

**3.23** The Authority had sought to prioritise between the competing bids but lacked some of the information it needed to take decisions. Working with regulators and other stakeholders the Authority developed new arrangements for deciding priorities in 2005 and 2006 and asked sites to use them in preparing lifetime plans completed in 2007. The process required sites to rank projects according to their benefit in reducing risks to safety and the environment.

**3.24** The information obtained from sites through the 2007 lifetime plan did not identify the degree of discretion, if any, in the timing of individual projects and thus, in isolation, did not enable the Authority to assess how a planned programme might be varied to reflect differing funding levels. To help it decide how to cut its 2007-08 work programme (see paragraphs 3.12 and 3.13), the Authority introduced a temporary prioritisation approach which changed the focus to the degree of discretion available over the timing of projects. This arrangement helped support decision making but the speed with which the prioritisation process was undertaken limited the opportunity for regulators and other stakeholders to provide their views on both how sites' had categorised their projects and the overall impact of changes to work programmes on individual sites.

31 The Department informed the Authority that it should plan on the basis of receiving additional grant-in-aid of £160 million but this, and the conditions under which the Authority could access the additional grant-in-aid, was not confirmed until February 2007.

32 The Shareholder Executive was set up in 2003 to improve the way Government manages public sector businesses.



## The development of contracting

**4.1** This Part examines the lessons to be learned from the Authority's use of contracting for decommissioning so far.

### The Authority's framework of contracting and competing through site licensees and parent bodies is still relatively new and untested

**4.2** The contracting and competition framework set out in the 2002 White Paper, separating site licensees and parent bodies, and implemented by the Authority, is relatively new and not widely tested. The initial model was chosen by the Department to avoid the need to relicence new contractors following competitions or takeovers, and to give a degree of continuity to site management whilst enabling injection of private sector best practice (see paragraph 1.15).

**4.3** There is a tension between the Authority's duties under the Energy Act 2004 to develop strategy, secure value for money, and ensure adoption of good practice, and the site licensee's responsibility for controlling all activity on site. To date this tension has caused the Authority to take a restricted view of its freedom to influence its contractors as to how it wants work done, for fear of cutting across site licensees' responsibilities and being deemed to have exercised control.

**4.4** The Authority has sought to clarify the boundaries between its own role and that of site licensees by issuing guidance to staff. In 2007 a review by the Health and Safety Executive's Nuclear Directorate and the environmental regulators concluded that most sites licensees had

autonomy in how they manage nuclear safety and nuclear waste management within an appropriate security regime. But there was a perception, and some evidence, that the Authority was exercising undue influence, for example, through its scrutiny or challenge to sites' plans or proposals. Conversely, our interviews with some Authority staff indicated concerns that their ability to effectively challenge current practices and plans, and encourage the adoption of practices which have been successful elsewhere, could be limited by the fear that they might be seen as exercising control over sites.

**4.5** The appointment of new parent bodies, drawn from the private sector, is creating a new set of relationships to manage. The Authority expects parent bodies to bring innovation and best practice through their governance of site licensees, and by seconding a relatively small number of their own key personnel. Until Summer 2007 all site licensees for decommissioning sites had been owned by (or an integral part of) state entities – either British Nuclear Fuels Limited or the United Kingdom Atomic Energy Authority. The owner of the site licensee for the Magnox power stations – British Nuclear Fuels Limited's Magnox Electric Ltd – was acquired by the company EnergySolutions in June 2007. It is too early to judge the extent to which commercial parent bodies will be able to drive performance improvements in site licensees. Previous National Audit Office examinations of complex contractual relationships and challenging projects, particularly in the defence area, have demonstrated the importance of establishing strong collaborative working relationships from the start, with a shared understanding of the factors important to each party and an agreed view of their respective roles and responsibilities.

The Authority's use of cost reimbursement contracts has meant that the risk of cost increases is borne by the taxpayer, but it had justifiable reasons for using this form of contract in the initial stages

**4.6** Prior to the establishment of the Authority in April 2005, the Department decided that the new contracts between the Authority and the site licensees at the outset should follow the cost reimbursement model. It also decided that there should be one contract per site, rather than a series of contracts for different work streams or projects on each site or group of sites.

**4.7** Under the cost reimbursement model costs incurred by the site licensee in performing or commissioning any work on its site are reimbursed by the Authority.<sup>33</sup> Site licensees pass on cost increases, including pay increases they agree with their workforce, to the Authority and do not bear the cost of expenditure in excess of budgets set down in the lifetime plans. All the risks of cost increases are therefore borne by the Authority. Expenditure is, however, limited by an annual site funding limit and the contract allows work to be deferred to avoid breaching this or, if approved by the Authority, extra funding to be introduced.

**4.8** The Authority, and prior to its creation the Department, could have opted for one of a number of contract models offering differing degrees of risk sharing (**Box 2**). Our review of international practice (Appendix 5) indicated that the cost-reimbursement approach has already been used frequently in the decommissioning market in the United States. Practice here had, in part, evolved from poor early experience with a turnkey contract for remediation at the Idaho National Laboratory (**Box 3**).<sup>34</sup>

**4.9** Cost reimbursement contracts are used elsewhere in the United Kingdom. In managing the Heathrow Terminal 5 project, for example, the British Airports Authority, has taken the view that cost reimbursement contracts can be appropriate for example where work scope is uncertain and/or cost is difficult to estimate (**Box 4 overleaf**).

## BOX 2

### Potential contract models

- i **Fixed price contracts** requiring specified work to be performed for a fixed payment, with the work and payment set at the outset. The risk of cost increases is borne by the contractor.
- ii **Turnkey contracts** specifying the product or outcome to be delivered by the contractor for a fixed price, rather than specifying in detail the work to be performed to arrive at that product or outcome.
- iii **Target cost contracts** setting a target cost for specified work at the outset, and the client and contractor share the gain from any under spend, and the pain of any overspend in accordance with agreed proportions set out in the contract. Sometimes the pain for the contractor is limited to reduced fee when costs exceed target, sometimes they have to bear a portion of costs in excess of the target or guaranteed maximum level.
- iv **Hybrid models** combining fixed or target cost components for some work, with cost reimbursement plus performance fee for others.

## BOX 3

### Risk Management 1 – The Idaho National Laboratory Pit 9 Project

In the United States, one of the Department of Energy's first fixed price performance contracts was the Pit 9 project at the Idaho National Engineering and Environmental Laboratory awarded in 1994. Pit 9 was an inactive waste disposal pit.

In July 1997, the Government Accountability Office reported that the cleanup of Pit 9 was at least 26 months behind the original schedule and could potentially cost well over twice the original estimate of \$200 million. The Department of Energy was also fined \$940,000 by its regulators for failure to meet deadlines for submitting acceptable design documents, and the contractor had hired legal counsel whose fees Department of Energy was obliged to pay under the terms of the contract.

The Government Accountability Office concluded that the fixed price had been adopted despite early indications of uncertainty regarding the nature of the waste in the pit – and uncertainty regarding the effectiveness of the contractor's proposed technology.

*Source: US Government Accountability Office Report Nuclear Waste: Department of Energy's Project to Clean Up Pit 9 at Idaho Falls is Experiencing Problems: July 1997*

<sup>33</sup> Some costs, such as fines paid by site licensees for breach of law or regulatory requirements, are defined as disallowable and are thus not reimbursed.

<sup>34</sup> *Improving Project Performance: An Analysis of Decommissioning Contract Models in the USDOE and Associated Results for Potential Application in the United Kingdom*: Peter Swenson – CH2MHill International: Conference Paper – 10th International Conference on Environmental Remediation and Radioactive Waste Management: 2005 Glasgow

**4.10** In the case of the Authority, our work suggested that there were sensible reasons for opting for the cost reimbursement approach, at least in the initial stages when all sides are attempting to define the decommissioning task. In particular:

- uncertainties regarding the volume, nature and disposition of wastes on the various sites and the best methods for its retrieval and stabilisation would probably have made it difficult to characterise a whole site sufficiently to produce a viable estimate of likely costs; and
- it would probably have been difficult to prevent cost migration between fixed cost and reimbursable elements on the same site, particularly when new accounting systems – and their use by the client body – were not well established as was the case on creation of the Authority.

The Authority has used performance and efficiency fees to drive improvements to decommissioning, but the focus on annual performance and in-year adjustments has limited their effectiveness

**4.11** In the absence of the straightforward cost incentive inherent in fixed-price contracts, the incentive on the site licensee to innovate and achieve cost reductions must come from other approaches. The Authority has used a performance incentive arrangement stipulated within the contracts, and has introduced separate arrangements to promote cost efficiency.

### Performance incentives

**4.12** Each year the site licensee agrees performance based incentives with the Authority. At decommissioning sites performance based incentives have included achieving key milestones on projects. They have also included, for example achieving generic targets such as fixed cost reductions, using shared services, and improvements in lifetime plans.

**4.13** The performance based incentive fee pool for each site was set at 3.6 per cent to 5.4 per cent of the annual site funding limit for 2005-06, and 3.25 per cent to 3.5 per cent for 2006-07, when a separate cost efficiency fee component was introduced. Sites were paid £75.4 million in 2006-07, representing 86 per cent of the available fee pool. **Figure 13** shows the proportion of maximum performance fee paid to each site in 2006-07.

## BOX 4

### Risk Management 2 – Heathrow Terminal 5

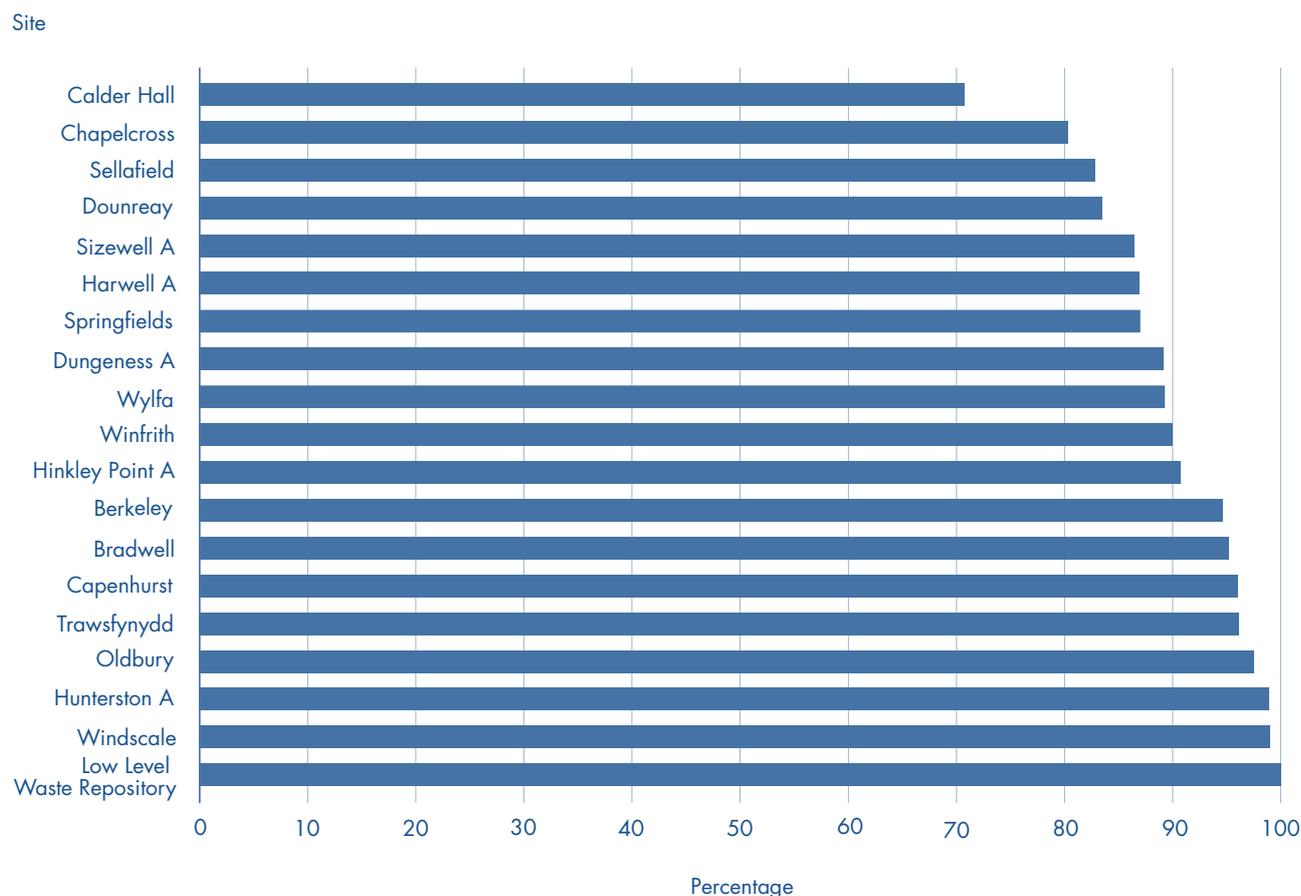
The principle for remuneration set out in British Airport Authority's contract, the T5 Agreement, is cost reimbursement plus overhead and profit. For costs to be reimbursable on T5 a contractor or supplier has to demonstrate that costs have been properly incurred. The majority of work has been paid for on this basis, but where appropriate, BAA has agreed other forms of remuneration, including fixed rates or lump sums for specific activities or work elements. One of the main supply chain lessons is that, when managing and contracting with a diverse range of contractors, consultants and suppliers, "one size does not fit all". The decision to fix prices or sums has been determined by factors such as clarity of scope, utilisation of standard products, price certainty and residual risks, and was considered on a work package by work package basis.

BAA has used benchmark information from other projects to set cost targets. BAA has sought to manage the financial risk associated with estimation by using a combination of detailed "bottom up" cost analysis and validation by independent consultants; and by working with more than one supplier in some areas to maintain competitive tension. If the out-turn cost is lower than target, and the work package is delivered on time, savings are shared between BAA and its delivery partners. If cost exceeds target BAA bears the pain but the supplier gets a reduced margin and loses the opportunity to share savings.

*Source: British Airports Authority and the National Audit Office's Report Improving Public Services Through Better Construction, March 2005*

**4.14** Changes to in-year plans requested by site licensees, or the Authority itself, due for example to regulatory requirements, uncertain work scope or funding availability can make it difficult to maintain a sufficiently testing performance incentive regime over a 12 month period. During the year the site licensee may propose, or the Authority may require, performance fees to be reassigned to another project because circumstances have changed. This may be justified, for example if a project cannot go ahead or work has revealed previously unexpected complications. There is also a risk, however, that this process can allow the substitution of alternative fee opportunities which offer little new benefit to the Authority. Our work suggested that in-year changes were sometimes significant. For the Magnox sites we visited, and for clean-up work at legacy ponds and silos at Sellafield, some 29 per cent of performance based fee was reassigned during 2006-07 to new or adjusted milestones. The fee changes we examined in detail were clearly linked to alterations in the planned work programme (**Box 5**) but illustrate the difficulty of putting in place appropriate incentives within the current annual framework.

### 13 Performance fee paid as a percentage of each site's maximum fee, 2006-07



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

### BOX 5

#### Examples of fee reassignment in 2006-07

- i **Bradwell** – Intermediate Level Waste store – £30,000 of fee was originally earmarked to the site licensee if it met a target for awarding a contract to design and build a new storage facility. But the tendering exercise yielded only one bid and the competition was abandoned. The fee was reallocated to the delivery by the site licensee of design options for the store.
- ii **Trawsfynydd** – Pond clearance – £202,000 of fee was allocated to removing, packaging and sealing 157 tons of debris cleared from fuel storage ponds at the start of the year. The site's difficulty in delivering the full value of its work programme within its smaller budget meant that by the end of the year some work had to be deferred from this project. Consequently, the project's incentives were revised. £81,000 of fee remained focussed on removal of pond debris, the original incentive, with a revised metric of filling one half-height freight container with pond debris, and £40,000 to starting the commissioning of an additional remediation capability of one further pond lane. The remaining £81,000 of fee was re-allocated to a new target on a different project covering waste recovery and containment from a reactor vault.
- iii **Hinkley Point A** – Retrieval and Decontamination of Skips – £239,000 of fee was originally allocated to retrieving 610 skips worth of waste from reactor ponds and preparing 360 empty skips to help handle it. This was later reallocated to a revised target of retrieving 40 skips worth of waste from the ponds and preparing 270 skips to help handle it and other waste. This was because the original characterisation of the pond waste as largely low level waste was called into doubt when the first batch of material retrieved was all intermediate level waste. Intermediate waste, unlike low level waste, needs to be processed in a decontamination unit and this unit was not fully operational. Consequently, the site was no longer able to retrieve skips at the planned rate necessary to achieve the original incentive.

Source: National Audit Office analysis of Authority incentive records

## Efficiency incentives

**4.15** The Authority has also sought to incentivise the site licensees to achieve efficiency savings. The Authority considers efficiency gains to be the saving in actual cost of work relative to its budgeted cost in the lifetime plan, provided those savings are the demonstrable result of positive action by the site licensee.<sup>35</sup> This approach therefore places significant reliance on the robustness of the budgets included in lifetime plans which are established as part of the lifetime planning process (see Part 2).

**4.16** An incentive formula was first introduced in 2005-06 and developed for 2006-07. The arrangements are described in **Box 6**. For 2005-06, the Authority reported that site licensees had achieved savings of £124 million, the equivalent of 5.8 per cent of the budgeted cost of the work completed during the year. In 2006-07 the reported savings increased to £208 million, or 8.5 per cent of the budgeted cost of the work completed during the year. In return, the site licensees earned efficiency fees totalling £20 million and £50 million in 2005-06 and 2006-07 respectively. The efficiency fee paid to sites in 2006-07, as a proportion of the work they performed during the year, is shown at **Figure 14**.

**4.17** The calculation of efficiency gains requires careful scrutiny by the Authority of any changes to plans and corresponding budgets over time. Budget adjustment can happen each time the lifetime plan as a whole is reviewed, but can also happen between such reviews when site licensees submit requests for changes to the baseline. In addition to its scrutiny of such proposals the Authority has put in place processes to check that savings claimed as efficiencies are due to demonstrable management action.

**4.18** It has proved difficult for the Authority to confirm that ongoing efficiencies are carried forward into future years' lifetime plans. At Sellafield, of the site's eighty operating units, only seven identified that they had been able to build efficiency savings made in 2006-07 into their 2007 lifetime plan submissions. Those units estimated that past efficiencies would help reduce costs in 2007-08 by some £6.4 million, despite the site achieving efficiencies totalling £76 million in the previous year. Some gains in 2006-07 will have been on one-off projects, and others may not have become evident at the time the lifetime plan for the following year was prepared.

**4.19** The annualised nature of the incentive, coupled with the opportunity to seek baseline adjustments, means that efficiency fee can be earned on projects where lifetime costs are increasing. This is illustrated for three individual projects in **Figure 15**. For the three projects shown, estimated total lifetime costs increased from £125.9 million to £138.2 million between the lifetime plan finalised in March 2006 and plan finalised in March 2007. Nevertheless in-year performance relative to the 2006-07 budget was such that efficiency fee of £657,000 was paid on these projects in 2006-07. The point here is not that these efficiency fees were all unmerited – the reasons for increases in lifetime costs may have been outside the contractor's control, for example because original assumptions about the radioactive level of waste proved to be incorrect. The point is that an annual efficiency fee relative to a moving target is not a strong incentive to control the overall cost of a project.

### BOX 6

#### Efficiency fees for site licensees in 2005-06 and 2006-07

The arrangements set out below were designed to achieve the Authority's own target of securing annual efficiency gains of 2 per cent after fee payments to its site licensees.

**2005-06** – The Authority set sites a target of achieving 7 per cent efficiency gains. Achievement of the target by an individual site triggered payment of a fee to its site licensee, equivalent to £1,000 per site employee. If the target was met the full fee was paid and, if not, nothing was paid.

**2006-07** – The Authority introduced a tapered efficiency fee in 2006-07. The amount payable was a quarter of the efficiency gain achieved, but with 58 per cent of this amount withheld until the value of the savings reach 6 per cent of the budgeted cost of work performed.

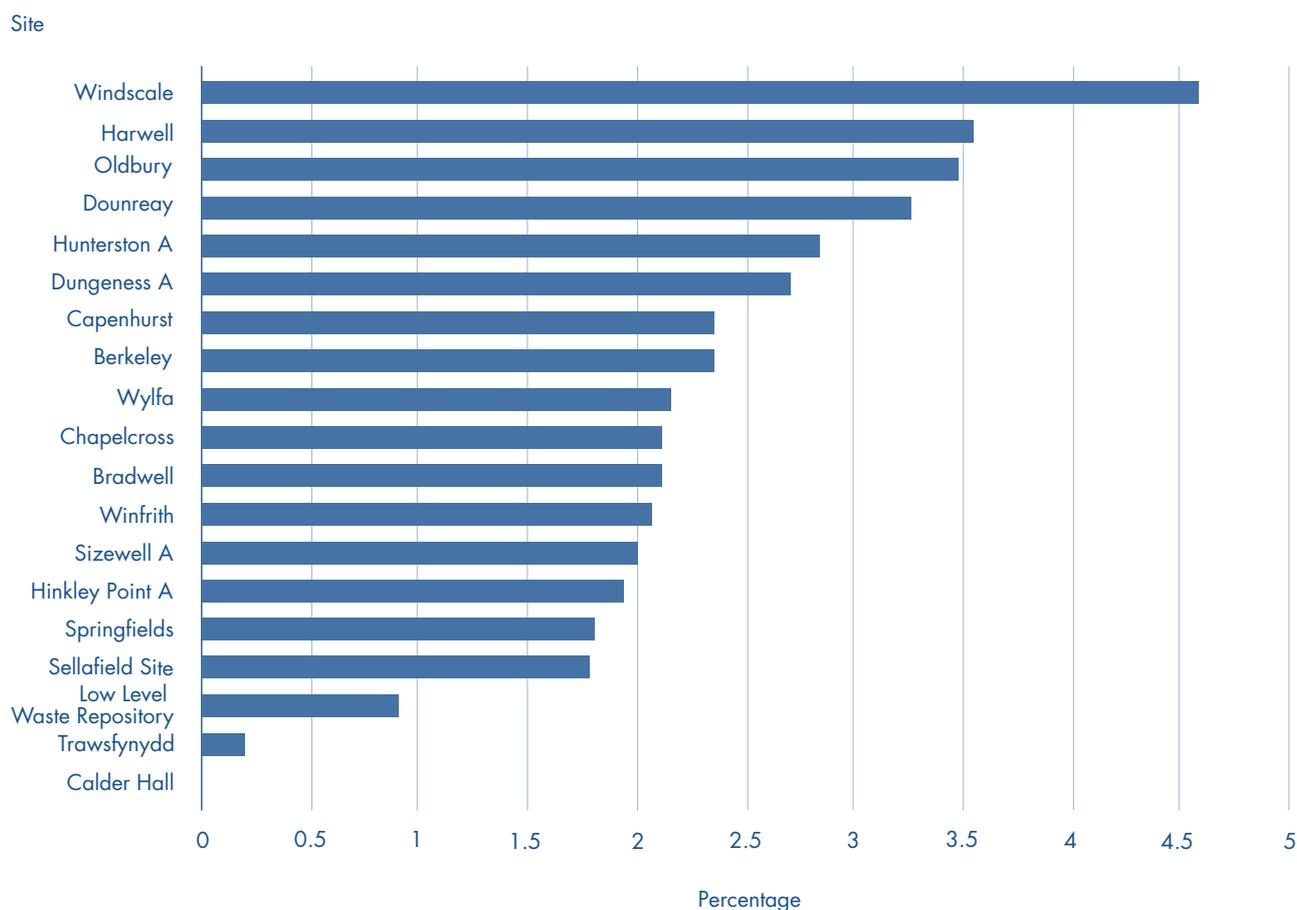
Efficiency fee for most sites was capped at 25 per cent of the net savings across the site as a whole.

The Authority's own staff are also incentivised to meet the 2 per cent efficiency target – the target is one of a number of corporate objectives, attainment of which partly determines the level of staff bonuses.

*Source: National Audit Office analysis of Authority efficiency fee documentation*

<sup>35</sup> In 2006-07, the four research sites were not required to demonstrate that savings had arisen from management action. From 2007-08, all sites will be required to demonstrate management action.

## 14 Efficiency fee paid as a percentage of budgeted cost of work performed in 2006-07 by site



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

## 15 Examples of projects where efficiency fees were earned in 2006-07 and lifetime costs increased compared to the budget at the start-of-year

Project	Estimated total lifetime cost in March 2006 plan (£000s)	Estimated total lifetime cost in March 2007 plan (£000s)	Increase in total lifetime cost between March 2006 and March 2007 (£000s)	Efficiency fee paid for performance in 2006-07 (£000s)
Hinkley Point A Ponds	36,300	39,200	2,900	239
Dounreay Shaft Isolation	24,400	25,600	1,200	191
Harwell B462 RH Intermediate Level Waste	65,200	73,400	8,200	227

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

### NOTE

All cost figures at 2007 prices.

## The Authority is seeking to identify further scope for cost reductions at site level

**4.20** The Authority believes it is possible for sites to reduce the cost of site support services thereby achieving efficiencies. These services include procurement services, engineering support, human resources and financial services. Its target is to reduce these costs by 10 per cent in 2008-09 compared to 2007-08. The Authority identified £826 million of site support services within its 2006-07 budgets, around a third of its programmed spend across its 19 sites. It believes services with a 2006-07 budget of £436 million could potentially be shared cost-effectively across sites. Site licensees, prompted by the Authority, are establishing an interim alliance for joint commissioning of supplies and services.

**4.21** The Authority is encouraging site licensees to expose more work to competition, and to open competitions to more companies. It requires site licensees to submit annual procurement plans listing and describing planned sub-contracts for the year ahead. The Authority has to approve any decommissioning sub-contract in excess of specified limits and, in some instances, has to approve decisions to award work in-house. At Trawsfynydd, for example, the Authority required the site licensee to obtain project management services through competition rather than awarding it to an affiliated company. There is currently no data collected on levels of competition for different types of work at each site.

## The current contract form has provided a platform for the development of consistent and transparent procedures and plans but it now needs to be developed to ensure maximum benefit is derived

**4.22** Cost reimbursement management and operations contracts have provided an environment of low financial risk for site licensees, coupled with fee rewards of around 5 per cent, while they work with the Authority to get to grips with a significantly changed industry structure and seek to define the decommissioning task. The competition process provides the Authority with the opportunity to alter the degree and nature of risk transferred to its contractors and test the appropriateness of the fee regime, and its level, given that the new contracts may provide the

successful parent body with up to 17 years of income, and make them well-placed when the contract is subsequently re-tendered.

**4.23** The current cost reimbursement contracts have a number of weaknesses. As already described in paragraph 4.14, the extent of changes made to in-year plans can significantly dilute the impact of the current framework. The Authority is considering setting some incentive targets on a multi-annual or contract term rather than annual basis. This would allow incentivisation of milestones for project completion and keep up the pressure to deliver, and reduce the risk that if an intermediate milestone is missed the fee is just reallocated.

**4.24** Whilst the cost reimbursement approach is sensible in situations where the true nature of work is very uncertain, this uncertainty does not apply to all elements of the decommissioning process, for example construction of new waste stores. Incorporating fixed or project-life target cost elements for some projects could strengthen commercial incentives and give greater cost certainty. These contracting approaches are already used frequently by site licensees in their contracts with sub-contractors. Incorporating them in the Authority's contracts could also bring pressure to bear on site licensees to design innovative solutions to well characterised tasks and give a sharper incentive to improving efficiency of self-performed work.

**4.25** The Authority has itself indicated it wishes to move to "more commercially leveraged positions" early in the term of the first competed Sellafield contract. This could include fixed or project-life target cost arrangements for certain work components. To gain value from the competition process it will need to have a clear view both of where those elements might lie prior to awarding contracts, and how it will ensure that the price and incentive regimes it subsequently agrees with the new parent body will provide the taxpayer with good value.

**4.26** As the Authority takes forward the process of competing parent body rights for each site, it may wish to review the contracts' intellectual property provisions, which limit site licensees' opportunity to extract value from the application of their innovations at other licensees' sites. The Authority will need to continue to capture as much of the value of innovation for the taxpayer as possible, while giving its site licensees and their parent bodies sufficient incentive to innovate.

**4.27** Under the existing management and operation contract, sites are reimbursed by the Authority for all the costs they incur in a year. The Authority informed potential bidders that it would be interested in discussing how a new parent body for Sellafield might be rewarded for investing its own funds to accelerate programmes of work. If any such arrangements were to be incorporated in new contracts, the Authority would need to ensure it is well placed to secure an appropriate share of any overall savings in lifetime costs for the taxpayer and, as the arrangements would be novel, gain approval from the Department and HM Treasury.

## Once sites are under commercial management, the Authority will need to adapt its contract management approach to both the risks and opportunities this will present

**4.28** Our visits to sites indicated that the Authority's site and regional teams had developed an in-depth understanding of site programme and project issues and had built sound working relationships with the site licensee's staff. The contract form and its validation and authorisation procedures had necessarily engaged the Authority's teams closely with decommissioning activities at site level.

**4.29** Ahead of the site competitions, the Authority has assembled and maintains risk registers for each of its major competitions, but these are mostly based on risks to programme milestones or potential challenges to the competition process. They do not specifically address the risks to the Authority or taxpayer value of more rigorous commercial exploitation of contract provisions, or suggest the mitigating actions – for example in the skills mix or training of its contracts management staff – which could be taken.

# APPENDIX ONE

## Study methods

**1** Study methods were selected so that the study team could examine the Authority's performance in taking forward decommissioning since April 2005, and identify lessons that it could learn for contracting for decommissioning ahead of the forthcoming competitions.

### Literature review

**2** The study team reviewed English and French language literature on strategies and contract forms for both nuclear decommissioning and more generalised programmes of construction, demolition or civil engineering works. The review used internet search engines, searches of publications from known international nuclear organisations, Factiva searches, and review of studies by the US Government Accountability Office and the French Cour des Comptes. The review identified evaluative studies of strategies for nuclear decommissioning, alternative contract forms for nuclear decommissioning, and the use of these contract forms in other contexts. The purpose was to establish a basic understanding of options for nuclear decommissioning, learn how UK processes compare with others, and test our findings against other evaluative work.

**3** The study team also reviewed previous National Audit Office reports and case studies on contracting for construction, civil engineering and defence projects for lessons on contract form and management, and triangulated its conclusions with evidence from those previous studies.

### Review and analysis of lifetime plan processes and content

**4** To assess the Authority's planning arrangements, the study team reviewed documentation associated with preparation of sites' lifetime plans. The team also analysed the content of successive plans, observed the Authority's reviews of submissions from two site licensees, and reviewed summary documentation arising from the Authority's scrutiny and challenge of submissions.

### Site visits

**5** The study team conducted preliminary visits to Chapelcross, Sellafield, Bradwell, Harwell and Springfields when designing the study. During main fieldwork the team visited the following six sites to understand how the Authority's staff managed contracts and the impact on the sites and their contractors:

- Sellafield
- Bradwell
- Hinkley Point A
- Trawsfynydd
- Dounreay
- Harwell which was in the process of combining with Winfrith

**6** These sites were chosen to give a mix of research reactor, power reactor and fuel processing sites as well as covering the Authority's two biggest sites at Sellafield and Dounreay.

**7** Semi-structured interviews with the Authority's programme and contract management staff, site licensee staff and tier 2 contractors were conducted on site visits. The study team examined the planned and actual size of each site's work programme, reasons for changes made to the programme, progress with major projects, the performance-based incentives set and efficiency fee paid to contractors.

### Review of the Authority's performance data

**8** The study team analysed data on the actual cost and progress of the Authority's sites against planned work, the composition of their work programmes and the performance and efficiency fees paid to its contractors.

## Interviews with staff from Nuclear Decommissioning Authority headquarters, Department for Business, Enterprise and Regulatory Reform and the Scottish Government

**9** The study team visited the Authority's headquarters at Herdus House near Whitehaven and conducted semi-structured interviews with commercial and contract management staff, as well as staff responsible for regulatory issues, lifetime plan improvement, major project reviews, decommissioning strategy and site support service initiatives. The team also reviewed documentation held by the Authority associated with these areas.

**10** The study team conducted interviews with staff from the Nuclear Decommissioning Authority governance section of the Department for Business, Enterprise and Regulatory Reform and reviewed documentation held by the Department relating to the establishment of the Authority and its on-going funding and governance. The team also discussed the study with staff of the Scottish Government as regards matters within its responsibility.

## Interviews with regulators

**11** Interviews were conducted with staff of the Nuclear Installations Inspectorate and the Office for Civil Nuclear Security (both part of the Health and Safety Executive's Nuclear Directorate), the Environment Agency and the Scottish Environment Protection Agency. The purpose was to secure evidence and views from regulators on the effectiveness of the management and operations contracts and their use by the Authority.

## Stakeholder engagement

**12** The study team wrote to stakeholders in the nuclear decommissioning process including non-governmental bodies and technical societies inviting submission of evidence to the study. The team also attended the Authority's National Stakeholder Group meeting in Manchester in July 2007 and engaged with attendees to secure their evidence or views on the study area.

## Benchmarking of contract form and procedures

**13** Mott MacDonald conducted a benchmarking exercise comparing the Authority's management and operations contracts with those used by other bodies or companies commissioning large scale programmes

of work. Benchmarking was performed through completion of questionnaires followed up by interviews, and application of the consultants' own knowledge of contract forms and their management. The following five organisations participated in the benchmarking exercise:

- European Bank for Reconstruction and Development
- Highways Agency
- Shell UK
- Strategic Investment Board for Northern Ireland
- National Grid

## Use of an expert panel

**14** In order to provide guidance on the design and preliminary conclusions of the study, six individuals with specific areas of knowledge and experience were recruited to serve on an expert panel.

### **Professor Dieter Helm**

Official Fellow in Economics – New College Oxford

Associate Editor – Oxford Review of Economic Policy

Director – Helm Associates Ltd

Non-Executive Director – Oxera Holdings Limited

### **Professor Gordon MacKerron**

Professorial Fellow, Science and Technology Policy Research, University of Sussex

Chairman – Committee on Radioactive Waste Management (CoRWM) (until August 2007)

### **Peter Wilkinson**

Independent Environmental Consultant

Member – Committee on Radioactive Waste Management (CoRWM)

### **Tom La Guardia**

Managing Member La Guardia and Associates LLC

US Nuclear Decommissioning, Decontamination and Cost Estimation Consultancy

### **Professor Sue Cox**

Dean and Professor of Safety and Risk Management

Lancaster University Management School

### **Gene Aloise**

Director – Natural Resources and Environment

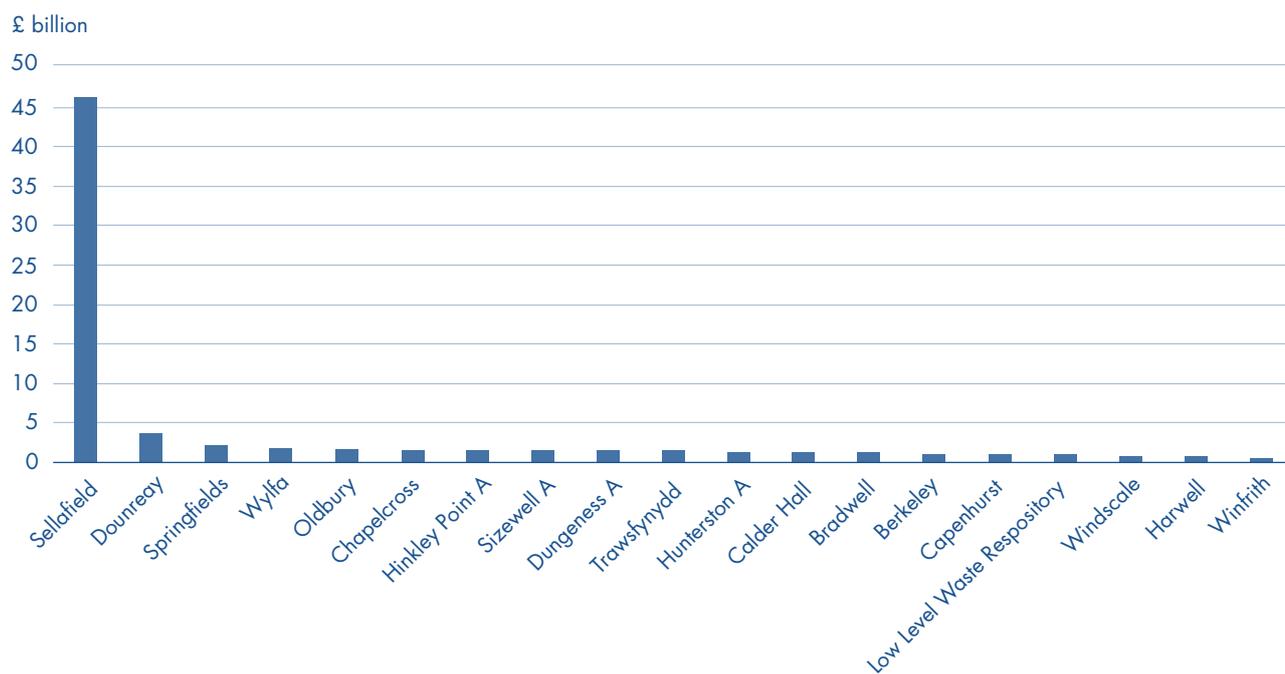
US Government Accountability Office (GAO)

# APPENDIX TWO

## Lifetime costs by site

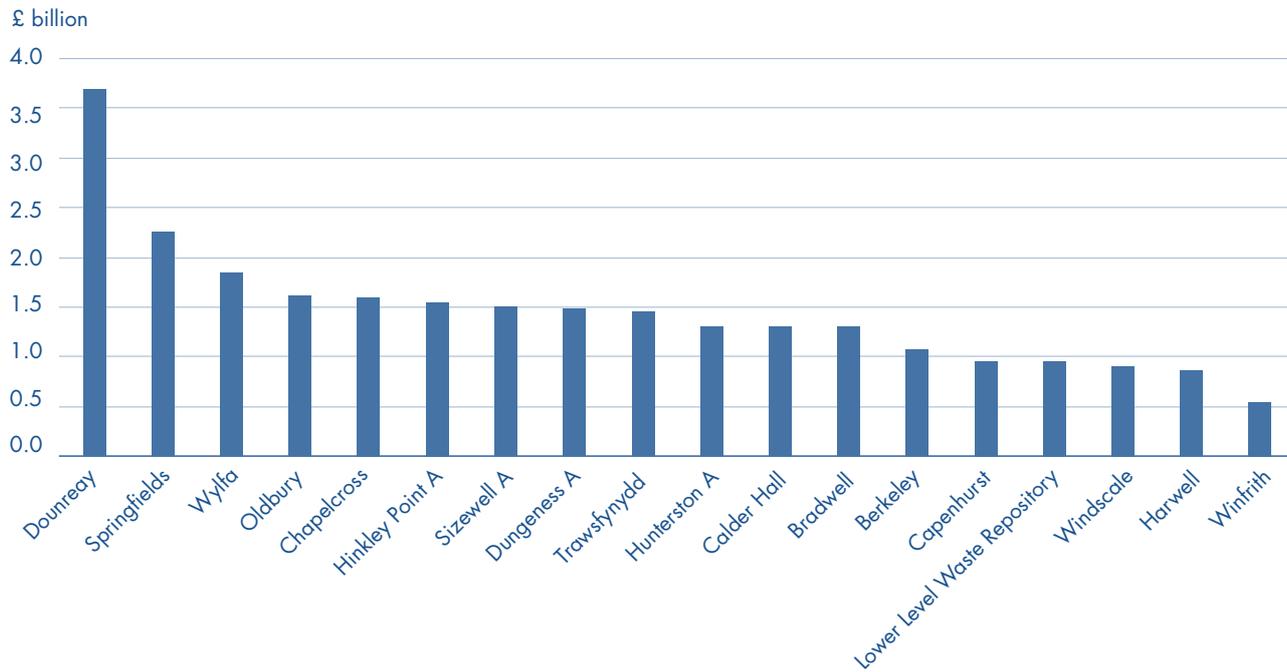
Lifetime costs are discussed at paragraphs 1, ii on page 7, 1.3 and 2.6 to 2.8 and Figures 3 and 8 (on pages 12 and 18). The values below reflect the Authority's best estimate of the undiscounted future cost of its 19 sites over their remaining life at 2007 prices. They include the cost of decommissioning sites and the cost of running operational facilities to the end of their commercial life. They do not reflect the anticipated revenue from operational sites.

### 16 Total lifetime cost – all sites



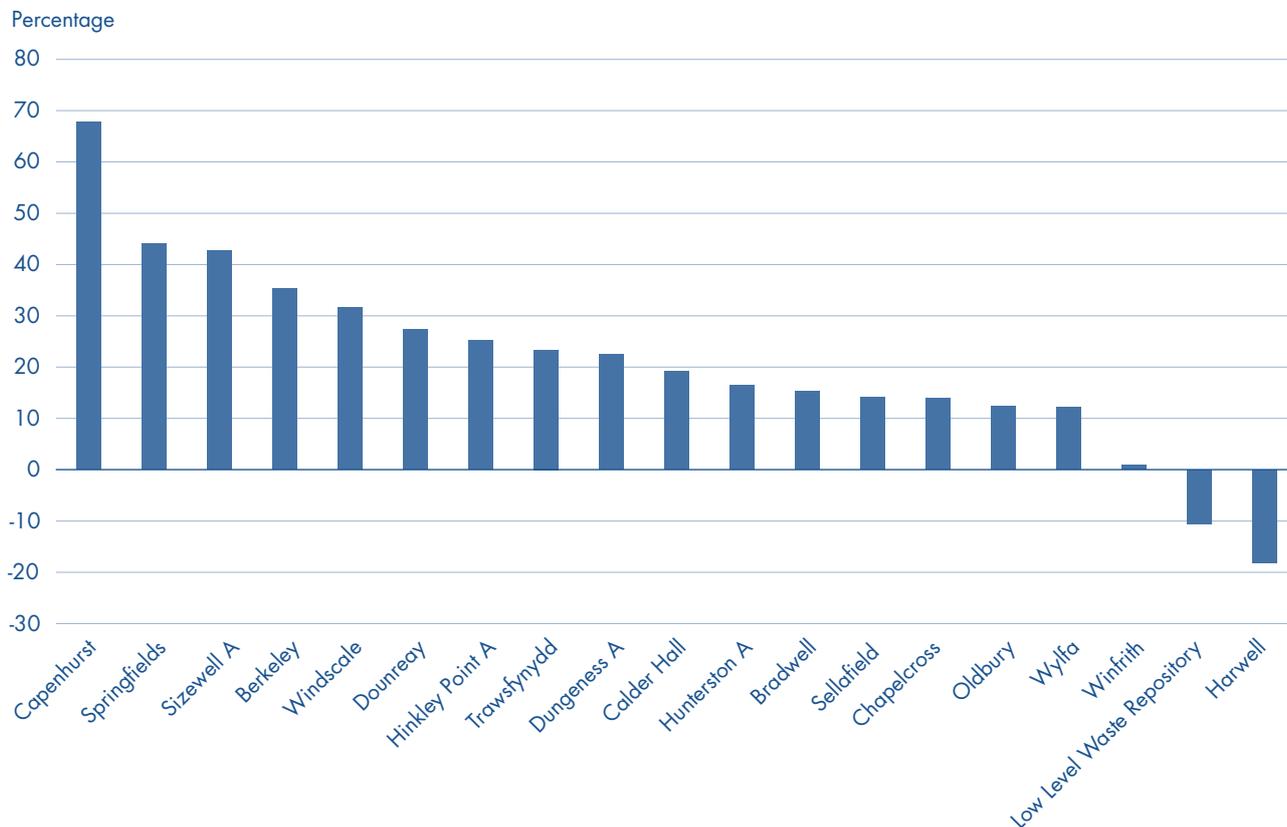
Source: National Audit Office analysis of the Authority's lifetime plans prepared in 2007

**17** Total lifetime cost – all sites except Sellafield



Source: National Audit Office analysis of the Authority's lifetime plans prepared in 2007

**18** Percentage growth in total lifetime costs between 2005 and 2007



Source: National Audit Office analysis of the Authority's lifetime plans prepared in 2005 and 2007

## APPENDIX THREE

### Site licensees, parent bodies and planned decommissioning end dates for the Authority's sites

Site and location	Type of site	Planned site end date <sup>1</sup>	Site licensee as at December 2007	Parent body as at December 2007
Berkeley, Gloucestershire	Magnox power station no longer operating	2083	Magnox Electric Ltd	Reactors Sites Management Company Ltd which is owned by EnergySolutions
Bradwell, Essex	Magnox power station no longer operating	2104		
Chapelcross, Dumfries and Galloway	Magnox power station no longer operating	2128		
Dungeness A, Kent	Magnox power station no longer operating	2111		
Hinkley Point A, Somerset	Magnox power station no longer operating	2104		
Hunterston A, Ayrshire	Magnox power station no longer operating	2090		
Oldbury, Gloucestershire	Operating Magnox power station	2118		
Sizewell A, Suffolk	Magnox power station no longer operating	2110		
Trawsfynydd, Gwynedd	Magnox power station no longer operating	2098		
Wylfa, Anglesey	Operating Magnox power station	2125		
Sellafield, Cumbria	Operating fuel facility	2120	Sellafield Ltd	British Nuclear Group Limited which is part of British Nuclear Fuels Limited
Calder Hall, Cumbria	Magnox power station no longer operating	2115		
Capenhurst, Cheshire	Fuel facility no longer operating	2120		
Low Level Waste Repository, Cumbria	Low level waste repository	2059		

Site and location	Type of site	Planned site end date <sup>1</sup>	Site licensee as at December 2007	Parent body as at December 2007
Dounreay, Caithness	Research site no longer operating	2032 <sup>1</sup>	United Kingdom Atomic Energy Authority	United Kingdom Atomic Energy Authority
Harwell, Oxfordshire	Research site no longer operating	2025		
Winfrith, Dorset	Research site no longer operating	2017		
Windscale, Cumbria	Research site no longer operating	2045		
Springfields, Lancashire	Operating fuel facility	2031	Springfields Fuels Limited	Westinghouse Electric Company which is part of the Toshiba Group

*Source: National Audit Office*

## NOTE

<sup>1</sup> This is the end date set out in the lifetime plans prepared in 2007. Site licensees will submit revised plans in March 2008 which may alter end dates. For Dounreay, it is planned that all facilities and waste will be removed by 2032 with the exception of waste awaiting for an intermediate waste repository. From this interim end point, it is assumed that it will be another 300 years before the site is closed in 2333. This period will allow for the radionuclides – atoms with an unstable nucleus – in any residual contamination in the ground to decay to insignificant levels.

## APPENDIX FOUR

# Reported performance of the Authority's decommissioning sites in 2006-07 against key milestones and deliverables

The following information was taken from the Authority's 2006-07 Annual Report and Accounts and thus reflects sites' performance during that year. Sites are ordered by site licensee.

### Sites run by Sellafield Ltd

#### Site **Calder Hall**

Type of Site      Magnox Power Station no longer operating (decommissioning and termination)

#### Key milestones and deliverables

Complete the preparations for defuelling

**Status**  
Not Achieved

#### Progress report

Planned work was not completed. A review of the Magnox Operating Plan (MOP), poor performance and safety issues resulted in delays in the programme and deferral of scope.

Completion of scope of work for all four reactors is now planned for 2007-08. A revised contracting strategy has been introduced to reduce risk to the project.

Fuel removal from reactors and transfer to fuel handling plant

Not Achieved

Since the preparations for defuelling have not been completed this work has not commenced.

Continue asbestos removal from heat exchangers and turbine hall

On Track

Planned work was completed to cost. Remaining work is planned to be completed over the next three years.

#### Summary of performance against key milestones and deliverables

Set	3
On track	1
Not Achieved	2

## Sites run by Sellafield Ltd *continued*

### Site **Capenhurst**

Type of Site Uranium Facility

Key milestones and deliverables	Status	Progress report
Complete removal of enriched uranium	Achieved	Completion of this project saw the removal of one of the major hazards from the site.
Disposal of 2,000 cubic metres of raw waste	Achieved	2006-07 was a record year for waste disposal from the Capenhurst site, with over 3,467 cubic metres of raw waste disposed of.
3,000 kg uranium recovered	Achieved	Over 3,000kg of uranium was recovered as part of the Non Standard Waste Project.
Capable to receive 3,700 drums of uranium	Achieved	All drums have been received as part of ongoing operations over a number of years.
Decontamination of B200/400 complex	Achieved	Decontamination of the complex has been completed. Demolition of the uncontaminated building is ongoing.
Best Practicable Environmental Option (BPEO) for slabbed areas	On Track	Characterisation work completed this year. Information from this is being used to generate BEPO for slabbed areas.

#### Summary of performance against key milestones and deliverables

Set	6
Achieved	5
On track	1

### Site **Sellafield**

Type of Site Nuclear chemical site

Key milestones and deliverables	Status	Progress report
Sellafield Product and Residue Store (SPRS) construction completion of the 13.2m level slab	Not Achieved	Construction progress has been delayed by a combination of the unusually poor prevailing weather and shortage of specific resources.
Inactive commissioning of Vitrification Export Facility	On Track	Inactive commissioning work has progressed well. The programme remains on track to deliver the first waste return in 2008.
Commence removal of Multi-Element Bottles (MEB) from B560	Achieved	First MEB was removed on schedule. As part of this work operational difficulties have required a review of the process to decontaminate MEBs that are removed from the pond.
Complete reprocessing of legacy fuel	Not Achieved	Delayed due to unreliability of operational facilities aggravated by evaporator performance issues which directly impacted the sites' reprocessing capability.
Reduce high activity liquor stocks in accordance with regulatory commitments (primarily the 'HAL Curve' specification from NII)	Achieved	The volume of stored Highly Active Liquor (HAL) has been reduced further than was planned.
Deliver a total of 16 fuel assemblies	Not Achieved	Sellafield MOX Plant (SMP) has continued to experience operational difficulties which constrained output for the year, to eight completed fuel assemblies.

#### Summary of performance against key milestones and deliverables

Set	6
Achieved	2
On track	1
Not Achieved	3

## Sites run by Magnox Electricity Ltd

### Site **Berkeley**

Type of Site      Magnox Power Station no longer operating (decommissioning and termination)

Key milestones and deliverables	Status	Progress report
Active Waste Vault Retrieval (AWVR) – completion of civil construction	On Track	The AWVR concept design is substantially complete and Invitations to Tender (ITTs) have been issued for civil construction/balance of plant and mechanical detail design and supply. Preparatory civil works have been completed.  Two prototype Vault Retrieval Machines have been designed, manufactured and tested.
Active Waste Vault Retrieval (AWVR) – completion of design and supply	On Track	As above
Shielded Area – cell dismantling	On Track	Four cells have been decontaminated and a further 19 cells have been demolished. All remaining cells have had equipment and plant removed to the extent possible prior to demolition.
Shielded Area – completion of West Wing deplant and decontamination	On Track	The West Wing laboratories have been fully decommissioned and remediated and are being converted to provide office space.
Be in a position to apply for partial site delicensing	Achieved	Partial site delicensing was applied for and achieved to plan during December 2006

#### Summary of performance against key milestones and deliverables

Set	5
Achieved	1
On track	4

### Site **Bradwell**

Type of Site      Magnox Power Station no longer operating (decommissioning and termination)

Key milestones and deliverables	Status	Progress report
Complete the despatch of all fuel to Sellafield and confirm fuel removed	Achieved	On 1 October 2006 the regulators agreed that all fuel had been removed from the reactors at Bradwell.
Complete the concept for Intermediate Level Waste (ILW) treatment and storage strategy and let contracts	On Track	The preparation of the Invitation to Tender (ITT) for the detailed design for the ILW management facility was completed but was not issued due to funding constraints.
Complete asbestos removals	On Track	2,100 cubic metres of asbestos have been successfully removed from the boiler house. Circulator halls work will remain ongoing in 2007-08.
Staff structure post defuelling complete and in place following submissions to the regulators	Achieved	Bradwell is now into its decommissioning stage. Work is progressing on a broad range of fronts on both conventional and nuclear systems decommissioning.
Circular Hall 1 strip-out complete	Achieved	Good practice techniques developed during the initial depplant stage have allowed current, similar works to be executed at lower cost than envisaged.

#### Summary of performance against key milestones and deliverables

Set	5
Achieved	3
On track	2

## Sites run by Magnox Electricity Ltd *continued*

### Site **Chapelcross**

Type of Site Magnox Power Station no longer operating (decommissioning and termination)

Key milestones and deliverables	Status	Progress report
Fuel route modifications – Reactors 1 and 3 completed	On Track	Preparations for the defuelling of Reactor 1 have been completed.
Demolition of four cooling towers	On Track	Drilling to enable explosive charging was completed in preparation for the demolition of the four cooling towers, which took place on 20 May 2007.
Magnox Depleted Uranium (MDU) drum processing and export to Capenhurst, (1,700 drums)	Achieved	1,802 drums of nuclear materials were despatched to Capenhurst.
Continue strip of asbestos from Turbine Hall	Behind Schedule	It was originally planned to retrain existing personnel to Asbestos Competent People (ACP). However, through further work it became apparent that this was not a viable option and therefore a contractor who is already Asbestos Competent has now been hired to undertake the work.

#### Summary of performance against key milestones and deliverables

Set	4
Achieved	1
On track	2
Behind Schedule	1

### Site **Hinkley Point A**

Type of Site Magnox Power Station no longer operating (decommissioning and termination)

Key milestones and deliverables	Status	Progress report
Commence construction of wet Intermediate Level Waste (ILW) facility	On Track	The business case for change to process wastes has been approved, from encapsulation to thermal vitrification.
Commence decontaminating pond skills	On Track	Retrieval of fuel pond skips from the skip store has been completed, with 40 skips retrieved. 270 skips have been characterised as ILW. The project will continue in 2007-08, with retrieval of skips from the ponds and size reduction of retrieved skips.
Hand new Low Level Waste (LLW) facility over for operation	On Track	Operations remain ongoing in this area.
Complete removal of asbestos on Boilers 10, 11 and 12.	Achieved	The major asbestos removal project is now complete.

#### Summary of performance against key milestones and deliverables

Set	4
Achieved	1
On track	3

## Sites run by Magnox Electricity Ltd *continued*

### Site **Hunterston A**

Type of Site Magnox Power Station no longer operating (decommissioning and termination)

#### Key milestones and deliverables

Key milestones and deliverables	Status	Progress report
Commence Intermediate Level Waste (ILW) Store cladding installation	On Track	External infrastructure of the store has been completed. The commissioning of equipment installation is in progress.
Demolish precipitator tower	Achieved	The tower has been completely removed.
Remove plant from fuel tunnels and block houses.	Achieved	Original scope was completed to schedule. Additional scope was accelerated during the year and is progressing well.
Progress design and build solid ILW retrieval plant	On Track	The sanctioning and validation process in preparation for award of the tender is in progress.
Complete commissioning of skip recovery equipment	Achieved	Commissioning of the equipment has been completed.

#### Summary of performance against key milestones and deliverables

Set	5
Achieved	3
On track	2

### Site **Trawsfynydd**

Type of Site Magnox Power Station no longer operating (decommissioning and termination)

#### Key milestones and deliverables

Key milestones and deliverables	Status	Progress report
Civil work for North Vault Fuel element Debris (FED) complete	Behind Schedule	The majority of civil scope was deferred to meet overall funding constraints in August 2006. The remaining project works for 2006-07 were completed as planned. As well as this, some acceleration of procurement activities to facilitate future scope was completed.
Reactor 1 capping roof contractor ready to start work	Behind Schedule	The majority of scope on this project was deferred to meet overall funding constraints in August 2006. The remaining project works for 2006-07 were completed as planned.
South Vault FED Pre-Commissioning Safety Report (PCSR) issued for project use	Behind Schedule	A PCSR for vacuum retrieval was achieved in June 2006. Commencement on the vacuum system scope was deferred to meet overall funding constraints in August 2006. A PCSR will be completed once the design works are completed.  Completion of Box 5 filling & grouting ahead of schedule allowed acceleration to commence Box 6 filling. Recovery of FED using existing technology continues. Scope to develop vacuum recovery equipment was deferred to meet overall funding constraints in August 2006.
Reactor 2 Miscellaneous Active Components (MAC) recovery and processing complete	Behind Schedule	Operations are ongoing to recover MAC from the vault in line with the current plan. 99 per cent of scheduled scope in Lifetime Plan (LTP) 2006-07 complete at the end of the year.
Resin Vault 2 ready for equipment deplanting	Behind Schedule	Plant modifications to commence bulk recovery of resin were completed in February 2007, and bulk recovery commenced in line with the LTP 2006-07 plan.

#### Summary of performance against key milestones and deliverables

Set	5
Behind Schedule	5

## Sites run by United Kingdom Atomic Energy Authority

### Site **Dounreay**

Type of Site Former Research Reactor Site

Key milestones and deliverables	Status	Progress report
Complete inactive commissioning of Dounreay Fast Reactor (DFR) Sodium / Potassium destruction plant (NDP)	Behind Schedule	Inactive commissioning has now been completed and the output from this is being reviewed by the Nuclear Installations Inspectorate (NII) [part of the Health and Safety Executive's Nuclear Directorate] before the commencement of active commissioning, which was planned to start in June 2007.
Commence DFR breeder examination	On Track	The installation of the cropping machine into D2001 cell 1 is imminent. Once the machine is operational, the examination of the breeder already in cell 1 will be undertaken followed by the unpacking, cladding removal and recanning (prior to transfer to the Remote Handled Intermediate Level Waste (RHILW) waste stream) of material currently stored in D9875.
Complete D1200 glovebox / fumehood decontamination	On Track	Post-Operation Clean Out (POCO) of Lab75 shielded cells was completed to schedule. The decommissioning of the D1200 complex continues into 2007/8 as planned.
Complete D1204 Stage 1 decommissioning	On Track	The schedule for submitting the Post-Operation Defuelling Safety Case (PODSC) has been agreed with regulators. However, defuelling is now scheduled to commence following the return to service of the ponds recirculation line and available evaporator capacity at Sellafield.
Complete D1206 Stage 1 decommissioning	On Track	Loose ILW was packaged and removed from the disassembly cave in March 2007.
Completion of PRF Sodium Destruction Plant (SDP) operations	On Track	Problems were encountered with the pumps which delayed this project. This is forecast for completion in October 2007.
Complete shaft plug reinforcement	Achieved	This was achieved in November 2006.
Start construction of Waste and Nuclear Materials Management Flask	On Track	DFR RHILW flask No 1 was delivered to Dounreay in February 2007. DFR RHILW flask No 2 delivery to Dounreay is due in March 2009. The Multi Purpose Overpack has been designed but fabrication is suspended pending a review. The Conditioned Waste Flask will be to the Windscale Pilot Encapsulation Plant design with delivery being due in 2011.

### Summary of performance against key milestones and deliverables

Set	8
Achieved	1
On track	6
Behind Schedule	1

## Sites run by United Kingdom Atomic Energy Authority *continued*

### Site Harwell

Type of Site Former Research Reactor Site

#### Key milestones and deliverables

Eastern area delicensing case submitted to NII

#### Status

Achieved

#### Progress report

The Nuclear Installations Inspectorate (NII) approved the delicensing of the 'pilot' area in the eastern area of the site, the first part of the site to be delicensed. Submissions were made to the NII to delicense two further areas in the eastern area.

A large section of a new fence line was installed and detailed plans were developed for new entrance facilities and a new police control building, which will allow the whole eastern area of the site to be outside the fenced site within a few years.

#### Key milestones and deliverables

New groundwater containment plant commissioned

#### Status

Achieved

#### Progress report

A new groundwater treatment plant to replace the existing ageing plant has been installed and the first phase of reliability testing was completed as planned. Targets for the treatment of groundwater were met.

'Difficult' wastes from Western Storage Area disposed of

Achieved

Drigg waste slipped as part of the Low Level Waste (LLW) programme at Harwell, remainder disposed of in 2006-07 to hazardous waste landfill site.

Manufacture and installation of second waste retrieval machine

Achieved

The second machine for retrieval of degrading Intermediate Level Waste (ILW) from B462.9 was received at the end of March 2007. A transfer corridor was also constructed to allow direct access to both of the old ILW tube stores.

Construction of Waste Encapsulation Plant

On Track

Construction commenced on a plant to allow encapsulation (grouting) of ILW repackaged in 500 litre stainless steel drums. The building base had been laid and the main cell raft, walls and roof cast, with construction of the main building structure underway.

Recovery of cans of waste from 'tube' stores

Achieved

156 cans of degrading remote-handled ILW were recovered against a target of 120 cans. 576 cans of remote handled ILW waste from the tube stores were assayed, characterised and repackaged into stainless steel containers suitable for long-term storage and disposal, 96 more than the planned 480.

A new assay system and programmable logic controllers were installed and commissioned in the Head End Cells during a planned shutdown during the year.

#### Summary of performance against key milestones and deliverables

Set	6
Achieved	5
On track	1

## Sites run by United Kingdom Atomic Energy Authority *continued*

Site	Windscale		
Type of Site	Former Research Reactor Site		
<b>Key milestones and deliverables</b>		<b>Status</b>	<b>Progress report</b>
Complete the removal of the Windscale Advanced Gas-Cooled Reactor (WAGR) pressure vessel		On Track	The tundish (i.e. container through which molten metal is poured) was removed and the gas baffle cleaned.
B50 Office of Government Commerce (OGC) Gateway Review 0 Complete		Behind schedule	Plan adjusted following NDA direction to take over decommissioning operations of reactor pressure vessel.  A combined decommissioning strategy paper for B50, B52 and B60 was completed on schedule in line with revised plan. Formal Gate 0 review planned for a future date.
B52 OGC Gateway Review 0 Complete		Behind schedule	A combined decommissioning strategy paper for B50, B52 and B60 was completed on schedule in line with revised plan as described above. Formal Gate 0 review planned for a future date.
B52 Examination Caves ILW conditioned and stored in B64		Revised schedule of work	Alternative options are now available for conditioning waste due to a change in strategy which no longer required this work to be completed in 2006-07.
Delivery of Approved Operational Safety Case for Pile 1		Achieved	Operational safety case approval was obtained.
Delivery of Approved Operational Safety Case for Pile 2		Achieved	Operational safety case approval was obtained.
B53, B76 and B77 demolished		Achieved	B53 demolished. B76 and B77 will now be utilised as a waste processing facility for the Windscale and Sellafield sites.

### Summary of performance against key milestones and deliverables

Set	7
Achieved	3
On track	1
Behind Schedule	2
Revised Schedule of Work	1

Site	Winfrith		
Type of Site:	Former Research Reactor Site		
<b>Key milestones and deliverables</b>		<b>Status</b>	<b>Progress report</b>
A59 decommissioning completed		Not Achieved	Additional scope arose around the refurbishment at the A59 area, which included removal. The building structure was removed to programme, however work remained ongoing.
Complete 1st phase of DRAGON decommissioning		On Track	Current phase 1 work for both reactors has continued and has been completed for the SGHWR. The letting of contracts for the phase 2 work was put on hold pending future funding decisions.
Complete 1st phase of Steam Generating Heavy Water Reactor (SGHWR) decommissioning		Behind Schedule	As above.

### Summary of performance against key milestones and deliverables

Set	3
On track	1
Behind Schedule	1
Not Achieved	1

## APPENDIX FIVE

# International decommissioning experience

### Decommissioning strategies and stages

1 The International Atomic Energy Authority recognises three decommissioning strategies:

i Immediate Dismantling

Immediate dismantling is the strategy in which the parts of a facility containing radioactive material are removed or decontaminated to a level that permits the facility to be released for unrestricted use as soon as possible after permanent shutdown. The implementation of the decommissioning strategy begins shortly after permanent termination of operational activities for which the facility was intended, normally within two years. Immediate dismantling involves the prompt removal and processing of all radioactive material from the facility for either long-term storage or disposal. Non-radioactive structures may remain on-site.

ii Deferred Dismantling

Deferred dismantling is the strategy in which the final dismantling of a facility is delayed and it is placed into long-term storage where it is maintained in a safe condition while radioactivity levels reduce. This strategy may involve some initial decontamination or dismantling, but much of the facility will remain for a period in care and maintenance mode. This period might range from a few years to over 50 years, after which time the decommissioning process will be completed and the facility can be released from regulatory control.

iii Entombment

Entombment is the strategy in which the radioactive contaminants are encased in a structurally long lasting material until the radioactivity decays to a level that permits release of the facility from regulatory control. The fact that radioactive material will remain on the site means that the facility will eventually become designated as a near surface waste disposal site and criteria for such a facility will need to be met.

2 The decommissioning of a facility can be categorised into a number of stages set out below. Not all reactors will pass through each stage. For example, if an “immediate dismantling” strategy is being followed then a reactor will not go through the care and maintenance phase. The stages<sup>36</sup> are:

i Plant Cleanout. This generally begins immediately following shutdown. For nuclear reactors, the used nuclear fuel – which can account for more than 99 per cent of the total radioactivity of the reactor – is removed from the reactor and transferred to interim or long-term storage depending on the spent fuel management policy of the owner. Radioactive wastes accumulated during operation may be treated and stored/disposed of. The reactor and associated plant will be prepared for the next stage of dismantling, or a period of care and maintenance, as determined by the chosen decommissioning strategy.

36 Based upon World Nuclear Association document *An introduction to Decommissioning*, [www.world-nuclear.org/wgs/decom/intro\\_print.html](http://www.world-nuclear.org/wgs/decom/intro_print.html).

- ii Decontamination. Incorporates the removal of contamination from surfaces of facilities or equipment by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques. May be carried out as an integral part of plant clean-out or as a separate phase.
- iii Dismantling. Following decontamination of the facility concerned, equipment within the radioactive side of the facility may be dismantled. For nuclear reactors, all equipment and buildings outside the reactor building (such as the turbines and turbine hall) may be dismantled. Similarly, equipment within the building(s) on the non-radioactive side of the facility (such as offices) can be removed for possible re-use, and the building(s) themselves demolished. With the reactor sealed and monitored, the rest of the site can be released for re-use.
- iv Care and maintenance. Incorporates a safe storage period prior to final dismantling of the radioactive facility, during which time the building remains sealed and monitored by decommissioning experts.
- v Demolition and site clearance. For nuclear reactors, the final stage of reactor dismantling is completed, buildings demolished and radioactive wastes removed to storage or disposal facilities. The site may then be delicensed and released for appropriate alternative use. No further inspection or monitoring is required.
- vi Decommissioned. Once it has been demonstrated that the site is safe and that radiation levels are below the national regulatory requirements, the operating licence can be terminated and the site is then available for re-use.

## United Kingdom

3 In the United Kingdom operators are responsible for proposing a strategy and justifying it to the Health and Safety Executive's Nuclear Directorate. The current decommissioning strategy for Magnox reactors is for deferred dismantling. Deferred dismantling was the original strategy for most of United Kingdom Atomic Energy Authority's research reactors, but a decision to curtail the care and maintenance period and pursue early dismantling has been taken with regard to the research reactor sites.

4 For British Nuclear Fuel Limited's Sellafield and Capenhurst fuel cycle facilities the current decommissioning strategy envisages initial decommissioning to remove or fix loose radioactivity and place the plant in a condition where further decommissioning may be safely deferred. This is followed by an extended period of surveillance and maintenance before dismantling of radioactive plant, at which stage all but low-level radioactive waste is removed, followed by a period of care and maintenance before demolition of buildings. This strategy is influenced by the fact that Sellafield has a combination of operational and decommissioning plants on a densely occupied single site. For Sellafield's legacy ponds and silos the strategy envisages retrieval of wastes and their storage in modern-standard facilities prior to treatment, at which point the ponds and silos themselves are regarded as having completed initial decommissioning. United Kingdom Atomic Energy Authority's strategy for its fuel cycle facilities at Harwell and Dounreay is similar, but with dismantling including removal of all radioactive waste, including low-level waste.

## Germany

**5** At present immediate dismantling is the preferred approach of the Government and the operators. Seventeen prototype and power reactors are at different phases of decommissioning. The immediate dismantling approach was adopted for the Neiderachbach plant which ceased operation in 1975 with decommissioning completed by 1995. The Grosswelzheim plant which ceased operation in 1971 has also completed decommissioning. The immediate dismantling approach was also adopted for six power reactors in the former GDR which shut in 1990, partly in order to use their operating workforce as far as possible. A further three power reactors have adopted a deferred decommissioning strategy and are currently in care and maintenance. In addition ten research reactors are currently being decommissioned, and a further twenty one had completed decommissioning by July 2005.

**6** As regards fuel cycle facilities three processing facilities are currently being decommissioned. Again early decommissioning is currently favoured. The Karlsruhe reprocessing plant, for example, was shut in 1991 after twenty years of operation and decommissioning is expected to be complete by 2010.

**7** Once a decision is taken by the Federal Government on a deep waste repository site it is expected that operators are even more likely to favour immediate dismantling of facilities.

**8** The decommissioning of most nuclear facilities is the responsibility of the body which operated them during their working life, or its successor. Hence, for example, the five reactors at Greifswald in East Germany have been decommissioned by Energiewerk Nord, the successor to their original operator following German reunification. Much of the work was performed by the company's own staff though some contracts for specialist non-nuclear work, such as asbestos removal, was sub-contracted.

## France

**9** In France the decommissioning strategy is selected by the operator on a case by case basis. But the safety regulator, the Nuclear Safety Authority favours early dismantling, considering that the risk of losing knowledge of design and operation is very serious. Until recently the main commercial power reactor operator, EDF, had adopted a strategy of deferred decommissioning. Complete dismantling was not envisaged until after several decades of containment to take advantage of natural radioactivity decay. The Nuclear Safety Authority asked EDF to review this strategy with a view to accelerating

dismantling. Such an accelerated strategy was adopted for the Monts D'Arée reactor in 1999, and for other shut down reactors in 2001. The plan currently provides for complete dismantling of these reactors by 2025.

**10** Eight research reactors shut down between 1965 and 1983 had already been dismantled and delicensed by 2003. A further research reactor shut down in 1983 was being dismantled and decommissioning had started on a further five research reactors shut since 1988.

**11** Decommissioning and dismantling of fuel cycle facilities has generally followed on closely after closure. By 2003 the Attila pilot reprocessing facility at Fontenay aux Roses which closed in 1974, and the BAT19 plutonium metallurgy facility at the same site which closed in 1984, had already been delicensed, and one of its radiometallurgy laboratory buildings was being dismantled. Recovery, treatment and removal of radioactive materials from the site's plutonium chemistry laboratory was nearing completion and delicensing of the site was planned for 2010. Fuel analysis and fabrication facilities at three other sites, which shut between 1984 and 1998, had been delicensed. The AT1 fuel reprocessing shop at the La Hague site was shut in 1979, and dismantling was completed in 2001. The UP1 reprocessing plant at the Marcoule site was shut down in 1997 and decommissioning is due to be completed within thirty years.

## United States

**12** In the United States since 1960 more than 70 test, demonstration and power reactors have been retired from service. In 2001, of the twenty three power reactors which had been shut down thirteen had adopted immediate decommissioning and ten had adopted deferred decommissioning. Where decommissioning was deferred this was sometimes because other nuclear units were still operating on the same site. In other cases companies were still accumulating the funds needed for decommissioning.

**13** The Department of Energy's legacy nuclear sites cover more than 20,000 facilities including production reactors, research reactors, fuel processing facilities, and uranium production facilities. More than 10,000 of these are now surplus to requirements. The Department often postpones immediate decontamination and dismantlement due to limited funding, emphasis on higher priority mission areas such as soil and ground water, low waste storage costs and limited future liabilities. The Department will place a facility into a known and stable condition that is economical to monitor and maintain for an extended period until the eventual completion of decommissioning.

## Contracting Approaches – the United States Experience

**14** The Nuclear Decommissioning Authority is the owner but not the operator or site license holder for its sites. It does not therefore contract directly for the provision of distinct work streams or projects in the way that an owner/operator/licensee does. The most direct comparator in terms of contracting for decommissioning is the US Department of Energy. Although the Department of Energy does not operate commercial nuclear facilities it is responsible for the clean-up of a range of legacy nuclear research and production facilities. It has used a variety of contracting arrangements for decommissioning, including various forms of whole-site contracts of the kind that the Nuclear Decommissioning Authority is bound to use given that it is not the license holder for its sites.

**15** For much of the post-war period the Department of Energy reimbursed contractors for all costs and paid fixed or incentive fees linked to production schedules. With the end of the cold war the Department's mission changed substantially with the emphasis shifting from operations to the project-based activities associated with decommissioning.<sup>37</sup>

**16** In the early 1990s, amid increasing congressional concern regarding the need to change the Department's contracting practices to reflect its changed mission, the Secretary of Energy began a contract reform initiative. Major components of the programme were increased competition, cost reduction and greater use of fixed price contracts with greater risk transfer to the contractor. The Department's first use of a fixed price contract for clean-up was in 1994 for the Idaho Laboratory, problems with which are cited in the main report (paragraph 4.8 on page 29).

**17** The other contract model being developed by the Department in the early 90's, which gained favour following the Idaho experience, was the cost plus incentive fee model. This incentivised the contractor to achieve specific milestones and, with the introduction of earned value analysis, was similar to the Nuclear Decommissioning Authority's management and operations contracts before the Authority's introduction of efficiency fee. The Department of Energy's contract form gave an immediate focus on imminent deliverables and allowed for variability in funding, as well as the possibility of

incentivising generic issues such as safety. But it still did not give a clear focus on site end state or, if that end state was beyond the contract horizon, site state at the end of a contract period. Nor did it incentivise acceleration of schedule or lowering of cost.

**18** To address these issues the Department chose to develop its contract approach when the management and operation contract for its shut-down Rocky Flats site was due for renewal in February 2000. The period of the contract was to final site closure rather than a fixed date and the scope to reach that end point was reasonably well defined. Fee was based on performance relative to a target cost, with funding available for each year stipulated and with "Government Furnished Items" – such as processing of security clearances and receiver sites for waste – specified within the contract. Extra fee could be earned for accelerated completion relative to baseline. Fee earned for delivery at target cost was 8 per cent. The contractor took 30 per cent of any variation relative to target cost up to a maximum fee of 15 per cent and a minimum fee of 2 per cent.

**19** The Rocky Flats contract was delivered below target cost of \$4.0 billion to \$4.2 billion and ahead of schedule. The contractor earned fee of \$500 million for this performance. Contractors have cited the strong financial incentive as the main reason for achievement of targets, but the Government Accountability Office has been more cautious.<sup>38</sup> It has pointed out that other factors, such as relatively benign geological conditions, specific resolution of four out of five key challenges (including identification of overall scope), and use of an accelerated clean-up approach – also contributed to the outcomes. It also commented that strong financial incentives were not always associated with cost reductions and timely delivery in its experience of government contracting as a whole.

**20** Following the Rocky Flats experience the Department put in place target cost style contracts at seven further sites. Its Hanford site, due to its complexity, has been split into two parts and each office issues specific contracts for discrete tasks. At other sites the Department is also moving towards subdivision of major project elements with differing schedule incentives. The Nuclear Decommissioning Authority cannot directly let contracts to different contractors for different work streams but it could adopt different payment mechanisms for different workstreams within a single site management contract.

<sup>37</sup> *Improving project performance: An Analysis of Decommissioning Contract Models in the USDOE and Associated Results for Potential Application in the United Kingdom*, P. Swenson, Conference Paper, ICEM05, Glasgow: Elsevier 2006.

<sup>38</sup> *Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities* Government Accountability Office: Washington July 2006



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