Major Equipment Storage

Report by the Comptroller and Auditor General

Ministry of Defence

HC 1005 Session 1997-98
29 July 1998
This report has been prepared under Section 6 of the National Audit Act 1983 for presentation to the House of Commons in accordance with Section 9 of the Act.

John Bourn
National Audit Office
Comptroller and Auditor General
21 July 1998

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# Contents

<table>
<thead>
<tr>
<th>Executive summary</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part 1: Introduction</strong></td>
<td>5</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Previous Parliamentary interest</td>
<td>7</td>
</tr>
<tr>
<td>Objectives and methodology</td>
<td>7</td>
</tr>
<tr>
<td><strong>Part 2: Planning for equipment storage</strong></td>
<td>10</td>
</tr>
<tr>
<td>Introduction</td>
<td>10</td>
</tr>
<tr>
<td>How the Department make decisions on what to store</td>
<td>10</td>
</tr>
<tr>
<td>Data requirements for storage planning</td>
<td>13</td>
</tr>
<tr>
<td>Systemic constraints on the Department’s ability to assess and introduce improvements to the storage task</td>
<td>27</td>
</tr>
<tr>
<td><strong>Part 3: Methods of storage</strong></td>
<td>34</td>
</tr>
<tr>
<td>Introduction</td>
<td>34</td>
</tr>
<tr>
<td>Risks to stored equipment</td>
<td>34</td>
</tr>
<tr>
<td>The Department’s current approach to storage</td>
<td>36</td>
</tr>
<tr>
<td>Other factors affecting equipment regeneration</td>
<td>56</td>
</tr>
<tr>
<td>Costs and benefits of approaches</td>
<td>59</td>
</tr>
<tr>
<td><strong>Part 4: Disposing of stored equipment</strong></td>
<td>66</td>
</tr>
<tr>
<td>Introduction</td>
<td>66</td>
</tr>
<tr>
<td>The principles of planning for disposal</td>
<td>66</td>
</tr>
<tr>
<td>The Impact of the Department’s disposal strategy and the scope for improvement</td>
<td>78</td>
</tr>
</tbody>
</table>

*Cover photograph*: A range of howitzers held at Base Ordnance Depot Donnington.
Annexes

A. Estimate of savings arising from alternative disposal action 80
B. The National Audit Office’s use of Cognitive Mapping 81
C. Case study equipments examined by the National Audit Office 83
Executive summary

Introduction

1. The Ministry of Defence (the Department) store some 204 aircraft, 9,166 vehicles and ground equipment, and 19 Naval vessels at an annual cash cost exceeding £50 million. The historic cost of equipment held in store is in the region of £10 billion - greater than the Department’s annual expenditure on equipment procurement. Equipment must be stored or held at a lower state of ‘readiness’ for a variety of reasons:
   - to maintain force levels, war reserves and provide for equipment failure or loss;
   - to facilitate the progress of modifications, servicing and fatigue management; and
   - to preserve the value and safety of equipment awaiting sale or disposal.

2. The National Audit Office undertook an examination of the cost effectiveness of the storage of equipments, focusing on equipment storage planning, storage methods and the process to initiate the disposal of equipment no longer needed.

Planning for equipment storage

3. The Department have instituted a system of defence planning which works from a statement of strategic defence objectives through to assumptions on planned military tasks, and hence the type and number of equipments needed. This is translated into the needs of individual Armed Services who are then able to determine their requirements for equipment storage. The merits of this system are that it links equipment storage directly with the required military capability and highlights surplus equipment. To work effectively, however, the planning process needs to be supplied with good basic data on equipments stored, on storage costs and on equipment regeneration performance. Equally, there need to be incentives for equipment planners to reduce storage costs and equipment fleets where possible. The National Audit Office found that weaknesses in each of these areas were preventing the Department from getting full value from their planning. We recommend that the Department:
improve the quality and dissemination of basic storage data, particularly that related to the costs of and reasons for storage, to facilitate reviews of the storage task as part of the annual planning process;

ensure that planning assumptions on the availability and hence, in part, regeneration of equipment, are more widely driven down to individual equipments in store in the form of readiness targets; and

incentivise decision makers to minimise storage costs and maximise disposal revenues through a better alignment of budgetary and decision-making responsibilities, and better co-ordination of the storage decision process.

Storage methods

The methods of storage used to hold equipment have an important influence not only on the condition of the items held and the costs incurred, but also on the prospect of recovery of equipment back into Service. Selecting the best storage strategy and taking full account of the risks to stored equipment is therefore crucial. The Department employ storage techniques which range from the simple utilisation of existing buildings and structures to more sophisticated practices such as Controlled Humidity Environments. Where the Department have used more sophisticated methods they have been content with the results, although they have not evaluated the performance achieved. The Department have raised the standard of some of their storage techniques to that of leading countries in the field, but should focus more effort on the weaker areas by:

investigating the case for investing in Controlled Humidity Environments for those military equipments currently stored in normal atmospheric conditions;

developing a clearer understanding of their ability to regenerate equipment from storage, particularly in the scenario of a single wave recovery associated with general war; and

analysing more closely their own and other countries’ experiences of storage methods, and making available the results more effectively to staff with storage and military planning responsibilities.
Disposing of stored equipment

Disposing of equipment that is no longer required can lead to lower storage costs and greater sales revenues. Being able to assess the relative merits of the disposal options available and take prompt action is essential in maximising the benefits available - an activity that must take into consideration both operational requirements and marketing constraints. The Department have put in place sensible procedures for dealing with disposals and have been able to achieve sales revenues of over £50 million each year. However, they have not taken full advantage of the opportunities presented by equipment disposal and more could be done by:

- raising the profile of equipment disposal and liaising more closely with the Disposal Sales Agency;
- undertaking thorough Investment Appraisals for all equipments eligible for disposal;
- assessing more rigorously the merits of further maintenance and anti-deterioration work on surplus equipment when there are prospects of sales; and
- shortening the time it takes to identify and dispose of surplus equipment.

Overall

The implementation of the recommendations above should enable the Department to increase disposal revenues whilst reducing storage costs and improving the condition of stored equipments. On the basis of case study work, the National Audit Office identified opportunities for extra revenue of £8 million and reduced costs of £1.5 million, while also demonstrating that improved storage methods could improve the ability to regenerate stored equipment within military service - and hence contribute directly to meeting military needs.
The location of main United Kingdom equipment storage sites

Key:
- Vehicle and land equipment storage sites
- Fixed and rotary wing aircraft storage sites
- Storage locations for naval vessels

Major storage sites are located around the United Kingdom.

Source: National Audit Office
Part 1: Introduction

Introduction

In July 1997 the Ministry of Defence (the Department) held in store some 204 aircraft and 9,166 vehicles, and 19 Naval vessels were berthed or laid up. Figure 1 sets out the number and location of equipments currently in store. The total cost of holding these equipments is over £50 million each year, a sum which was matched in 1997 by sales of previously stored equipments. The historic cost of those equipments held in store is in the region of £10 billion - greater than the Department’s annual expenditure on equipment procurement.

Table 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Numbers</th>
<th>Location</th>
<th>Numbers</th>
<th>Location</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashchurch BVD</td>
<td>4,742</td>
<td>RAF Shawbury</td>
<td>107</td>
<td>Rosyth</td>
<td>7</td>
</tr>
<tr>
<td>Training Materiel</td>
<td>1,557</td>
<td>NARO Fleetlands</td>
<td>45</td>
<td>Devonport</td>
<td>4</td>
</tr>
<tr>
<td>Long Marston</td>
<td>1,161</td>
<td>RAF St Athan</td>
<td>42</td>
<td>Barrow</td>
<td>4</td>
</tr>
<tr>
<td>Aston Down</td>
<td>404</td>
<td>Others</td>
<td>10</td>
<td>Portsmouth</td>
<td>4</td>
</tr>
<tr>
<td>Old Dalby</td>
<td>288</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donington BOD</td>
<td>256</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAF Kinloss</td>
<td>218</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>540</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9,166</td>
<td><strong>Total</strong></td>
<td>204</td>
<td>Total</td>
<td>19</td>
</tr>
</tbody>
</table>

These figures illustrate the extent to which the Armed Services store equipment.

Note: The 11 vessels held at Rosyth and Devonport are laid up nuclear submarines, and of the 4 vessels at Portsmouth, 1 is awaiting disposal and the remaining 3 are held at an extended state of readiness.

BVD: Base Vehicle Depot, BOD: Base Ordnance Depot, NARO: Naval Aircraft Repair Organisation.

Source: National Audit Office

1.2 The Department are responsible for equipment storage for all three Armed Services, providing storage facilities and in-store maintenance support for aircraft, vehicles, and ships, along with numerous other weapon systems and military apparatus. The storage task itself is undertaken by the technical and stores divisions of each Armed Service or in some circumstances by outside companies under contract to the Department. Figure 2 outlines the major organisational entities involved with storage.
This figure illustrates the main areas of the Department dealing with storage.

Note (1): The Defence Helicopter Support Agency determine the requirement for helicopters for all 3 Services.

Source: National Audit Office
1.2 Against the background of the end of the Cold War and the contraction of the military task, the Department have begun to review their equipment holdings and the impact this has on the storage strategy. Under the Strategic Defence Review a series of developments are planned by the Department to improve further defence logistics capability. The aim is that the Department will hold only that equipment which cannot be provided by other means (such as by arrangements with private sector companies) within readiness targets and without unacceptable operational risks or increased cost. Therefore, the Department are looking at further reductions in stock holdings and stock procurement and closer links with industry in order to continue the rationalisation of storage and distribution. This will, inevitably, have a significant impact on the future major equipment storage task. This Report builds on the work that has already been undertaken and, in the light of a changing defence environment, examines the scope for further improvements.

Previous Parliamentary interest

1.3 As a part of their Report on the Disposal by Sale of Defence Surplus Equipment and Stores (27th Report, Session 1993-1994) the Committee of Public Accounts highlighted the importance of equipment sales, in particular the level of revenue that can be obtained through the sale of surplus ships and other major platforms. The House of Commons Defence Committee have considered equipment storage and disposal in successive reports which have included examinations of the Department’s approach to aircraft “cannibalisation” to release valuable spares, and reviews of visible storage holdings. However, previous Parliamentary and National Audit Office work has focused more on equipment spares and their removal than on the major equipments that they support.

Objectives and methodology

1.4 The overall objective of this Report is to evaluate the Department’s equipment storage strategy, in particular the planning and implementation of storage decisions. As such, the National Audit Office have considered:

- how the Department undertake planning for equipment storage (Part 2 of the Report);

- the storage techniques employed by the Department as compared with practices abroad and in industry (Part 3); and
the Department’s approach to surplus equipment disposal and where improvements might be made (Part 4).

1.6 For the purposes of this examination the National Audit Office have defined “stored equipment” as major military vehicles, vessels, aircraft, weapon systems and logistic equipment that have remained out-of-use for a minimum period of one month. The study excludes all forms of ammunition and other “man-portable” items, along with routine commercial vehicles and equipments undergoing repair or maintenance. It should be noted that although reference is made to naval vessels in store, they are not ‘stored’ in the same manner as land equipment and aircraft. Instead vessels are usually berthed or laid up alongside jetties or in docks. The definitions used and the scope of the examination were agreed with the Department at the outset of the study and they also contributed to the development of some of the themes explored in this Report.

1.7 In carrying out this study the National Audit Office drew on the management information available to the Department and the views of a wide range of staff involved with storage and equipment disposal. Because of gaps in the data routinely collected by the Department, the National Audit Office undertook a number of exercises to generate and analyse further data. The objectives of these exercises are summarised in Figure 3.

1.8 Further to the work identified in Figure 3, the National Audit Office commissioned a consultant experienced in both equipment storage and logistics to investigate the methods of storage employed by the Department and to benchmark these against practices abroad and in industry. In addition, the National Audit Office visited key storage comparators including the German Army in Koblenz, the French Air Force in Châteaudun, Vickers Defence Systems who are currently storing Challenger 2 tanks, and TNT Truckcare who are responsible for the care of more than 1,000 Green Goddess Fire Engines.

1.9 The National Audit Office would like to thank all those within the Department and the comparator organisations who assisted us in this study.
Methodology used by the National Audit Office to obtain data on equipment storage and disposal

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Method and objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Basic Survey</td>
<td>Postal questionnaire to 150 establishments and Equipment Managers to determine the number of equipments stored, the holding periods, the extent of spares removal and the prospect of recovery (98 per cent response rate received).</td>
</tr>
<tr>
<td>2. Case Study Examinations</td>
<td>Detailed analysis of 10 equipments held in store to understand the specific factors influencing the storage/disposal decision (3 Naval vessels, 3 Army equipments and 4 aircraft were investigated).</td>
</tr>
<tr>
<td>(Annex C)</td>
<td></td>
</tr>
<tr>
<td>3. Site Visits</td>
<td>Visits were undertaken to 10 storage establishments to follow up responses to the survey and detailed enquiries arising from case study work.</td>
</tr>
<tr>
<td>4. Storage Costing</td>
<td>Full costing work was performed at each of the major storage facilities (RAF Shawbury, RAF St Athan, Naval Aircraft Repair Organisation Fleetlands, Base Vehicle Depot Ashchurch and HM Naval Base Portsmouth).</td>
</tr>
<tr>
<td>5. Cognitive Mapping</td>
<td>An analytical technique used to establish the influences and pressures on the storage and disposal decision process. This involved a series of structured interviews with each of the 13 key decision-makers to understand how decisions are reached.</td>
</tr>
<tr>
<td>(Annex B)</td>
<td></td>
</tr>
</tbody>
</table>

Source: National Audit Office

The methodology used helped to build a clear picture of the storage task, and the processes leading to storage and disposal decisions.
Part 2: Planning for equipment storage

Introduction

2.1 The Department routinely require military equipments to be withdrawn from active use and placed in storage, often for extended periods of time. The need to do this is not solely explained by a military requirement to retain war stock or attrition reserves in the event of equipment loss or failure. Storage decisions are the result of complex strategic, logistic and financial considerations that shape the size and nature of the task. This part of the report examines the current storage task and the decision processes that contribute to the storage strategy.

How the Department make decisions on what to store

2.2 The process of planning for equipment storage is driven by two main elements: the Department’s high level defence planning process and the logistics strategy adopted by each of the three Services. Figure 4 and the following paragraphs explain this process in more detail.

2.3 The key output of the Department’s planning process is the provision of a military capability to fulfil defence policy. In addressing this, the Department have developed Defence Planning Assumptions which reflect key planning parameters for the deployment of British Armed Forces. Defence Planning Assumptions include advice on what operations might be undertaken, the scale, force structure, likely locations and other strategic factors. On this basis the shape, size, readiness and sustainability of the Armed Forces is derived. Flowing from Defence Planning Assumptions is the Departmental Programme Directory which sets out the assumed military tasks, and then the Department’s major annual planning documents. These include the top level “Departmental Plan”, Individual Service (Army, Navy, RAF) “Management Plans” and lower level “Top Level Budget Plans”. All of these are amplified in the Long Term Costing statement which is the key budgetary discipline to which the Department work.

2.4 Strategic planning leads to a statement of equipment liabilities that the Department are required to meet from their existing holdings of equipments. Storage is an appropriate strategic response in two circumstances. First, the need to provide for deployments in excess of those required during peace, and where
there is no prospect of rapid procurement from industry or commerce, means that some equipments must be stored. Secondly, changes to the threat, to policy or to precise requirements from equipments may lead to storage as an interim measure pending clarification of needs and, usually, either modification or disposal.

At the same time that requirements cascade down from central plans, demands are placed on the storage task by each of the three Services and their logistics staff. For example, the RAF use storage as a means of managing the fatigue on an aircraft fleet by periodically exchanging in-use aircraft with those in store, thereby spreading the usage across the fleet evenly. In a similar way, the Army often issue equipment from storage to replace vehicles that are required to undergo repair. These logistic requirements constitute a major element of storage planning at the lower levels.

2.5

Source: National Audit Office
The storage decision chain is also influenced by wider Departmental initiatives and efficiency drives. For example, recent developments in the Army as a result of the Defence Costs Studies include the rationalisation of some stored vehicles on to a single site in Ashchurch. Figure 5 illustrates the range of factors that contribute to storage and disposal decisions.

Note: * A small number of storage locations are contractor facilities and are not, therefore, owned by the Department.

A number of key players are involved with making decisions on equipment storage and disposal

Source: National Audit Office
For planners within the Department to manage this process effectively they must be able to capture and analyse information on stored equipment and, where appropriate, take prompt action. The following paragraphs explore the extent to which the Department have been able to satisfy these requirements and take forward decisions on equipment storage.

**Key points**

- The Department have instituted a planning process that enables the storage task to be linked directly with high level military objectives (paragraphs 2.2 - 2.4).

- The size and shape of the storage task is also greatly influenced by the logistics strategy employed by each Armed Service and by periodic reviews of the Department such as the Defence Costs Studies (paragraphs 2.5 - 2.6).

**Data requirements for storage planning**

Information on requirements and available resources is key to delivering the stated military capability. For the Army alone, the number of equipments held in store represents around 10 per cent of all Army vehicles, whilst stored aircraft account for approximately a fifth of all aircraft owned by the Department. In the light of the significant number and potential contribution of stored equipments to military capability, it is essential that the Department hold current and comprehensive data on those equipments. It is equally important that the information held is made available to all of the participants in the decision-making chain. Figure 6 identifies the key data requirements for equipments held in store.

**Figure 6**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>the number, type, condition, modification state and location of all equipments stored</td>
<td>the time spent in storage for all equipments</td>
<td>the anticipated remaining storage period for all equipments</td>
</tr>
<tr>
<td>the reasons and purpose of storage for all equipments</td>
<td>the estimated storage costs for each equipment held</td>
<td>the timescale within which each equipment must be made ready (known as “readiness”)</td>
</tr>
<tr>
<td>the extent to which storage facilities are being used</td>
<td>Source: National Audit Office</td>
<td></td>
</tr>
</tbody>
</table>

Key forms of data are required to assist the Department in fulfilling its military capability.
The number, type and location of stored equipments

2.9 Information on the storage task is gathered and compiled at the local level by the many storage providers throughout the three Services. In total, there are 39 sites covering the storage needs of the three Services and as many sources of data on equipment holdings. The Department’s existing management information systems are unable to provide a single statement of stored equipment holdings and as such their visibility of the task is limited. Therefore, in order to determine the precise number, type and location of stored equipments, the National Audit Office undertook a review of existing databases and issued questionnaires to some 150 establishments and Equipment Managers. The results of this work are summarised in Figure 1 in the introduction to this report.

2.10 The reason for the inability of central planners in the Department to readily identify all equipments in store at the time of this study, is explained by the large number of establishments undertaking storage (39 sites) and the large number of information holders.

2.11 Most stored equipments are concentrated at military establishments managed by the separate Armed Services. For example, 95 per cent of stored aircraft are held at RAF Shawbury, RAF St Athan and Naval Aircraft Repair Organisation Fleetlands, whilst the remainder are spread over three more establishments. Similarly, 59 per cent of stored vehicles and ground weapon systems are held at Ashchurch, whilst the remainder are located at 27 other military and contractor establishments in the United Kingdom and in Germany. As a result, the Department experience difficulties in drawing together the management information held at the main storage facilities across the three Services, and even more so in consolidating the information on holdings at the remaining establishments. The size of the storage commitment at the remaining establishments (i.e. not Ashchurch) is significant and for the Army alone accounts for nearly 4,500 equipments. An important storage facility used to hold howitzers is pictured in Figure 7.
The length of time stored equipments have been, and are planned to remain in storage

2.12 The Department’s management information systems, although capable of identifying storage periods for a proportion of equipments held (for example, fixed wing aircraft), could not readily provide information on holding periods for all equipments in store. The National Audit Office therefore interrogated existing databases and analysed survey results to provide full information on storage periods. The results highlighted in Figure 8 illustrate that storage holding periods varied widely, reflecting the reasons for storage and the overall strategy that had been developed for certain equipment types.
The National Audit Office survey analysis showed that just under a half of military equipments in store had been held for over two years and were likely to remain there for at least a further two years. A number of factors influence the period an item of equipment spends in storage, for example the rundown of a fleet or the need for a major maintenance programme. The reasons for storage are examined in detail from paragraph 2.17 onwards.

The National Audit Office survey analysis showed that just under a half of military equipments in store had been held for over two years and were likely to remain there for at least a further two years. A number of factors influence the period an item of equipment spends in storage, for example the rundown of a fleet or the need for a major maintenance programme. The reasons for storage are examined in detail from paragraph 2.17 onwards.

2.13 The National Audit Office survey analysis showed that just under a half of military equipments in store had been held for over two years and were likely to remain there for at least a further two years. A number of factors influence the period an item of equipment spends in storage, for example the rundown of a fleet or the need for a major maintenance programme. The reasons for storage are examined in detail from paragraph 2.17 onwards.

2.14 The analysis of storage periods undertaken by the National Audit Office also pointed to a large number of equipments that have a low prospect of recovery into active service. This is partly explained by the age of the equipments concerned, but also because the requirement for certain ranges of equipment has reduced in response to wider equipment reductions. Figure 9 provides some examples of equipments that have remained in store for long periods of time and are unlikely to be recovered prior to disposal.
An illustration of an exceptional case of lengthy storage is that of seven Scout helicopters pictured in Figure 10. As can be seen, widespread spares removal has taken place leaving, in each case, a helicopter hulk retaining a negligible financial and operational value. At least five years ago (records prior to 1992 have not been retained), these aircraft were declared non-effective and transferred to the Naval Aircraft Repair Organisation at Almondbank in Scotland. Prior to this, almost all the spares and components held on board were removed and returned to the supply system. In the years that followed, several unsuccessful attempts were made to dispose of all seven hulks and only in late 1997 was action put in hand to undertake their disposal.

### Figure 9

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Number in store</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chieftain Mk2 Tanks</td>
<td>59</td>
<td>All 59 Tanks have recently been declared available for disposal - most of which have been in store for between 1 and 2 years.</td>
</tr>
<tr>
<td>FV 432 Armoured Personnel Carriers</td>
<td>180</td>
<td>All 180 vehicles have been in store for over 2 years, and based on their age and condition, the majority are unlikely to return to active use unless, as has been the case in the past, they are required for warlike operations.</td>
</tr>
<tr>
<td>Wessex helicopters</td>
<td>30</td>
<td>All aircraft have been in store for under a year but because of the planned run-down of the Wessex fleet, from 60 to 17 helicopters by 1998-99, it is unlikely that any will be recovered.</td>
</tr>
<tr>
<td>Hercules aircraft</td>
<td>4</td>
<td>Most aircraft have been non-effective and held in store on contractor premises for over 18 months. The prospect of future RAF use is minimal.</td>
</tr>
</tbody>
</table>

Note: During the course of this study 11 Wessex helicopters have been sold and 4 Hercules aircraft are in the process of negotiation for sale.

Source: National Audit Office

Many stored equipments are unlikely to be regenerated into active use.
The Department do not have a common procedure for highlighting those equipments in store that are approaching the end of their Service life. Within the high level planning process, decision-makers are not routinely kept informed of the volume and type of equipments for which disposal could be a sensible option. This does not mean that age analysis and out of Service dates are not monitored, but that a formalised and routine procedure is not in place.

The reasons for storage

The reasons for equipment storage vary widely, mainly reflecting the logistics strategy adopted by Equipment Managers, and the ageing profile and sophistication of different equipment types. With the exception of large, visible assets such as Naval vessels, the Department do not routinely record the reason for storage. The Army’s MERLIN database covering vehicles stored at the main depot in Ashchurch does not indicate why equipments are held in store, although the Holding Status Code will identify certain classes – for example, those for disposal or repair. Similarly, reasons for storage were available for only a minority of aircraft stored at the three principal storage facilities, and in most cases the narrative provided on storage records did not fully correspond with the reason expressed by RAF Support Authorities. This may partly reflect delays by Fleet Managers in revising documented reasons for storage.
Results from the National Audit Office’s survey and subsequent follow-up work aimed at clarifying the reasons for storage, are illustrated in Figure 11.

**Figure 11**

The main reasons for equipment storage

<table>
<thead>
<tr>
<th>Reason for the storage of vehicles, armoured equipment and ground weapon systems</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>awaiting repair, issue decisions or disposal</td>
<td>65%</td>
</tr>
<tr>
<td>war reserve/attrition</td>
<td>25%</td>
</tr>
<tr>
<td>in transit</td>
<td>6%</td>
</tr>
<tr>
<td>other</td>
<td>4%</td>
</tr>
</tbody>
</table>

**Reason for the storage of fixed and rotary wing aircraft**

<table>
<thead>
<tr>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>awaiting repair, issue decisions or disposal</td>
</tr>
<tr>
<td>fatigue management/attrition</td>
</tr>
<tr>
<td>spares source</td>
</tr>
<tr>
<td>other</td>
</tr>
</tbody>
</table>

Most vehicles and aircraft are stored awaiting action, or as a war or attrition reserve

Source: National Audit Office

Note: Of the 19 Naval vessels in store, 11 nuclear submarines are held awaiting disposal and the remaining 8 vessels are awaiting sale or held at extended readiness.

The survey results indicate that a major reason for storage is that equipments are held, often for lengthy periods of time, awaiting decisions on their use, the method of disposal or pending other action rather than as a designated war or attrition reserve. At the Army’s largest storage facility in Ashchurch, such reasons accounted for more than half of the military vehicles held. Similarly, nearly a third of all aircraft are held in store pending the resolution of outstanding action or decisions. By contrast, the storage task also includes equipments that may be in store for brief periods, for example vehicles held at Training Materiel Parks, which on average remain unused for no more than three to four months at a time. The
National Audit Office recognise that there are other important factors which contribute to the reasons for storage which include delays caused by the failure of new equipments to meet reliability targets and changing, often conflicting, political, operational and technical interests.

2.20 Figure 12 highlights some examples of the main reasons for storage for particular equipments.

<table>
<thead>
<tr>
<th>Reason for storage</th>
<th>Equipment</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipments held in store awaiting the resolution of technical problems</td>
<td>RB44 heavy utility trucks</td>
<td>318 RB44s have remained in storage at Ashchurch for 4-6 years whilst the Department have explored technical problems presented by the braking system.</td>
</tr>
<tr>
<td>Equipments held in store awaiting decisions on their future use</td>
<td>Tucano trainer aircraft</td>
<td>Between 40 and 50 Tucano aircraft have been held at RAF Shawbury for more than 2½ years whilst the Department have considered how many aircraft holdings exceed training needs.</td>
</tr>
<tr>
<td>Equipments held in store awaiting disposal</td>
<td>Upholder submarines</td>
<td>4 Upholder class submarines have been held at Barrow-in-Furness for over 2 years whilst the Defence Export and Sales Organisation (DESO) have undertaken marketing activity.</td>
</tr>
<tr>
<td>Chieftain Mk2 tanks</td>
<td></td>
<td>59 tanks were declared surplus to requirements in February 1997, and a disposal declaration made. The Department will salvage components over the next 2 years, during which time tanks will remain in storage at a cost of around £250,000. The tanks will then be sold for scrap.</td>
</tr>
<tr>
<td>Equipments held in store to assist with fatigue management, fluctuations in requirements and as war reserves</td>
<td>‘B’ vehicles (see Figure 13)</td>
<td>Over 1,500 general purpose vehicles are held at Training Materiel Parks (TMP) at 6 sites around the country. On average these remain in store for 3-4 months at a time, until they are lent to Territorial Army units for training purposes.</td>
</tr>
</tbody>
</table>

The reasons for holding equipments in store fall into four main categories

Source: National Audit Office
The relatively high proportion of equipments stored for reasons other than meeting contingent military needs reflects, in part, the ending of the Cold War and the associated scaling down of defence materiel, and also uncertainty over the future stability of the former Soviet bloc. This has militated in favour of retaining some equipments not immediately needed in case of changes to the military threat. In addition, similar action in most developed economies has led to an oversupplied market for many surplus equipments, thus reducing possible disposal proceeds.

The costs of storing equipment

Cost information is needed for a variety of purposes. Information on full costs is needed to maintain visibility of and accountability for storage costs within the Department, and to underlie strategic management of storage. Information on local storage costs, highlighting variable costs, is needed by managers of storage facilities to maintain and improve the efficiency of their operations. Finally, information on opportunity costs - highlighting the net benefit of alternative courses of action - needs to be readily obtainable to inform specific decisions, for example the retention or disposal of equipment, or a choice between storage options. Figure 14 overleaf sets out the cost elements that are needed for accountability and routine management purposes, and the extent to which such information is currently available. Later parts deal with option appraisals.
There are a number of gaps in costing information, notably but not solely related to treatment of capital, which militate against good financial management. Even when information is present, as for example on running costs, it may not be analysed in a consistent way from site to site, or Service to Service, making benchmarking difficult. The Department should ensure that the introduction of Resource Accounting and Budgeting will lead not only to a fuller picture of storage costs, but also to a stronger basis for decision-making and management action.

Given the lack of full cost data, it is not possible to establish precisely the costs of storing different equipments or different methods of storage. Figure 15 presents such data as is available on the costs of storage at main sites, together with broad estimates of the missing elements. Figure 15 shows that the addition of missing or incomplete costs materially alters the perception of the cost of storage.
### Figure 15

An illustration of the full cost data available for major storage centres

<table>
<thead>
<tr>
<th>Elements of Full Cost</th>
<th>Ashchurch (6,200 vehicles)</th>
<th>RAF St Athan (42 aircraft)</th>
<th>HMS Intrepid (1 vessel)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(£)</td>
<td>(£)</td>
<td>(£)</td>
</tr>
<tr>
<td>1. Staff costs</td>
<td>3,837,846</td>
<td>985,673</td>
<td>2,700,000</td>
</tr>
<tr>
<td>2. Materials consumed</td>
<td>500,000</td>
<td>12,000</td>
<td>626,000</td>
</tr>
<tr>
<td>3. Utility usage</td>
<td>837,198</td>
<td>86,871</td>
<td>20,000</td>
</tr>
<tr>
<td>4. Shared services and other overheads</td>
<td>n/a</td>
<td>867,394</td>
<td>100,000</td>
</tr>
<tr>
<td>5. Property management</td>
<td>1,218,456</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>6. Depreciation of equipment and buildings</td>
<td>11,300,000</td>
<td>94,782 + 1,000,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>7. Interest on capital (known also as “cost of capital”)</td>
<td>5,800,000</td>
<td>172,607 + 2,000,000</td>
<td>500,000</td>
</tr>
<tr>
<td>8. Contracted-Out work</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>9. Other costs</td>
<td>196,270</td>
<td>12,361</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Total Cost Per Year (excluding additional cost estimate)**

<table>
<thead>
<tr>
<th></th>
<th>(£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashchurch</td>
<td>6,091,770</td>
</tr>
<tr>
<td>RAF St Athan</td>
<td>2,221,588</td>
</tr>
<tr>
<td>HMS Intrepid</td>
<td>4,270,000</td>
</tr>
</tbody>
</table>

**Total Full Cost Per Year (including additional estimates of cost)**

<table>
<thead>
<tr>
<th></th>
<th>(£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashchurch</td>
<td>23,691,770</td>
</tr>
<tr>
<td>RAF St Athan</td>
<td>5,233,588</td>
</tr>
<tr>
<td>HMS Intrepid</td>
<td>6,890,000</td>
</tr>
</tbody>
</table>

#### Key to Symbols:
- **✓**: Cost information readily available
- **☓**: Cost information not readily available
- **○**: Cost information partially available

5,800,000 “Order of magnitude” estimates reached jointly by the Department and the National Audit Office.

The cost information that the Department do not routinely gather is a significant component of the full costs of storage.

Source: National Audit Office
Identifying readiness requirements

2.25 Within military planning, “readiness” is a well established and well understood term. It refers to the Department’s preparedness to mobilise manpower and equipments to agreed timescales as determined by various operational scenarios. Each active military unit is prescribed a readiness label for which appropriate funding and resources are made available.

2.26 The merits of applying a readiness labelling system to stored equipments (as well as operational equipments) and reflecting this in management information are clear. In their application:

- they help to determine the optimum method of storage (where it is possible to forecast the storage period);

- they help to ensure that stored equipment can be regenerated in line with central planning assumptions; and

- they form a clear measure of the level of service required of the Storage Organisation by each Equipment Manager.

2.27 As an illustration, the practice of readiness labelling within the Navy has been successfully applied to a number of ships including HMS Ark Royal, one of the Navy’s three aircraft carriers. HMS Ark Royal has been in store for three years, during which time it has been maintained at a single readiness level specified at the outset of its docking period. In keeping with this target, HMS Ark Royal has a crew of 90 staff, security cameras have been installed on board, spares removal is closely monitored, and a Controlled Humidity Environment is maintained throughout some internal areas of the ship. Furthermore, as a part of a separate but related exercise, the Navy have also been involved in examining the scope for regenerating all categories of equipment and manpower, as well as mobilising industry to produce essential ship components to pre-determined warning times. This exercise, known as “Regeneration 97”, was sharply focused on the issue of regeneration time and was equally concerned with operational and non-operational vessels, such as those held in long term preservation.

2.28 For Army and RAF equipment the Department are still in the early stages of developing a clear and useful readiness system for stored items. The following paragraphs highlight the difficulties that the Department have encountered and the impact this has had on the management information that has been generated.
2.29 Army vehicles held at the main storage depot in Ashchurch are subject to maintenance levels which govern availability and readiness. The associated availability targets are 90 per cent for Armoured (‘A’) vehicles (9 out of 10 stored vehicles should be available at any one time) and 80 per cent for non-armoured (‘B’) vehicles and earth moving (‘C’) vehicles. These figures exclude all other vehicle types. However, the reasons for storage are not taken into account when setting targets and no distinction is drawn between equipments in long-term storage, for example, war reserves, and those held for shorter periods, for example, repair pool vehicles.

2.30 The weaknesses of the existing readiness system for Army equipments are beginning to be addressed by Equipment Managers who have recognised the value of setting readiness expectations for stored equipments on an individual, rather than general, basis. Figure 16 shows that only seven per cent of equipments in store have been allocated individual readiness targets, the majority of these being armoured vehicles. However, this way of doing business is in its infancy and has not yet been formalised in Service Level Agreements or as targets in the storage depot Business Plan.

Figure 16

The proportion of vehicles and other stored ground weapon systems that have been given readiness labels

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>With readiness label</td>
<td>7%</td>
</tr>
<tr>
<td>Without readiness label</td>
<td>93%</td>
</tr>
</tbody>
</table>

Source: Equipment Support Manager questionnaire responses

The vast majority of stored vehicles and ground weapon systems have not been allocated readiness targets.

2.31 The RAF approach to storage and equipment readiness is centred around four major categories of readiness ranging from Immediate Readiness Reserve to Long Term Reserve. As each aircraft is placed in store it is attributed a level of reserve. Compared with the readiness labelling strategy for most Army
equipments, this approach gives the appearance of providing a more robust basis on which to select storage methods, monitor performance and plan for equipment retrieval. However, although readiness categories are recorded for each aircraft placed in store, the extent to which they are used as a management tool is somewhat limited. The main reason for this is that the readiness labels used do not adequately represent the full range of tasks that have to be undertaken to return aircraft to the active fleet, which can include maintenance and modification work. The National Audit Office recognise that it is difficult for the Department to forecast the nature and impact of down-stream maintenance and modification requirements on readiness, but consider it important that management information should reflect, as closely as possible, planning assumptions of this kind.

The extent of use of storage facilities

Another potentially useful piece of management information concerns the extent to which storage facilities are being, or are planned to be, used. When more sophisticated storage is available, such as Controlled Humidity Environments - discussed in Part 3 - information on usage enables management to monitor the efficient use of capital equipment or facilities, and to identify any surplus capacity accurately and perhaps to find uses for it. For more straightforward buildings and sites, monitoring usage helps to assess overall capacity of building and land, and to identify any scope for rationalisation.

On Controlled Humidity Environments, information on the use of facilities is currently held only by local storage facility managers, and is not widely disseminated to other storage facilities, particularly those in other Service environments. It is difficult to be certain, therefore, that existing Controlled Humidity Environments facilities are used to the fullest extent, either within or between Services, or that lessons learned in the use of such apparatus are widely applied.

The position is similar as regards storage sites with more basic facilities, although here the concept of ‘capacity’ is less precise. Nevertheless, information on the extent to which buildings and land are occupied is valuable in monitoring utilisation of assets and property. It is this type of information which can prompt questions of rationalisation of storage sites, a process which has been ongoing within the Department for many years, but one which is not yet well-serviced by routine management information.
In this context, the National Audit Office note that there are some 39 sites currently storing (and therefore receiving, maintaining and issuing) equipment. Some duplication of facilities and effort occurs, reflecting access requirements and military needs but also as a consequence of past judgements on storage facilities and their location. With this in mind, and given the review of requirements currently underway with the Strategic Defence Review there may be scope for further cost-effective rationalisation, which will further emphasise the importance of the efficient provision and use of the remaining storage facilities.

**Key Points**

- Although the Department routinely gather information on different aspects of equipment storage, gaps in key data exist and some information relevant to central planning and monitoring is difficult to collate (paragraph 2.9).
- There are clear indications that some equipments currently held in store are unlikely to be recovered back into Service and could be disposed of (paragraphs 2.14 - 2.15).
- A significant proportion of equipments have been held in store for longer than necessary awaiting decisions on their use, or pending other action (paragraph 2.19).
- The full costs of equipment storage may be several times larger than the costs of storage currently reported. The Department should ensure that, in moving to accruals accounting, all relevant costs are captured, assessed and reported in a sufficiently standardised way to facilitate comparison and benchmarking (paragraphs 2.23 - 2.24).
- For the Department to understand fully the scope for, and the impact of, improvements to equipment storage, they should seek to gather better information on the reasons for storage, past performance in regenerating equipment and the full costs of storage (paragraphs 2.17 - 2.31).

**Systemic constraints on the Department's ability to assess and introduce improvements to the storage task**

In examining the storage planning process and the influences on decision-making, the National Audit Office found that there was a propensity within the Department to retain equipments in store for longer than necessary and to be slow in responding to some Departmental efficiency drives. In addition to the difficulties generated by the Department’s limited visibility of the storage task, this is explained by a combination of factors:

- the length of the decision-making chain;
- the lines of responsibility for equipment storage;
limited incentives to minimise costs; and

limited incentives to maximise disposal revenues.

The length of the decision-making chain and the lines of responsibility

In each of the three Services, decision-making for equipment storage is multi-staged. Typically, there are three main players who make a contribution to planning and decisions. These are:

- the Central Plans staff of each Service (who pass down Defence Planning Assumptions);

- Equipment Managers within each Service (who are responsible for equipment management and match equipment requirements to assets); and

- Managers of the storage facility to which decisions will relate (who undertake the storage task and usually hold management information).

In practice, many other divisions of the Department routinely contribute to storage and disposal decisions. For example in the RAF additional players include:

- the Aircraft Engineering Support Wing – responsible for co-ordinating the aircraft storage task at the two main sites;

- the Aircraft Mechanical Maintenance division – notionally responsible for bearing the costs of storage;

- the Engineering Authority within the Support Authority – responsible for technical input on the condition of active and stored equipment;

- the Joint Services Aircraft Disposals Committee – responsible for determining what should be done with surplus aircraft;

- the Disposal Sales Agency – responsible for the disposal of surplus aircraft where instructed; and

- the Air Force Board – responsible for decisions on the run-down of aircraft fleets, for example the Tucano fleet.
The National Audit Office employed an analytical technique known as “Cognitive Mapping” (Annex B) to map and understand the relationships between the different players involved with storage decisions. This exercise highlighted two main issues which are equally applicable to storage undertaken within the RAF and the Army. First, the Departmental staff interviewed agreed that despite being an important fleet management activity, equipment storage is essentially a low priority activity that is not the sole concern of any section of the Department. Secondly, Departmental staff identified the interdependency of the players involved with decision-making as a key factor in making the storage decision process both inflexible and slow. The results of this examination strongly pointed to the need for a review of storage requirements and existing arrangements with particular focus on the costs of storage and the revenues from disposal. The importance of this conclusion is underscored by numerous Departmental studies, such as the Defence Costs Studies, which have looked closely at the scope for minimising storage costs for all categories of defence stores.

**Incentives to minimise costs**

The direct costs involved with storage are usually borne by the establishment undertaking equipment storage for example, RAF St Athan or the Base Vehicle Depot in Ashchurch. In some instances a notional charge is registered on the High Level Budget of the area responsible for equipment management, as with the RAF’s Maintenance Group Defence Agency. For whole aircraft storage, the notional charge is communicated to the individual Support Authority who sanctions the costs through the ‘Long Term Costings’ screening process. However, the National Audit Office found that the main players in the decision-making process, for example Aircraft Support Authorities, seldom considered the cost implications of their storage decisions, or were charged for them. Costs instead rested with the storage providers who have a limited influence over the number of equipments that are selected for storage.

Furthermore, when taking decisions on whether to retain equipment in store or make them available for disposal, for example by sale, the Department rarely factor in the costs of storage. The disposal process, which is examined in depth in Part 4 of this Report, has used Investment Appraisals to compare competing options only twice in the last five years.
The introduction of the Resource Accounting and Budgeting regime in 1998 will help to address this by ensuring that assets are valued, and factors such as the cost of capital and depreciation are in future reflected as costs in the Department’s accounts. The Department will need to ensure that the data generated under Resource Accounting and Budgeting will provide appropriate information and incentives to enable storage decision-makers to maximise cost effectiveness.

**Incentives to maximise disposal revenues from stored equipment**

Revenue incentives associated with the disposal of stored equipment are equally diffuse. For example, in the case of disposal through sale, two key benefits can arise:

- the size of the storage task can be reduced (thereby releasing valuable storage space, reducing some running costs and providing the opportunity to dispose of equipment specific spares); and
- revenues can be raised for the Department.

Incentives should therefore be in place to encourage decision-makers to review regularly their equipment portfolios and their need for storage holdings. However, the scope for identifying surplus equipments is hindered, in most instances, by the separation of budgets to which disposal revenues are allocated from those from which Equipment Managers are funded.

Within the Department, Top Level Budgets are the highest level of budgetary authority, for which there are 13 budget holders. Beneath them are more than 90 High Level Budget holders and at the lowest level, thousands of Basic Level Budget holders typically serving individual establishments. This budgetary framework was introduced by the Department in 1991 under the New Management Strategy which sought to align budgetary and management responsibilities more closely through a devolved budgetary system. Figure 17 provides a more detailed illustration of the degree of congruence between budgetary and functional responsibilities.

As illustrated in Figure 17, there is only one example, on the RAF side, where the functional responsibility for equipment management is coincident with budgetary authority for disposal receipts, and where incentives for disposal are thus obvious. However, even in this case individual RAF Support Authorities responsible for aircraft such as Tornado are foremost held accountable to a Basic
### Figure 17

An illustration of the relationship between the Department’s budgetary system and functional responsibilities for specific equipment types.

<table>
<thead>
<tr>
<th>Service</th>
<th>Top level budget (TLB) holder</th>
<th>High level budget (HLB) holder</th>
<th>Examples of potential equipment disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVY</td>
<td>2nd Sealord</td>
<td>Director General Fleet Support (OP)</td>
<td>Wessex helicopters</td>
</tr>
<tr>
<td></td>
<td>Chief of Fleet Support</td>
<td>Ships Support Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C in C Fleet</td>
<td>Director General Aircraft (Navy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUS (Fleet Support)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Naval Base and Supply Agency</td>
<td></td>
</tr>
<tr>
<td>ARMY</td>
<td>Land Command</td>
<td>Director General Equipment Support</td>
<td>Chieftain Mk2 Tanks</td>
</tr>
<tr>
<td></td>
<td>Quartermaster General</td>
<td>Director General Logistics Support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjutant General</td>
<td>Chief of Staff Headquarters Quartermaster General</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOC NI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAF</td>
<td>HQ Strike Command</td>
<td>Chief of Staff</td>
<td>Tornado aircraft</td>
</tr>
<tr>
<td></td>
<td>Logistics Command</td>
<td>Director General Equipment Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personnel and Training</td>
<td>Air Officer Communication and Information Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air Officer Maintenance</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**
- Title of budget holder
- Budget holder responsible for receiving revenue from disposal
- Budget holder with functional responsibility for equipment storage

**Note:** Although there is a clear separation of responsibility between the above functional and budgetary areas, consultation will still take place over matters such as storage and disposal of equipment.

The budget holders responsible for receiving disposal revenues are usually different from the budget holders functionally responsible for equipment management and storage.

**Source:** National Audit Office
Level Budget, which brings to bear different cost disciplines and revenue incentives from the High Level Budget. In the Army and the Navy, equipment management and disposal receipts are in the same chain of command, but are separated by the boundaries between top and higher level budgets. The result is that Support Authorities, like other equipment managers, are at least one step removed from the disposal incentive and its influence is therefore diminished. The extent of budgetary alignment that is desirable must be set against the costs of increased precision in accounting arrangements – costs which could be relatively high for large volume but low value disposals. But for low volume, high value items, such as the equipments that are the focus of this study, the balance of advantage is firmly in favour of aligning budgetary and functional responsibilities to maximise the incentive to consider, and where appropriate pursue, disposal.

2.47 Since the introduction of the New Management Strategy, there has been an inevitable process of refinement to budgetary arrangements and the Department have continually reviewed the fit between budgetary and functional responsibilities. Shortly after the introduction of the New Management Strategy, the Committee of Public Accounts commented, in the light of new arrangements, on the Department’s strategy for asset management and disposal, and stressed the need to provide incentives to budget holders to exercise initiative in identifying surplus assets for surrender. The success that has been found in embodying these incentives in the budgetary system has varied, with the disposal of defence land as one example of the good progress that has been made.

2.48 Under an initiative known as the “Land Command Incentive Scheme” provision has been made for a proportion of the revenue from land sales to be retained by Units. Concurrent work undertaken by the National Audit Office for their Report “Identifying and Selling Surplus Property” (C&AG’s Report, HC 776 Session 1997-98) showed that it was not possible to draw conclusions on the effectiveness of the scheme. However, such an arrangement offers a clear incentive for asset managers actively to review their holdings and, where possible, recommend disposal. With regard to major equipments, no such arrangements are in place.

2.49 Interviews with Departmental staff have drawn attention to some incentives that act in favour of cost minimisation and revenue maximisation. First, storage organisations are often constrained by the physical capacity of available storage facilities, and this may manifest itself in the form of pressures on Equipment Managers to tailor their call on the storage task accordingly. The National Audit Office’s “Cognitive Mapping” exercise clearly pointed to this as a key decision-driver. Secondly, the Disposal Sales Agency periodically meet with
decision-makers to remind them of the prospect for equipment sale and to explore the likelihood of future disposal declarations. Finally, Equipment Managers may also seek to dispose of stored equipments where they are known to present repetitive technical problems.

Key Points

- The Department are constrained in their ability to introduce improvements to storage planning by lengthy decision processes (paragraphs 2.37 - 2.39).
- The cost implications of equipment storage play a limited role in decision-making both in routine planning decisions and periodic option appraisals (paragraph 2.41).
- Because budgets and functional responsibilities are not always clearly aligned, incentives for decision-makers to minimise costs and maximise disposal revenues are weakened. The Department will need to ensure that budgeting structures under Resource Accounting and Budgeting act to reinforce incentives to pursue value for money (paragraphs 2.46 - 2.47).
Part 3: Methods of storage

Introduction

Once decisions have been taken on equipments that must be stored, the Department have to choose the most cost-effective method of storage, within the various constraints they face. This Part outlines the main risks to stored equipment and available responses to those risks, and then records the actual storage arrangements in place. The Part closes with an assessment of the quality of existing arrangements and the potential for more cost-effective equipment storage.

Risks to stored equipment

Humidity

One of the major problems with storing materiel is deterioration due to the effects of atmospheric moisture. For metals, this deterioration takes the form of rust, corrosion, and, in many cases, a change in dimensions of critical tolerance areas. As the humidity of the air increases so does the rate of corrosion of metals through increased condensation and oxidisation. This is illustrated in Figure 18 which shows how corrosion increases dramatically as atmospheric humidity increases above a certain level – around 45 per cent relative humidity for steel.

3.3 Stored materiel is also subject to:

- **Biodeterioration:** when micro-organisms such as moulds, fungi, bacteria and yeasts utilise atmospheric moisture to develop and grow.

- **Photodegradation:** when ultraviolet or visible radiation causes deterioration of materials. Plastics and rubber are highly susceptible to photodegradation. Insulating materials can be affected causing faulty signals to be sent and processed.

- **Stresses and strains:** which can cause rubber seals to corrode and ‘flat spots’ to develop on tyres. In order to alleviate this, windows should be left open and vehicles moved periodically.
Rodents and birds: which can, and often do, enter storage premises. Rodents can gnaw their way through wiring looms and wood. Bird droppings are alkaline and can corrode metals as well as encouraging the growth of micro-organisms.

Avoiding equipment degradation

3.4 Metals can be protected against corrosion with coatings such as paints, oils or greases. However, it is generally accepted that for the purposes of controlling degradation, both metallic corrosion and biodegradation, a reduction in humidity is key. Studies have shown that the optimum relative humidity for inhibiting degradation should be between 35 and 50 per cent. The average relative humidity of the atmosphere in the United Kingdom is 80 per cent with seasonal and 24-hour variations - as the temperature rises, humidity falls.

3.5 Relative humidity may be controlled by heating, cooling or desiccation of the ambient air. Desiccation, where atmospheric moisture is absorbed by a desiccant, is considered to be the most cost-effective method of humidity control. Storage in a Controlled Humidity Environment offers the following advantages over storage in normal atmospheric conditions:

Vernon’s curve for steel

Figure 18


Relative humidity percentage

Increase in weight (mg/dm²) caused by corrosion

0 20 40 60 80 100 120

0 20 40 60 80 100

Note: Relative humidity is defined as the amount of water in a sample of air compared to the maximum amount of water the sample can hold at the same temperature.

As relative humidity increases so does the level of corrosion.
the onset or spread of corrosion or other deterioration is severely restricted;

the requirement for frequent in-storage servicing and maintenance may be negated offering the prospect of substantial savings in manpower and spares costs; and

the time taken to recover equipment from storage may be reduced.

Maintaining security and safety

Choice of storage method also has implications for the physical security of stored items and for safety. Methods which involve specific buildings provide potential for security measures, and some protection against animal and pest damage. But they also increase the significance of fire risks and safety issues connected with the density of storage. For fire safety, vehicles are kept in aisles at the main Ashchurch depot which currently has a lower level of fire support than its risk level justifies. However, the Department are assessing the current fire risk at Ashchurch in order to determine future fire protection requirements. This exercise is due to be completed by the end of 1998. Methods such as cocooning provide a further measure of security, and also deter unauthorised or unappraised “spares robbing”. By the same token, they make it more difficult to remove spares from stored equipments where it would otherwise be cost-effective so to do.

Key Points

- Stored equipment deteriorates as a result of exposure to atmospheric moisture (paragraphs 3.2 - 3.3).
- Dry Air storage or a Controlled Humidity Environment offers a number of advantages over storage in normal atmospheric conditions (paragraph 3.5).
- Safety and security considerations may also influence the selection of storage methods (paragraph 3.6).

The Department’s current approach to storage

The Department have no overarching policy on storage methods or on how to arrive at decisions on storage methods. Different considerations apply to ships, aircraft and ground equipment and the National Audit Office therefore examined storage arrangements in each of these areas. The following paragraphs set out the results of that examination, by area, in the following format:
a description of the context, the storage methods adopted, and how decisions on these methods were reached;

an analysis of available data on the regeneration of stored equipment to military use, regeneration being a key indicator of the success of storage in meeting the military objectives underlying Defence Planning; and

a description of methods employed by other, including overseas, storers of equipment, to provide comparative insights.

Later sections then look at the overall picture of equipment storage and the scope for greater cost-effectiveness.

Ships

3.8 The Navy normally employ Controlled Humidity Environments within their large ships in long term storage when the readiness state of the ship is sufficiently extended so that frequent maintenance can be avoided. For example, current operational planning requires only two aircraft carriers at immediate readiness with the third at extended readiness. Having learned lessons from previous long-term storage of vessels, the Navy decided that Controlled Humidity Environments should be applied to some internal cavities such as the engine room and operations room of HMS Ark Royal, the carrier currently at extended readiness. When the ship is regenerated, the Navy confidently expect that this storage approach will have minimised the problems associated with lack of use.

3.9 By contrast, the Navy decided not to use such techniques on the Landing Platform Dock, HMS Intrepid. This vessel, whose primary function is to transport troops, heavy equipment and tanks to a beach head, is now 30 years old and a decision was taken in the late 1980s that the ship would be placed at extended readiness in 1990 until the end of its Service life. This was a pragmatic option aimed at realising savings from refit and upkeep costs and was based on the assumption that the ship would be replaced by a new ship at the end of 1994. However, slippage to its planned replacement means that it is now likely that HMS Intrepid will be laid up until 2001 after spending some 11 years at extended readiness.

3.10 There are 16 vessels in long-term storage awaiting disposal. Four of those vessels are the Upholder Class submarines which were withdrawn from service prematurely, reflecting a reduced need for submarine operations. The Department let a custody, care and maintenance contract for the submarines at an annual cost
of £4.5 million to Vickers Shipbuilding & Engineering Ltd. in November 1994 pending sale of the vessels. The National Audit Office visited the contractor in December 1996 to view the storage conditions. They found the submarines to be in a good state of preservation. The atmosphere inside the submarines is maintained at a comfortable ambient temperature by warm air ducted-in through the hatches. There was no evidence of condensation inside and little sign of internal corrosion or degradation. External hull corrosion is being inhibited by the use of an electric cathodic protection system run from the dockside. Rigorous controls have been put in place to ensure that equipment onboard cannot be “cannibalised” to keep other Royal Navy submarines operational except in emergencies.

3.11 Since the National Audit Office inspection of the submarines, the Secretary of State for Defence announced to Parliament in April 1998 that the Canadian Government had declared their intention, subject to final negotiations, to lease all four submarines for eight years. This arrangement is likely to be worth some £200 million to the Department over the eight year period against which must be set the cost to the Department of reactivating the submarines over a $3\frac{1}{2}$ year period, estimated to be in the order of £100 million. By comparison, the currently estimated scrap value of the four submarines and spares is £20 million. In addition to the financial advantage of the deal, the programme will bring work to industry in the United Kingdom and the Department will receive a modest return from licence fees and levies payable by the Canadian Government.

3.12 Eleven of the vessels awaiting disposal are decommissioned nuclear submarines where safety issues are paramount in the storage method. The National Audit Office examined how the Department had approached the storage task for these submarines in Case Study 1.

Case Study 1: The decommissioning of nuclear submarines

The Royal Navy have decommissioned 11 nuclear submarines to date. Under international agreements, such submarines cannot be sold or de-fuelled and then dumped at sea. The Department’s current policy is to de-fuel, de-equip and lay-up each submarine for long-term storage afloat after withdrawal from service, pending the final disposal of the remaining intermediate and low level waste and the scrapping of the remainder of the submarine. This is necessary because the residual radioactivity associated with the reactor compartment remains even after the nuclear fuel has been removed. The radioactivity decays gradually and after 30 years the majority of the short lived intermediate level waste has decayed to low level and compartment radiation levels are greatly reduced. The reactor compartment can be most safely dismantled after that time and the radioactive waste removed for final disposal. This policy complies with Health and Safety principles of limiting doses to personnel carrying out the task to as low as is reasonably practicable. The residual radioactivity cannot penetrate outside the pressure hull and the Department consider the submarines to be totally safe. By way of reassurance to the local population, the level of radioactivity external to the hull is measured frequently and found to be of the same order of magnitude as the level of...
radioactivity that occurs naturally in rocks. An independent report commissioned by Dunfermline District Council in 1991 showed that the external dose to the general public resulting from the presence of the nuclear submarine HMS Dreadnought is so small that it is not measurable.

The de-fuelling, de-equipping and preparation for laying up period usually lasts about 12 months. The de-equipping process is necessary to remove components that are required for operational submarines and sensitive equipments. The lay-up preparations are mainly concerned with making the hull permanently watertight by sealing up the various openings in the pressure hull save for one access hatch. Assessments of the corrosion rates of the steel pressure hull suggest that, provided the submarines are docked every 10 years to inspect and repair any incipient corrosion and receive an extended docking period every 30 years to carry out a structural survey and repair of ballast tanks, the submarines could be stored afloat safely for a long period of time.

The total cost for the eight submarines which have been through three stages of de-fuelling, de-equipping and laying up preparation amounts to around £126 million. On the assumption that costs will be similar for the remaining three submarines yet to go through the process, a further £36 million will be spent on preparing these for storage. If costs for the waiting period before decommissioned submarines are allowed access to scarce dry-dock facilities are also included, the total cost of preparing the 11 submarines for long-term storage amounts to some £220 million.

Once they have completed this process the submarines are stored afloat in non-tidal basins at Rosyth and Devonport. The costs associated with the long-term storage are made up of:

- care-taking costs and the costs of minor maintenance work;
- the costs of the 10-yearly docking to survey the hulls and carry out any essential work to maintain the submarine’s watertight integrity; and
- the costs of more extensive work every third docking (every 30 years) if the submarine is not finally disposed of at that point.

Such costs are estimated to be spread over a period of more than 50 years.

In order finally to dispose of a nuclear submarine, the reactor compartment must be cut out. The remaining two parts of the submarine can then be dismantled and scrapped in dock or can be welded back together and towed away for scrap. The intermediate level nuclear waste from the reactor compartment must be isolated and packaged into manageable volumes before final disposal in a repository.

The Department’s current policy is to lay up decommissioned nuclear submarines afloat for an indefinite period pending disposal of the intermediate level waste to a deep waste repository. Current plans have assumed that a national underground repository, currently known as the NIREX facility, would be available for the permanent safe storage of the intermediate level waste from the reactor compartment.

However, the NIREX project has been refused planning permission and it is now unlikely that the facility will be operational until 2030. The setbacks to the NIREX project have forced the Department to re-evaluate their approach to disposing of nuclear submarines. They are currently exploring alternative strategies, some of which include storage for greater or lesser periods than their current strategy envisages. These strategies range from afloat storage assuming no repository is ever commissioned to afloat and land storage for 30 years followed by repository storage when it finally becomes available.
Regeneration of Naval Vessels

3.13 In the 12 months to June 1997, the Navy were not required to regenerate any ships from preservation. The National Audit Office, therefore, considered the prospects of regenerating HMS Intrepid – one of the Case Study equipments examined for this Report.

3.14 When HMS Intrepid was first placed in store in April 1991, it was set a readiness target which indicated that the vessel had to be recoverable within 30 days. Routine structural surveys have since taken place to establish the material condition of the ship. These have revealed significant deterioration and highlighted serious corrosion on the stern gate used to land equipments and troops. Furthermore, in addition to having to address widespread deterioration throughout the ship, the Navy must also replace numerous components, spares, sub-systems and even items of furniture, that have been removed from HMS Intrepid and supplied to her sister ship, HMS Fearless, whilst in active use.

3.15 Since HMS Intrepid first entered a state of preservation in 1991 its readiness timescale has been lengthened to reflect the practical regeneration difficulties presented by its material condition. The Department’s military planners now consider that, in the current strategic situation, the risk of maintaining HMS Intrepid at the current readiness level is acceptable. However, based on estimates provided by Departmental staff at all levels, serious doubts still remain over the revised readiness target, and indications are that a more realistic regeneration timeframe could be two to three times greater than the currently declared level. The Department’s current estimate is that Intrepid is capable of regeneration within 14-20 weeks. The Department are now considering whether the vessel should be retained or whether her readiness target should be extended.

Key Points

- The Navy do not normally use full Controlled Humidity Environments for vessels held at extended readiness because of the expense (paragraphs 3.8 - 3.9).
- The withdrawal of nuclear submarines from service poses safety risks. The Department will spend in excess of £290 million to counter the risk in preparing and storing the 11 submarines decommissioned so far. It is unclear at present how the submarines will finally be disposed of (paragraph 3.12 and Case Study 1).
- The state of the stored Landing Platform Dock, HMS Intrepid, makes it doubtful that the ship could be regenerated within the Department’s current readiness target. The Department should review the position to ensure that military planning is based on accurate assumptions and costs are minimised consistent with military needs (paragraph 3.15).
Aircraft

3.16 The vast majority of aircraft in long-term storage are held at either RAF Shawbury, RAF St Athan or the Naval Aircraft Repair Organisation, Fleetlands in Controlled Humidity Environments. The allocation of storage space depends upon the designation of the aircraft stored and the Royal Air Force draw a distinction between “effective” aircraft which are held to meet a future requirement and “non-effective” aircraft for which there is no operational requirement. “Non-effective” aircraft are held in store pending disposal or diverted to other uses such as Ground Instructional Aircraft. “Effective” aircraft are allocated the prime storage space whereas “non-effective” aircraft are held in whatever storage space is available. The Royal Navy are more constrained for space and the only “non-effective” aircraft that are likely to be in storage are those that have changed their category from “effective” since being placed in storage.

3.17 Depending on the readiness labels attached by aircraft fleet managers (see paragraphs 2.25-2.26), the Royal Air Force use four recovery categories which influence their approach to storage:

- **Immediate Readiness Reserve.** This applies to aircraft which are maintained to the in-use fleet standard enabling them to be returned to operational use within three days.

- **Short Term Reserve.** These aircraft are maintained to in-use fleet standard and require limited anti-deterioration measures to be applied. Aircraft are flight tested annually and can be returned to operational use within one month.

- **Medium Term Reserve.** Anti-deterioration measures are applied to this category of aircraft which are not maintained to in-use standard and are not flight tested annually. Modifications to the aircraft are discretionary but the aircraft should be capable of being returned to use within three months.

- **Long Term Reserve.** This label applies to aircraft in deep storage and extensive anti-deterioration measures are carried out. They are not maintained to in-use standard and no modifications are carried out until the aircraft are required for issue. They should be capable of being returned to use within six months.
The Royal Air Force have carried out a series of studies with the aim of improving both long term storage conditions and flight line availability. For example, they have examined the possibility of “cocooning” aircraft following its successful application to new aircraft by Fokker in the Netherlands. Further studies have involved consideration of the possibility of relocating surplus aircraft to the dry climate of the Arizona Desert. Study teams have recently visited both the French Air Force for a technical visit and attended a course in Sweden where the benefits of Controlled Humidity Environments for flight line aircraft were explained.

It is now Royal Air Force policy to dehumidify all in-use flight line aircraft whenever they are not flying unless there are time constraints between sorties or the remaining in-Service life of the aircraft would not justify the procurement of the necessary equipment. The Royal Air Force believe that this policy improves availability of aircraft and leads to savings in maintenance man-hours from improved avionics reliability. They also note that spares consumption is reduced and the onset of corrosion is delayed or its progress arrested. However, the National Audit Office noted that the Royal Air Force are restricted in the application of the policy because Controlled Humidity equipment is limited. The National Audit Office noted that there was a wealth of anecdotal evidence from overseas and from pilots that flight line dehumidification was beneficial but that the Department had not as yet carried out a cost-benefit analysis, either of their own experience or of potential for further applications.

Recovering aircraft from storage

Over the 12 month period to July 1997, 32 fixed and rotary wing aircraft have been recovered from storage and issued to active units. Figure 19 sets out the number and type of aircraft recovered during this period. Of those aircraft recovered from storage, two were held at Immediate Readiness Reserve – and were successfully recovered according to the three day timeframe allowed. Of the remaining 30 aircraft, almost all (28 aircraft) were held at a Medium Term Reserve level and should therefore have been capable of recovery within a three month period. The Department’s performance in recovering aircraft and meeting this target varied, with recovery times ranging from just over three months (85 working days) to seven months – well beyond the target.
There are a number of factors which help to explain the cause of the delays noted in paragraph 3.20. In the case of Hawk, some aircraft were required to undergo minor maintenance work prior to issue which had the effect of extending recovery time by six weeks. Occasionally, there was a requirement to undertake “Calendar Back-Stop” work which is a major service required after each aircraft has flown 2,000 hours or has been in-Service for 10 years. The longer aircraft remain in store the greater the likelihood that Calendar Back-Stops are necessary.

Recovery delays also arose due to competing demands placed on the engineering and technical staff at the storage facilities. For example, at RAF Shawbury, Tucano recoveries were broadly achieved according to the timescales set. However, slippages occurred as some aircraft were being re-activated and engineers were re-directed to urgent repair work for higher priority front line aircraft. This reflects the limited resources that the Royal Air Force has at its disposal at each of its storage facilities.

International comparisons

The National Audit Office reviewed military aircraft storage practices in other countries, to see if their experience could yield lessons for the United Kingdom.
France

3.24 The National Audit Office visited the French Air Force at Châteaudun, where all long-term storage of French combat aircraft takes place, in order to investigate their approach towards the storage of aircraft. The need for storage arises primarily from the initial purchase of “attrition” aircraft to cover for estimated losses during peacetime and to be available at times of crisis. These aircraft are stored at immediate readiness and must be kept in immaculate condition. Storage is seen as “freezing the life” of an aircraft and deterioration must not occur. Aircraft are cycled through storage with operational aircraft coming in at a later stage in order to equalise fatigue life. A further storage task arises from the need to keep aircraft earmarked for disposal but these are mainly kept in the open with no preventative measures taken against corrosion.

3.25 The French Air Force aim to minimise the costs of maintenance for all effective aircraft in storage. In order to achieve this they use Controlled Humidity Environments applied to the whole aircraft both for groups of aircraft and singly. A variety of different techniques are used as shown in Figure 20, and the advantages and disadvantages of each are shown in Figure 21.

3.26 The French Air Force are currently conducting a series of studies on the effect of operational dehumidification on aircraft avionics. Current indications are that such dehumidification increases the Mean Time Between Failures by some 15-20 per cent with a corresponding increase in aircraft availability and hence a substantial cost saving. The French learned a considerable amount on avionics dehumidification from the British experience in dehumidifying E3F AWACS airborne early warning aircraft at RAF Waddington.
### Dry air techniques trialled by the French Air Force

<table>
<thead>
<tr>
<th>Storage method</th>
<th>Typical number of aircraft</th>
<th>Investment per aircraft</th>
<th>Duration of Investment</th>
<th>Cost Per Year of Energy &amp; Maintenance</th>
<th>Total cost per aircraft per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing standard hangar with PVC lining</td>
<td>20</td>
<td>£24,000 (not including construction)</td>
<td>15 years</td>
<td>£876</td>
<td>£2,476</td>
</tr>
<tr>
<td>Concrete HAS hangar or ‘rub’ hangar</td>
<td>5</td>
<td>£2,200 (not including construction)</td>
<td>10 years</td>
<td>£292</td>
<td>£512</td>
</tr>
<tr>
<td>Metallic textile tent</td>
<td>2-10</td>
<td>£35,000</td>
<td>15 years</td>
<td>£730</td>
<td>£3,063</td>
</tr>
<tr>
<td>PVC envelope or cocoon</td>
<td>1</td>
<td>£20,000</td>
<td>5 years</td>
<td>£91</td>
<td>£4,091</td>
</tr>
<tr>
<td>Loose fitting PVC cover</td>
<td>1</td>
<td>£18,000</td>
<td>10 years</td>
<td>£128</td>
<td>£1,928</td>
</tr>
<tr>
<td>Loose fitting PVC cover stored inside</td>
<td>1</td>
<td>£5,300</td>
<td>10 years</td>
<td>£128</td>
<td>£658</td>
</tr>
<tr>
<td>Thermo-weldable bag stored inside</td>
<td>1</td>
<td>£750</td>
<td>3 years</td>
<td>£37</td>
<td>£287</td>
</tr>
</tbody>
</table>

The cost of dry air storage techniques varies considerably.

Source: French Air Force
The dry air storage techniques used by the French Air Force

<table>
<thead>
<tr>
<th>Technique</th>
<th>Main Advantages</th>
<th>Main Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing standard hangar with PVC lining</td>
<td>✓ long-term storage arrangement ✓ full access to aircraft</td>
<td>✗ requires hangar space</td>
</tr>
<tr>
<td>Concrete HAS hangar or 'rub' hangar</td>
<td>✓ long-term storage arrangement ✓ full access to aircraft</td>
<td>✗ requires hangar space</td>
</tr>
<tr>
<td>Metallic textile tent</td>
<td>✓ low cost storage method ✓ long-term storage method ✓ full access to aircraft</td>
<td>✗ requires existing facilities ✗ high set-up costs</td>
</tr>
<tr>
<td>PVC envelope or cocoon</td>
<td>✓ can be stored outside ✓ extremely effective method of preservation</td>
<td>✗ high set-up costs ✗ high maintenance costs ✗ limited access to aircraft ✗ once-only use ✗ disposal of material costly</td>
</tr>
</tbody>
</table>

continued...
The storage techniques adopted by the French Air Force have a range of associated advantages and disadvantages.

Source: French Air Force - Equipment Studies Unit
Other countries

3.27 The National Audit Office also obtained summary information on practices in several other countries:

- The Swedish Air Force conducted a controlled trial on aircraft which showed that those subject to operational dehumidification had an increased Mean Time Between Failure of 26 per cent. This improved aircraft availability by five per cent. All aircraft and helicopters in Swedish defence duty are now dehumidified.

- NATO AWACS airborne early warning aircraft were subject to operational dehumidification at a cost of £1 million. Savings on avionics replacements due to corrosion ensured pay back.

- German Luftwaffe units were reluctant at first to implement the strategy of operational dehumidification despite the Germans’ acceptance of the benefits demonstrated by other nations. However, when Tornado aircraft were deployed in support of Bosnian operations the operating units demanded that dehumidification be made available.

3.28 The National Audit Office noted that aircraft are now being designed so that dehumidification is facilitated. Both the Swedish Gripen and the collaborative Eurofighter have been constructed so that their sensitive material and electronics may be protected through dehumidification. Given the increasing use of electronics in all equipments, there may be scope for wider application of this type of approach.

Key Points

- The Department have introduced Controlled Humidity Environments for the majority of aircraft and claim marked improvements in so doing through reduced deterioration and better availability (paragraphs 3.16, 3.19).

- The Department have not in general been successful in regenerating aircraft according to the target times set. Delays have resulted from a number of factors including the need for maintenance work, the need for servicing and limited manpower resources (paragraphs 3.20 - 3.22).

- The French Air Force, along with other countries, use a variety of techniques for long-term storage of their aircraft and believe that each method is cost-effective for different applications. The French are also trialling Controlled Humidity Environments for in-use aircraft and believe that this leads to improved availability. The Royal Air Force also use Controlled Humidity Environments for in-use aircraft but are hampered by a lack of equipment (paragraphs 3.19, 3.24 - 3.28).
### Ground equipment

3.29 All ‘A’ (Armoured) and ‘B’ (Logistic) vehicles which are not issued to units and which are not held in Training Materiel Parks are now held in the Army Base Storage and Distribution Agency Base Vehicle Depot at Ashchurch in Gloucestershire. The ‘A’ vehicle fleet has recently been moved from another depot, Ludgershall, as part of a rationalisation exercise following from Defence Costs Studies. In mid-1997 there were 4,742 vehicles and trailers fitting the definition used for this study in Ashchurch with a value of about £400 million. ‘C’ vehicles (Engineer plant) are stored at Long Marston but this is due to close in 1999 and bridging equipment may be transferred to Ashchurch. Storage policy is that older vehicles – both ‘A’ and ‘B’ – are to be held at Ashchurch until required for issue to units. Issue will be dictated by operational needs or the need to fill gaps in unit establishments resulting from base overhaul or major repair programmes. All vehicles held in store for extended periods are inspected, run and maintained at laid down intervals.

3.30 The Army reviewed their storage task in 1992 and 1993. A major recommendation of the resulting report in November 1993 (the Calderwood Study) was that a Departmental policy should be formulated for the application of Controlled Humidity Storage to defence materiel. It was suggested that a tri-Service policy should be considered. Despite the conclusions of the Calderwood Study being accepted as official Departmental Army policy, the Army still do not store vehicles in Controlled Humidity Environments even if they are stored for many years. Apart from a small scale trial based on a handful of vehicles there is no Controlled Humidity equipment available at the main vehicle storage depot at Ashchurch. In the Department’s view, Controlled Humidity storage has not been implemented at Ashchurch because of uncertainty over the future requirement for long-term vehicle storage. Plans for the private sector to operate the depot - which might have included Controlled Humidity storage - were shelved pending the outcome of the Strategic Defence Review. However, since the start of the National Audit Office Study the Department have identified between 250 and 400 Armoured vehicles that have been in store long enough to benefit from Controlled Humidity storage. A project has been initiated to provide it, but final decisions are being considered in the context of the Strategic Defence Review, which may have an impact on vehicle numbers and storage arrangements.

3.31 More recently, a year long review of storage preparation and maintenance requirements for Controlled Humidity storage was carried out by the Field Equipment and Recovery Group of the Army Technical Support Agency at Chertsey. This resulted in the circulation of draft guidelines in 1995 for a wide range of equipments on “Technical Instruction for Depth Storage of Out of Use..."
The guidelines cover procedures for pre-storage preparation, in-storage inspection and maintenance and break out from storage. However, the guidelines assume that Controlled Humidity storage will normally be used. In practice, the guidelines have not been implemented because of the uncertainty surrounding the future shape of the Ashchurch depot.

3.32 The Army’s approach to storage is currently developing in a piecemeal fashion as evidenced by the following developments:

- Eight out-of-use Rapier Field Standard ‘B’ missile systems are to be stored in a Controlled Humidity Environment for periods of up to two years. The Department estimate that this will save some £280,000 a year through reductions in the cost of base repair, contract repair and spares consumption.

- Six Multiple Launch Rocket Systems are to be placed in long-term storage at the Ashchurch depot in a normal atmospheric environment. The Department’s approach contrasts with that of the Royal Netherlands Army who apply total dehumidification to their Multiple Launch Rocket Systems in view of the high electronics content of the vehicles.

3.33 The National Audit Office noted that Controlled Humidity Environments are to be introduced for active Challenger Main Battle Tanks for whenever the tanks are temporarily out of use – for example, at weekends. This involves dehumidification of the interior of the tank and in particular the electronics systems. The Department believe that this approach will reduce maintenance time and costs and will reduce the number of faults found with electronics.

**Issue of ground equipment from storage**

3.34 At the principal storage facility in Ashchurch, around 9,063 vehicles were issued from storage in the financial year 1996-97. The data that were available indicated that less than one per cent of issues were subject to discrepancy reports indicating problems that were raised either by equipment operators at the receiving units or by staff at the depot. Discussions with military staff indicated that raising discrepancy notices was a low priority for units receiving equipment from storage, and that the absence of formal complaints was not a reliable indicator of customer satisfaction. However, formal customer complaints and the level of discrepancy reporting are currently the only tools available to judge customer satisfaction. The depot has attempted to survey customers but the response rate was too low to give
meaningful data. Estimates provided by the depot Commandant who has oversight of the full range of recovery activities on-site indicate that some 45 per cent of armoured vehicles met their availability and readiness targets compared to a target of 90 per cent. This target is not being met because there are no purpose-built facilities for the servicing of armoured vehicles at Ashchurch and will not be until at least August 1999. However, Ashchurch has yet to fail to meet an operational demand. The depot Commandant was unable to estimate recovery performance for non-armoured vehicles held at Ashchurch. Based on these estimates and the management information that is available, it is not possible to draw firm conclusions on the Army’s performance in regenerating stored equipments from Ashchurch. As a minimum, however, this exercise illustrates that scope for improvement exists.

3.35 A more encouraging situation exists with regard to equipments stored at Training Materiel Parks. In the financial year 1996-97, there were 4,858 short term vehicle loans from the six Parks around the country. The overall availability of these vehicles was judged to be 76 per cent, beating the target of 70 per cent. The reasons for the relatively good performance for these vehicles, given that they are stored in the open air, are associated partly with their simple nature and partly with their relatively frequent use: few vehicles will spend more than 12 weeks in store between periods of use. The recent introduction of a management information system across all Parks has enhanced the visibility of operations and made them more accountable for their equipment recoveries than their counterparts elsewhere.

International and Commercial comparisons

3.36 The National Audit Office examined land vehicle storage in industry and in other countries, to provide some comparators for Departmental storage practices.

Challenger 2 Main Battle Tanks

3.37 The National Audit Office visited Vickers plc to view the storage of Challenger 2 Main Battle Tanks prior to delivery to the Department. By June 1998, about 140 tanks were stockpiled, of which some were in store for up to two years (see Figure 22). Several purpose built unheated weather-proof buildings have been erected to house the tanks. Vickers’ studies showed that dehumidifying only tank interiors – and so protecting sensitive equipment such as sights, computers and electronics – was the most cost-effective approach. Vickers purchased a number of

Ministry of Defence: Major Equipment Storage
dehumidifier units, each of which serves four tanks with flexible ducting leading to the tank interiors. The relative humidity is maintained at below 42 per cent with this system.

The humidity inside the vehicles is checked monthly to ensure it does not exceed 42 per cent, and monthly maintenance checks are carried out on batteries, sights and desiccators. Every four months a more comprehensive maintenance check involves starting up the engine and road testing the tank. The complexity of the fire and gun control equipment have led to a requirement to keep the hull batteries connected and charged, while turret batteries are disconnected when the tank is prepared for storage to avoid deterioration. Mindful of the costs associated with storage, Vickers are striving to increase the time between checks from four to six months. They pointed out that 10 driver-fitters are employed exclusively to carry out maintenance and inspection tasks and that some 50 man-hours per tank are required to carry out these functions every four months. The company’s ultimate aim is to reduce the workload by half.
Emergency Fire Service (‘Green Goddesses’)

3.39 During the 1950s and 1960s the Home Office purchased a large stockpile of equipment to form mobile fire fighting columns in time of war. Following the drought of 1976 and the firemen’s strike of 1977-78 it was decided to set aside part of this stockpile for use in peacetime emergencies. This Emergency Fire Service stockpile was managed by the Home Office and located in covered storage in four sites. In 1991, the Home Office let a contract to TNT Truckcare to ensure that the Emergency Fire Tenders, more commonly known as Green Goddesses, remain in a serviceable condition and ready for use at short notice (see Figure 23).

Green Goddesses held in store

3.40 Over 1,000 Green Goddesses are now stored at a single depot in Marchington, Uttoxeter by TNT Truckcare. The vehicles are stored in four large buildings each with an oil-fired heating system installed. However, the heating system is rarely used even in winter because the running cost budget of around £15,000 for storage does not allow for its frequent use. During the summer months the doors of the buildings are left open in order to reduce the relative humidity. A Controlled Humidity Environment was deemed to be too expensive except for storage of some £8 million worth of spares which are prone to corrosion.

3.41 Some 50 vehicles are earmarked for issue within 24 hours and are left with full fuel tanks. The remaining 995 are available for issue within 20 working days. About three years ago, the Home Office increased the servicing interval to three years with visual inspections every month. In their recent use during industrial
action in Merseyside and Derbyshire, the stored vehicles demonstrated a high level of roadworthiness. In Merseyside, only three out of 24 Green Goddesses and in Derbyshire one out of 12 had to be replaced prior to deployment because of mechanical breakdown. Nearly all of the appliances, however, required some remedial action on their water pumps.

**Germany**

3.42 The National Audit Office visited the German Army in order to investigate their approach to long-term storage. In the German Army, non-active units have all their equipment in long-term storage and active units will have up to 25 per cent of their tracked and wheeled vehicles and their major weapon systems in long-term storage for about five years. After five years, the stored equipment is regenerated and replaced by equipment in use by active Units. Currently they have over 2,500 (around 80 per cent of target) armoured vehicles stored, but very few logistics vehicles. All equipment is held in unit lines whether in use or in long-term storage.

3.43 The chosen method for long-term storage is a Controlled Humidity Environment. A number of different systems have been developed as shown in Figure 24. The adopted system depends on the available infrastructure at unit level: if suitable buildings are available they will be used but if not mobile frameworks are necessary. The Multi-Purpose Tunnel has been developed for operational deployments to allow reserve equipment to be stored in theatre. Cocooning is used only for simpler equipments. The “exit” to the cocoon is an expensive part of the system, mostly made from PVC. This enables vehicles to be extracted from storage for modification programmes.

**Figure 24**

Storage methods trialled by the German Army

The multi-purpose tunnel

Purpose-built enclosure with PVC lining
The Germans’ experience is that the technical risk of storage has proved to be less than expected and savings, against having the equipment in-use, are significant. The savings arise because no routine maintenance is carried out on vehicles in store – the Germans estimate that this reduces the costs of ownership of the equipment to 20 per cent of the operating costs of in-use equipment. However, the savings are lessened by the fact that more intensive use is made of the remaining 75 per cent of an active unit’s equipment. In this case the Germans estimate that operating costs are increased by 30 per cent for such equipment. After taking account of this increased usage and the very intensive usage of equipment by the Crisis Reaction Forces, the Germans estimate that they will save £26 million through long term storage in 1997. That figure could rise to £39 million per year as more equipment is put into storage.

Prior to long term storage, each equipment must be brought to a fully serviceable condition with all outstanding modifications completed. Having completed these preparatory measures, no maintenance of equipment will be undertaken for five years. Vehicles will simply be monitored, to check tyre pressures and for leaks. The “break-even” point of storage preparation costs against savings from operating costs is estimated at one and a half years for armoured vehicles and four to five years for logistics vehicles. Mobilisation has been trialled recently at a Tank Company. After five years in long-term storage, all engines started within 20 seconds and the tanks were operationally ready within one week. In general, the stored equipments are in better condition than those that have been in use. However, some care should be taken in attempting to draw lessons from the German Army’s experience of Controlled Humidity Environments. Holding equipment in Unit lines does not necessarily imply the same solution as holding significant numbers of vehicles in centralised storage facilities, where the bulk of the Department’s storage task is concentrated.

Other nations

A number of other nations are now applying dehumidification for in-use and stored ground equipment. These nations believe that dehumidification lowers ownership costs and increases readiness. A number of examples have been cited for the benefit of Controlled Humidity Environments:

- The Swedish Army estimated savings from the application of dehumidification to their equipment at around £50 million per year. In addition to the saving, overall readiness levels rose.
The Commander-in-chief of the Swedish Army decided in 1987 that all materiel in use containing electronic equipment shall be connected to dry air when the materiel is not in use for training.

The United States General Accounting Office found in 1997 that the National Guard could save more than £6 million annually in maintenance costs if they kept 25 per cent of their high maintenance cost equipment in dry air. Equipment with high maintenance costs included tanks, howitzers and armoured personnel carriers.

Key Points

- A report in 1993 recommended that stored Army vehicles should be kept in Controlled Humidity Environments. However, no stored Army vehicles, armoured or otherwise, are currently held in these conditions. In the Department's view, Controlled Humidity Environment storage has not been implemented because of uncertainty over the future requirement for long-term vehicle storage (paragraph 3.30).
- Estimates indicate that availability targets are currently being met for only 45 per cent of the armoured vehicles stored at the Army's main storage depot (paragraph 3.34).
- Green Goddesses are subject to very infrequent routine maintenance whilst the mechanical condition of vehicles emerging from storage is generally good. This suggests that savings could be made on Army logistics vehicle storage costs if the maintenance cycle is lengthened (paragraph 3.41).
- The German Army have made substantial savings through taking equipment out of use and placing it in a Controlled Humidity Environment. The British Army have also estimated that savings can be made through removing Rapier missile systems from use. The National Audit Office recommend that the Department conduct a survey of in-use equipment to determine the scope for further savings (paragraphs 3.32, 3.44).

Other factors affecting equipment regeneration

The sections above set out the Department's actual performance at regenerating equipment from storage, based on factors such as the sophistication of equipment being recovered and the method of storage adopted. There are, however, three further important factors:

- the extent of spares removal whilst in storage;
- the number of outstanding modifications and maintenance work required prior to recovery; and
the extent of simultaneous equipment recovery.

The following paragraphs explore each of these influences.

**The extent of spares removal**

3.48 In order to provide replacement parts to equipment operators and repair organisations, the Department have put in place an extensive provisioning system that relies on a combination of “just-in-time” deliveries from suppliers and the Department’s own storage and distribution infrastructure. However, as a result of sudden surges in demand which can run down stocks, or because original spares packages procured with the main equipments are insufficient to meet usage patterns, equipments can lie idle whilst replacement parts are awaited. Alternatively, as is often the case, parts are authorised to be taken from equipments held in store and the replacement, already on order, is re-directed to the stored equipment. “Spares Robbing”, as this activity is known, introduces extra stripping and refitting costs, but can be a sensible and cost-effective response to temporary spares shortages. The National Audit Office recognise that a balance needs to be struck between the cost of “down-time” of active equipments, and the impact this can have on the operation of important military exercises, and the impact on readiness of robbing stored equipment. Nevertheless, this creates a tension that the Department need to manage carefully with due regard to the implications for stored equipment regeneration and associated targets.

3.49 In some instances the cumulative effect of prolonged spares robbing is to remove the prospect of ever returning equipments to active use. An extreme example of this is the case of nine Tornado aircraft that have been held in store at St Athan for over a decade. A long history accompanies the decision to remove these aircraft from active use and place them in storage as a source of spares. However, early records indicate that after a decision had been taken to take the Tornado F2s out of Service, extensive robbing had taken place preventing the aircraft from being used, even in a very limited ground training role. At least 18 months passed before the condition of the stored Tornado F2s was formally recognised and a decision was taken to declare them surplus.

3.50 Spares removal is a time-consuming and complex activity and one that technical staff in each of the Armed Services would rather avoid having to undertake. However, if provisioning systems continue to give rise to temporary “stock-outs” and delivery delays, the Department are left with no cost-effective
alternative to spares robbing. The Department should ensure, where it is cost-effective to do so, that the extra costs of spares robbing, and its implications for achieving regeneration targets for stored equipments, are fully visible and factored into provisioning decisions and military planning.

**Outstanding modifications and maintenance work**

3.51 Another influence on equipment reactivation is the need for modification and maintenance immediately following recovery. During the storage period the Department do not usually embody modifications on stored equipment corresponding to those undertaken on the active fleet, and likewise, outstanding major maintenance work (more common to aircraft) is also withheld pending recovery action. At the point of regeneration therefore a backlog of work is often encountered and this has the effect of extending the re-activation period.

3.52 An example of this is the recent recovery from storage of seven front-line aircraft including Tornados and Jaguars. In most instances the elapsed time from recovery request to re-activation almost doubled as a result of essential major maintenance work. Taking this additional time into account at the planning stage is essential, yet the current labelling system does not adequately draw together the disparate elements of the regeneration task to give a single measure of the lead time that should be expected. Support Authorities respond to this in different ways. Some specify their requirements for recovery well in advance of need, leaving it to the storage organisation to mobilise the appropriate resources to meet a pre-defined date of release. Others calculate the notification time required by adding together the different elements of regeneration and working backwards to an optimum request date. Most, however, regard equipment retrieval from storage as a fluid process that would benefit from a clearer commitment by storage organisations to communicating single recovery timescales for each equipment in store.

**Single wave recoveries from storage**

3.53 Most of the analysis in this section of the Report has focused on the prospect of regeneration for individual equipments, rather than equipment recovery on a large scale, as might be required in the event of general war. In the light of the analysis undertaken in this Report, and the significantly increased challenge associated with multiple, as opposed to single, equipment recoveries, the Department may wish to give attention to the following points:
current management information systems are not sophisticated enough to provide the Department with the assurance they need to draw conclusions on their overall preparedness to mobilise war stock; and

there are clear indications that, for certain categories and types of equipments, assumed regeneration targets cannot be met.

Key Points

- Often the Department are left with no alternative but to 'rob' spares from stored equipment. The cost and regeneration implications are difficult to establish, but are important for cost-effective provisioning decisions (paragraphs 3.48 - 3.50).
- Regeneration timescales are often extended through the need to perform essential maintenance and modifications work (paragraphs 3.51 - 3.52).
- Assumed regeneration targets cannot be met for certain types of equipment (paragraph 3.53).
- There are clear indications that the Department would face difficulties in regenerating equipment in a single wave, for example, in the event of general war (paragraph 3.53).

Costs and benefits of approaches

3.54 The above material shows a wide diversity of practice, in part occasioned by the physical circumstances of different equipments, in part by different approaches to the analysis of opportunities or the will to take action. The final sections of this part of the Report explore two key issues: the quality of storage method analysis, and prospects for more cost-effective storage.

Quality of storage method appraisals

3.55 One factor influencing choice of storage method is the process by which options are appraised. Departmental guidance, which reflects Treasury guidance, sets out the main factors to be considered when contemplating an investment, and those factors are summarised in Figure 25 below, along with an assessment of how the various Departmental studies and appraisals of storage options match up to the guidance. The column for “in-use” Challenger tanks is included for comparison purposes: in practice these tanks are unlikely to be stored for one month or more, the definition of storage adopted for this report (see paragraph 1.6).
Study objectives were broad: to identify options for the long-term storage and maintenance of unit equipment not manned in peace on a ‘best value for money’ basis.

A variety of different options were considered from ‘do nothing’ through to complete centralised storage. A number of different locations were considered for centralised storage and investment appraisals were carried out for each.

Investment appraisal focused mainly on the estimated cost of each option. Benefits were considered separately in a qualitative manner. It was assumed that Controlled Humidity Environments would underlie options and this was not costed.

The strategic risk of concentrating vehicles on one site was considered but not quantified. Risks from not obtaining planning consent for development were considered as were the risks of the storage task increasing above that assumed.

The investment appraisal findings were expressed as a Net Present Value over a period of 30 years.
Option appraisals can be used in several ways - informally, to help establish the opportunities available, formally, accompanying submissions for investment approvals, and retrospectively, to check on the actual outcome of investment. The last two are mandated in Departmental guidance for significant investments. In this context, there are several points that flow from Figure 25:

- where investments in storage equipment and facilities have occurred, the associated investment appraisals are inadequate by reference to Departmental guidance;

- whether conducted as a formal or informal exercise, appraisals have not given any accurate sense of rates of return from more sophisticated storage methods; and

- there have been no retrospective appraisals of the performance of Controlled Humidity Environments, where installed.
In these circumstances, the potential for cost saving and improved operational readiness from investment in better storage facilities is obscured. Moreover, where Controlled Humidity Environments have been installed, the lessons learned cannot accurately be distilled and disseminated to other store and equipment managers.

**Potential for more cost-effective equipment storage**

In many instances, the discipline of good investment appraisal is needed to prevent over-optimistic capital projects being commissioned. But good investment appraisal can also help identify the best opportunities for investment and, in this instance, there is every indication that more investment in storage technology would be cost-effective. Accordingly, the National Audit Office have performed an “informal” appraisal of the prospects for applying Controlled Humidity Environments to the storage of AS90 self-propelled guns and Challenger 2 Main Battle Tanks – the former already held at the Ashchurch Base Vehicle Depot, the latter to be stored there in due course. The assumptions made in the following paragraphs – realistic at the time of writing – are that a war reserve of 70 AS90s and 30 Challenger 2s may be held at Ashchurch although other initiatives including partnering arrangements with industry are currently being pursued.

There are a number of different factors affecting the cost of storing vehicles in a conventional manner. These include:

- Costs of preparation and inspection. Preparation costs consist mainly of the man-hours required for vehicle inhibition to a basic level but also include the cost of parts replaced during routine servicing. Inspection costs consist mainly of the man-hours required to check vehicles periodically for physical deterioration.

- In-store maintenance costs. These consist mainly of checks and actions required to keep the vehicle in a serviceable condition.

- In-store spares usage. This consists of the cost of oils and spares to keep the vehicle in a serviceable condition.

Based on the Department’s own estimates, the National Audit Office have estimated the conventional costs of storage for 70 AS90 self-propelled guns and 30 Challenger 2 tanks over a five year storage period. It is assumed that there is no significant cost of regenerating conventionally stored equipments as they are kept in a near fully-serviceable condition. The costs of storage in a Controlled Humidity
Environment are different from those for conventional storage. Preparation costs for Controlled Humidity Environments tend to be greater as the vehicles need to be inhibited to a more advanced level and sealed as appropriate as well as being brought up to the required standard; and there is also a one-off cost for regenerating the vehicles as a result of the need to de-inhibit them. The purchase costs of Controlled Humidity Environment apparatus and its installation, maintenance and operation costs must also be taken into account in any appraisal.

By contrast, there are no inspection costs for Controlled Humidity Environments as the vehicles are left alone after being placed in storage, and equipment maintenance costs are less as there are fewer actions required and the cost of oils and spares is correspondingly less. Estimated costs of Controlled Humidity Environment storage for AS90 and Challenger 2 are shown in Figure 26, based on Vickers’ experience of dehumidifying Challenger 2, in comparison with the costs of conventional storage.

Notes:
1. Costs occur at various times throughout the year. For the purposes of presentation, in this Figure it is assumed that they are all incurred mid-year.
2. The Controlled Humidity storage figures include estimates for procurement and installation costs of de-humidification and maintenance and running costs over the five years.
3. It is assumed that there is no re-sale value of the Controlled Humidity equipment after five years.
4. Break Even Point (a) does not take account of extraction costs.
5. Break Even Point (b) does take account of extraction costs.

Investment in Controlled Humidity Environment facilities results in a saving of over £400,000 over a five year period for AS90s and Challenger 2 tanks.
The figure shows that the investment in Controlled Humidity Environment facilities is recouped after about three years. Over the full five year period there would be a saving of some £416,000 at constant prices through investing in the Controlled Humidity Environment facilities, equivalent to a Net Present Value of £342,000 using the standard discount rate of 6 per cent. This represents an internal rate of return on the initial investment in the Controlled Humidity Environment of some 34 per cent. The potential exists at Ashchurch to store a large number of other vehicles such as FV432 in Controlled Humidity Environments and if these and other vehicles are included the saving over a five year period rises towards £1 million. Not all vehicles can be dehumidified in the way assumed - some need the whole building to be dehumidified - but changes of methods are unlikely, on the information available, to alter the investment decision.

There are also operational benefits from storing vehicles in Controlled Humidity Environments. The physical deterioration of the vehicles would be arrested and it is likely that the vehicles would last longer than those stored conventionally. The experience of other nations of long-term storage in Controlled Humidity Environments suggests that equipment stored in this way does not suffer from lack of inspection. In addition, subsequent maintenance costs could be lower after extraction for vehicles that have benefited from a Controlled Humidity Environment. Figure 26 shows that there is a strong case for the Department to investigate Controlled Humidity Environment options wherever there is military equipment to be stored.

**The Strategic Defence Review and its impact upon the storage task**

Logistic support has received a high level of attention during the Department’s Strategic Defence Review including further rationalisation of logistics support and an increasing emphasis on joint or Service-led arrangements. The Department recognise that some of their current stockholdings have been derived from Cold War requirements, and that stocks should now normally only be held when they cannot be regenerated within the same timeframe as the forces they support. This appreciation, coupled with the Strategic Defence Review, has enabled a more fundamental review to take place.

Following the Strategic Defence Review, therefore, the Department anticipate a trend away from a stockholding culture towards a demand led system – similar to the just-in-time supply practice in the private sector. In addition to this the Department are looking to improve their business processes for logistics
through stronger IT arrangements and a better interface between those in the Department who procure equipment (the Procurement Executive) and those responsible for equipment in-Service support. And where appropriate, the Department are considering the use of existing private sector storage facilities.

3.65 All of these elements will impact upon the storage task and the Department will be well placed to consider the conclusions emerging from this Report in the light of these significant changes. In the event that greater emphasis is placed on the role of the private sector in the storage task, knowledge of modern and cost effective storage techniques, such as Controlled Humidity Environments, will be essential if the Department are to be an ‘intelligent customer’.

**Key Points**

- The Department’s investment appraisals of storage options do not fully meet the guidance for conducting such appraisals and do not give expected rates of return (paragraph 3.56).
- Under sensible assumptions, there are financial and operational benefits from applying Controlled Humidity Environments to ground equipment (paragraphs 3.61 - 3.62).
- Changes in prospect to equipment and materiel management will highlight the importance of good information on storage performance and options, including possible private sector involvement (paragraphs 3.64 - 3.65).
Part 4: Disposing of stored equipment

Introduction

During 1996-97, the Department secured receipts of over £52 million from the sale of surplus military equipment previously held in store. Important sales included four Type 22 Frigates to Brazil (revenue for two Frigates was received in 1996-97), refurbished M578 Light Armoured Vehicles to Austria and six Wessex helicopters to Uruguay. The benefits of disposal by sale are significant, not only in terms of the revenue generated, but also in the extent to which storage costs are alleviated for main equipments and associated spares. Emphasising this, the Department have established high level disposal targets for key Top Level Budget holders in each of the three Service environments. This part of the Report is concerned with how well the Department apply sound principles of planning for disposal and whether, through improved procedures, they might be able to achieve a higher impact with their disposal activity. This Report does not examine how the Department undertake marketing or sale after the point of declaration, as this area was examined in depth by the National Audit Office in their 1993 report “Disposal by Sale of Defence Surplus Equipment and Stores” (C&AG’s Report, HC 557 Session 1992-93). However, some of the recommendations made in that report are relevant to the identification of sales prospects and we have followed up the recommendations in the relevant sections.

The principles of planning for disposal

Whether considering the disposal of land, buildings or other assets, broad principles of good practice apply. The Department recognise this and have embodied these principles, along with the lessons learned from past disposals, in the form of guidance issued to each of the three Services. Figure 27 draws together these principles as a template for effective disposal planning and the following paragraphs consider how successful the Department have been in applying these principles in practice.
Disposal forecasting and advance notification to the disposal authority

4.3 All equipments have a life expectancy based on key assumptions such as expected usage, the in-Service date of replacement equipment and resource availability. Taking these and other elements into account the Department are able to plan for equipment disposal, focusing much of their effort on storage holdings, where most equipments eligible for disposal can be found. One of the key players needing to be continually kept up-to-date with this process is the disposal authority who ultimately take responsibility for timely and effective disposal of out-of-use equipment.

4.4 High level Departmental plans covering all aspects of strategic and operational importance are drawn up on an annual basis. The starting point for this process is Defence Planning Assumptions which give rise to Army, Navy and RAF Management Plans, and in turn to Top Level Budget and Agency plans. Within these, forecasts are made of the in-Service date of new equipments and, in the case of the Navy, of the decommissioning date for major equipments. Service Management Plans and, particularly, Long Term Costings which reflect these forecasts are a valuable source of information for the disposal authority, in this case the Disposal Sales Agency. The Disposal Sales Agency play a major part in deciding the sale value of major assets.

4.5 In practice, the Disposal Sales Agency find that they have to undertake a significant amount of additional pre-emptive and investigative work before marketing and disposal activity can commence. This is because beyond broad indications of likely equipment disposals, the formal notifications that the Agency
receive tend to be inaccurate and at relatively short notice. In Service-specific guidance, the Department have defined what is meant by reasonable advance notification. The Joint Services Aircraft Disposals Committee acting as a decision-making body on the disposal of surplus aircraft, are required to be informed of intended declarations two years in advance by aircraft “run-down” plans, which in turn should be circulated to all committee members. The Disposal Sales Agency state that they have never been formally provided with an adequate equipment run-down plan for any equipments recommended for disposal, and that they do not receive accurate prior notification as set out in the Department’s guidance. The Department recognise that the actual advance notification of potential disposals to the Disposal Sales Agency can be considerably shorter than the two year time frame but consider disposal forecasting to be difficult and complicated by unavoidable uncertainties over equipment out-of-Service dates and protracted introductions of new equipments.

4.6 The disposal of Gazelle helicopters examined by the National Audit Office as a part of their case study work, provides an illustration of the tensions that exist in this process (Case Study 2).

**Case Study 2:**

**The consultation process for Gazelle helicopters**

In the case of Gazelle, established procedure appeared to be working well when the Disposal Sales Agency were informed just over two years prior to declaration that 65 Gazelles might be declared non-effective and available for disposal. At the time, the Disposal Sales Agency were confident that significant sales opportunities existed and they undertook tentative marketing work. However, a decision was halted approximately one year before the anticipated target date because of uncertainty over numbers which, central planners considered, were unlikely to be resolved until the following year’s Long Term Costing cycle had been completed. Some nine months later, at about the same time as the originally conceived disposal date, the Department began to examine the scope for using a proportion of non-effective Gazelles as a source of spares, rather than in a sale agreement. And finally, a further three months later, only 17 out of the 65 aircraft originally scheduled for disposal were formally made available for sale. During this time the Disposal Sales Agency had not been provided with a run-down plan for the Gazelle fleet, or an accurate forecast of disposal numbers.

4.7 The National Audit Office found that the pattern of events illustrated in Case Study 2 was repeated for most other aircraft disposals examined, with problems between key areas of the Department, notably the Disposal Sales Agency and the Joint Services Aircraft Disposals Committee (on which the Disposal Sales Agency is represented), remaining unresolved. Tensions between the interests of the disposal authority and those of the Joint Services Aircraft Disposals Committee are to an extent inevitable as both stand to benefit from assuming ownership of surplus equipment. The Disposal Sales Agency have sales targets to which they are held accountable, whilst the Joint Services Aircraft Disposals Committee,
predominantly comprising of military logisticians and equipment operators, has a specific interest in utilising surplus equipment to assist with the activities for which its members are responsible, such as ground training or spares provisioning. In order to maximise the potential offered by all available options, the Department should seek to ensure that all parties affected by disposal, particularly the disposal authority, are accurately notified well in advance of declaration.

4.8 Similar problems are encountered with disposal planning and notification within the Army. Published notification periods differ according to the cause of disposal. For example, Army guidelines state that three to four years prior notice is required for equipments due to expire because of obsolescence, whereas one year is expected for equipments that no longer satisfy the purpose for which they were procured. Recent disposals are Rapier Field Standard B equipments and Chieftain MkII tanks. In both cases, pre-declaration timescales were less than the recommended minimum of 12 months, with the Disposal Sales Agency being informed of Rapier FSB declarations only three to six months in advance, and no warning time whatsoever provided in the case of Chieftain MkII tanks.

4.9 The problems generated by late notification of disposal opportunities were previously highlighted in the National Audit Office’s Report “The Disposal of Defence Surplus Equipment and Stores” (see paragraph 4.1). Surplus RAF and Army equipment were noted as a particular area for concern and the Department were encouraged to improve their arrangements for advance consultation through bodies such as the Joint Services Aircraft Disposals Committee. The available evidence suggests that little improvement has been made since the publication of this Report in 1993, indicating that the business of equipment disposal is still regarded as a low priority within the Department, despite previous recommendations that they should raise the profile of disposal activity.

4.10 In contrast to the declaration practices adopted by the RAF and the Army, the Navy have developed strong procedures for keeping the disposal authority closely informed of progress. The Disposal Sales Agency generally liaises well with the Naval Support Command through the Surplus Ships Committee for Disposals and Commercial Sales. At least 18 months prior notice is given to the Committee for each ship disposal although difficulties are inevitably encountered where revisions to replacement ship in-Service dates occur and as a result of wider Departmental reviews. The planning arrangements for ship disposals also assist the Department in selling ships that are fully operational and as such have not spent any time in extended preservation. This is particularly important where annual storage costs can be in the order of £5 million for each ship.
**Thorough assessments of disposal costs and revenues and the scope for alternative equipment use**

*4.11* As with other Government Departments, the Department are coming under increasing pressure to achieve efficiency gains, to dispense with non-essential business and to demonstrate value for money in all their activities. These concepts have found expression in routine decision processes such as Investment Appraisals and Cost-Benefit analyses used to evaluate competing options, for example with major equipment procurements. The opportunities presented by surplus equipment are numerous and require assessment in the same way to ensure that optimum decisions are reached. For surplus aircraft these options can include:

- disposal by scrapping;
- disposal by sale;
- usage as a spares source;
- alternative use as Ground Instructional Aircraft; and
- alternative use in a Battle Damage Repair/Fire Training role.

*4.12* For each aircraft or group of equipments eligible for disposal, the Department need to select the option that offers the best value for money. This means being able to identify all the elements of cost and benefit associated with each option, and comparing them on an equitable and systematic basis. The National Audit Office examined the assessments undertaken by the Department for each of the four aircraft case study equipments – Wessex, Gazelle, Hercules, and Tucano. These illustrated that a degree of assessment took place in all cases but that the quality of assessments varied, with only one instance of a thorough appraisal – that of the sale of Wessex helicopters.

*4.13* An example of the quality of the assessments undertaken is given in the case of Gazelle helicopters, first evaluated by the Department in January 1997 (Case Study 3).
Case Study 3: The quality of disposal assessments

The Department explored the implications of Gazelle disposal, particularly with regard to the prospect of using Gazelles as a source of spares. An analysis performed by the Support Authority estimated savings of over £400,000 for each aircraft thought to arise through “breaking up” aircraft and directing the spares recovered into the provisioning system. Their estimate was subject to a caveat that the potential cost-benefit of spares recovery would not be realised for every single aircraft and would depend on life remaining to the next overhaul and the serviceability of each asset when removed. Six months later, however, the Support Authority responsible for this calculation significantly revised their savings estimates downwards to £100,000 per aircraft explaining that key elements such as the “life consumed on the assets before...disposal”, along with “the cost of removal of assets and storing them before they are needed” had been “ignored”. Finally, the Support Authority recognised that the revised estimate of the value of spares - a quarter of that originally calculated - “still ignored the (Department’s) need for a smaller pool of spares to support the reduced size of the Gazelle fleet”. The difference in savings between these two assessments if applied to the number of airframes originally considered is in the region of £6 million.

4.14 In the above Case Study it was apparent that not only had the Department’s initial and subsequent assessment failed to produce a thorough and reliable assessment of the costs and benefits associated with one option, that of spares recovery, but that they had not brought together the competing bids for other uses and compared them on an equitable basis. This is partly explained by the procedure adopted in considering the destiny of surplus aircraft. Departmental guidelines clearly state that the highest priority will normally be given to the use of surplus aircraft to support the operational fleet, such as by spares recovery or for structural integrity evaluation. Priorities then flow from training and engineering use down to disposal by sale - the lowest priority. The National Audit Office consider that in adopting this priority system the Department are constrained in their ability to weigh up the relative cost and benefits of the available options. As a result it is difficult for the Department to demonstrate that they have selected the option that offers the best value for money, although Case Study 3 the checks and balances inherent to the system resulted in the overvaluation being addressed before any work had taken place to recover parts.

4.15 During the course of the National Audit Office study, the Department introduced the requirement within the Joint Services Aircraft Disposals Committee for an abbreviated form of economic appraisal to accompany proposals for the use of surplus aircraft. The National Audit Office note that this initiative offers the prospect of making an important contribution to future decision-making.
The situation with surplus Army and Navy equipment is somewhat different as the relative merits of competing options tend to be more clear cut. For example, the case for selling rather than retaining ships in any capacity is particularly persuasive. The direct revenues arising from the sale of two Type 22 Frigates to Brazil in 1996-97 were in the order of £30 million, whilst other benefits included Essential Work Packages provided by British industry and remuneration to the Royal Navy for preliminary sea training of Brazilian crews. Conversely, with surplus Army equipment the comparatively small sale values that can be achieved militate in favour of alternative use or scrap. Existing procedures dealing with Army and Navy equipment do not call for formal appraisals of the different disposal options, although consultation and a form of consideration does take place in all cases.

Key Points

- Declarations of prospective land equipment and aircraft equipment disposals have not always provided the notice required in Departmental guidance, to the detriment of marketing of the equipment to potential buyers, and despite previous National Audit Office recommendations (paragraphs 4.6 - 4.9).
- The system for dealing with a relatively low number of high-value ship disposals has, by contrast, worked well (paragraph 4.10).
- Appraisal of disposal options for aircraft was weak in three out of four cases examined, and over-constrained by the standard set of priorities applied to various disposal options (paragraph 4.12).
- Disposal options for land equipments tend to favour scrap or spares use, and for naval vessels sales, because of the relatively low and high respective sale values obtainable (paragraph 4.16).

Assessing and maintaining the condition of surplus equipment

The condition of surplus equipment greatly influences the disposal options available. In most cases, equipment will have remained in Service for many years prior to declaration and will have reached a point where a number of “lifed” components are due to expire. Others may have performed well beyond their anticipated Service life and will have relied on Mid Life Updates or specific life extension programmes in order to do so. From this perspective, it is possible to make broad assumptions about the material condition of most surplus equipments as they are declared and to form general views on the scope for sale or alternative use. However, detailed technical information on equipment condition provides a very important amplification of this. For example, in determining the value of spares recovery work it is important that information is readily available on the
age of equipment components and their rate of deterioration. Otherwise, equipments may be “broken up” for spares only to find that they are near the end of their life or that unacceptable wear and tear has taken place. In the case of four Upholder submarines currently held at Barrow-in-Furness, comprehensive information on their material condition was essential to the marketing task, and the Defence Export Sales Organisation could not have hoped to secure any agreement without providing this information to prospective purchasers. (The Department have now successfully agreed a leasing arrangement for all four submarines.)

4.18 In examining the Department’s procedures for assessing the condition of surplus equipment and acting upon the decisions reached, the National Audit Office found that:

- delays in disposal declaration and revisions to initial forecasts, in turn, caused delays to technical assessments;

- technical assessments were usually undertaken, but varied widely in their comprehensiveness;

- notification given to the disposals authority rarely exceeded three months; and

- in a number of instances, important components were removed from equipment after disposal declaration.

4.19 These observations applied to Army and RAF disposals, rather than Navy ship declarations which were few in number and were the subject of thorough and timely structural surveys.

4.20 Illustrating the significance of these points is the revenue that can be achieved through sale of equipments, such as aircraft, whose condition is known and generally sound. In July 1997 six Wessex helicopters were sold to Uruguay achieving revenues of over £1.5 million for the Department, whilst estimates of the value of 17 Gazelles recently declared non-effective are just under £3 million. Tucano training aircraft, still relatively young and scheduled for disposal in the next 6-12 months, may attract revenues in excess of £5 million, and possibly more if further airframes are declared available (Case Study 4).
Case Study 4: The treatment of Tucano aircraft after disposal declaration

In the case of Tucano aircraft, the tail numbers of specific surplus aircraft were notified to the Disposal Sales Agency some two months after declaration, following which the Agency were expected to contact the Tucano Support Authority to seek technical information on their condition. The process of marketing surplus Tucanos had already been hindered by protracted decision making only to be delayed further by the late notification of the condition of the aircraft. To compound the difficulties this had created, a programme involving the removal of propellers commenced a few months later, leading to a number of aircraft originally earmarked for disposal being exchanged for different Tucanos. This was a sensible response to the proven unreliability of the blades on operational Tucanos, but nevertheless had a negative knock-on effect on the marketing campaign. This example highlights both bad and good practice in the use of non-effective aircraft.

On the maintenance of surplus RAF and Army equipment the National Audit Office found that in accordance with the Department’s instructions for the disposal of non-effective aircraft at the point of equipment declaration for disposal, maintenance usually ceased and budgetary provision for equipment upkeep was removed. Illustrating this, most aircraft held at RAF Shawbury pending disposal are transferred from one of the controlled humidity hangars on site to a separate unheated and un-dehumidified hangar, where no maintenance, routine or otherwise is undertaken. Furthermore, as previously highlighted in the National Audit Office’s “Disposal by Sale of Defence Surplus Equipment and Stores” Report (see paragraph 4.1), and confirmed by subsequent analysis undertaken for this study, parts are often removed from those aircraft held in store. Although such actions are permitted by the Department’s regulations the removal of parts diminishes the value of the aircraft. In contrast, the Defence Estates Organisation, responsible for the care and upkeep of all defence land and buildings, have dedicated maintenance funds for all surplus assets. In 1996-97 alone the Department spent a sum equivalent to approximately 20 per cent of the value of property sales on the maintenance of surplus land and buildings.
4.22 The Defence Estates Organisation approach is mirrored in the treatment of stored naval vessels pending disposal which are routinely maintained to minimise deterioration. However, the upkeep period to which this applies is often very brief as the Navy and the Disposal Sales Agency actively plan to achieve “hot sales”, which enable vessels to pass seamlessly from Naval ownership to that of the purchaser without entering a state of preservation. The financial rewards of this strategy are usually far greater than with “cold sales”, not least because the costs of main platform and ancillary spares storage, along with ship maintenance, are entirely avoided.

4.23 It is important to note that Treasury guidance on the treatment of surplus assets disallow ‘speculative’ expenditure for the purposes of enhancing sale or disposal values. This may in part explain the Department’s reluctance to allocate continued funding to equipments selected for disposal. However, maintenance expenditure on surplus Government assets is allowed under Treasury guidance and the Department should be alert to the benefits that can accrue as a result and actively weigh-up the costs and benefits of continuing to undertake maintenance work on surplus assets.

**Disposal timetabling and the use of revenue estimates**

4.24 The Department have recognised the value of agreeing estimates for equipment disposal activity and forecast revenues within each of their annual Service Management Plans. These estimates are also embodied within Long Term Costings which are one of the major budgetary disciplines to which the Department work. The status of these estimates is therefore taken seriously and variations from estimated levels provoke considerable effort to try to establish the cause. The Disposal Sales Agency also establish sales performance targets to which they are held accountable. For the year 1996-97 the revenue target for sales of ships, armaments and aircraft was £50.5 million, which the Agency successfully achieved.

4.25 The Disposal Sales Agency told the National Audit Office that despite its good track record in revenue estimation, it had encountered difficulties in setting targets because of poor advance notification of surplus aircraft and Army equipments. The National Audit Office recognise that advance forecasting of disposals is difficult and heavily influenced by factors outside the control of those declaring equipments available for disposal, but consider it to be an important area on which the Department should continue to concentrate their efforts. Fortunately, the majority of government to government sales which attract the greatest revenues are accounted for by Naval vessels, which the Agency have
found to be identified well in advance by the Department. Furthermore, the Navy Management Plan has proved to be a reliable predictor of ship disposals, and despite sudden policy shifts and delays to replacement programmes, such as that for Type 42 vessels, the Disposal Sales Agency have found planning and estimation within the Navy to be sound.

The case study of the Tucano aircraft helps to illustrate some of the problems with timetabling disposal action (Case Study 5).

**Case Study 5:**

**The disposal of Tucano aircraft**

Between 40 and 50 Tucano trainer aircraft have been held in store for over two and a half years, while the Department have attempted to determine the utility of those aircraft that exceed the training task. Based on the Department’s own calculations in February 1995, 50 Tucano aircraft were surplus to requirement for pilot training - a number that had previously increased dramatically following the recommendations of Defence Costs Studies. Allowing for a prudent attrition estimate of 20 aircraft and an extension of the out-of-Service date for the fleet, the Department concluded that there were 30 aircraft for which a decision had to be made. The following table sets out the chronology of events that led to the final decision to remove 15 aircraft from storage for disposal. It should be noted that in the case of Tucano high level managers within the Department - such as the Commander-in-Chief Headquarters Logistics Command - were pivotal to the decision-making process.

On uncertainty, the Department examined a variety of factors, including rate of usage, out-of-Service data and outturn rates, about which assumptions had to be made and which affect the keep or sell argument. In moving between the first and second appraisals, the Department adopted more conservative assumptions. By comparison with good appraisal practices, these appraisals had a number of shortcomings:

- in defining options, any option which could lead to subsequent shortages of Tucano aircraft was not fully pursued in that the options for responding to such shortages were not developed or costed;
- in dealing with uncertainties, the analysis did not establish a “most likely” scenario, nor did it estimate the likelihood of less likely scenarios; and
- assumptions have been valued in a way which maximises the need for retaining aircraft (for example, defining an attrition reserve five times larger than five years experience indicated as the most likely value and increasing the number of flying hours required above planned levels, while adopting ‘minimum’ assessments of potential sales revenue).

By dealing with uncertainty and estimates in this conservative way, the marginal costs and benefits of keeping or selling aircraft were obscured - and in this case, disadvantaged the case for more disposals.

continued...
Case Study 5: The disposal of Tucano aircraft continued

On organisational and budgetary matters, the decision time was lengthened by the large number of people involved in taking the decision, including the Equipment Manager, Air Training Staff, the central RAF Committee, the Joint Services Aircraft Disposals Committee and the Disposal Sales Agency. Furthermore, the budgetary incentives to maximise revenue are centered on provision in the Department’s Long-Term Costings - provisions which are deliberately conservative to avoid revenue shortfalls in any given year causing overall budgetary problems. These arrangements are likely to avoid unprofitable or over-hasty disposal of equipment, but are unlikely to promote cost-effective equipment disposal.

Chronology of Events Concerning “Surplus” Tucano Aircraft

<table>
<thead>
<tr>
<th>Date</th>
<th>Area of Department</th>
<th>Key Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 14, 1995</td>
<td>RAF Equipment Manager (SM69 RAF)</td>
<td>Investment Appraisal (IA) proposes disposal of 30 aircraft.</td>
</tr>
<tr>
<td>Jun 20, 1995</td>
<td>RAF Air Office Training (AOT)</td>
<td>Confirms proposal to sell 30 aircraft.</td>
</tr>
<tr>
<td>Sep 14, 1995</td>
<td>RAF Air Office Training (AOT)</td>
<td>Second IA suggests selling 15 aircraft “with possibility of more later”.</td>
</tr>
<tr>
<td>Dec 19, 1995</td>
<td>Central RAF Committee (Air Force Board)</td>
<td>Confirms that disposal of 15 aircraft would be “robust”.</td>
</tr>
<tr>
<td>Apr 10, 1996</td>
<td>Central RAF Committee (Air Force Board)</td>
<td>Confirms that 15 aircraft will be sold with another 2-4 possible later.</td>
</tr>
<tr>
<td>May 16, 1996</td>
<td>Joint Services Aircraft Disposals Committee (JSADC)</td>
<td>Informed Disposal Sales Agency (DSA) of “no objection to considering tentative disposal arrangements for these, but any overt advertising on sales activity should await their formal declaration for disposal from D Air Plans”.</td>
</tr>
<tr>
<td>Sept, 1996</td>
<td>Disposal Sales Agency (DSA)</td>
<td>Queries JSADC’s intentions.</td>
</tr>
<tr>
<td>Apr 8, 1997</td>
<td>Joint Services Aircraft Disposals Committee (JSADC)</td>
<td>Instructs DSA to halt marketing as surplus aircraft may be used in a ground training role.</td>
</tr>
<tr>
<td>Apr 15, 1997</td>
<td>Disposal Sales Agency (DSA)</td>
<td>Internal memo illustrates DSA’s frustration at Personnel and Training Command, with JSADC “inventing” a use for the aircraft to overcome the “sales disposal decision”.</td>
</tr>
<tr>
<td>Oct 1, 1997</td>
<td>Joint Services Aircraft Disposals Committee (JSADC)</td>
<td>Tucano marketing activity resumed. No sale as yet made.</td>
</tr>
<tr>
<td>Oct/Nov 1997</td>
<td>Joint Services Aircraft Disposals Committee (JSADC)</td>
<td>Marketing suspended while possible RAF training requirement considered.</td>
</tr>
</tbody>
</table>

The decision-making process in assessing the scope for Tucano disposal has been unco-ordinated and subject to delay.

Source: National Audit Office
The impact of the Department’s disposal strategy and the scope for improvement

4.27 The Department have established procedures for surplus equipment disposal which have enabled them to achieve many of their core objectives. These include:

- ongoing reductions in storage costs for main and ancillary equipments;
- revenues from equipment sale;
- the cost-effective provision of scarce equipment components; and
- the continued availability of training equipment, particularly for engineer and ground training purposes.

4.28 However, the observations made in this Report highlight key weaknesses that have largely remained un-addressed since the National Audit Office last examined the subject in 1993. Drawing together these themes, Figure 28 sets out the main areas where the Department could seek to make improvements to their existing strategy and in doing so strengthen its disposal impact.
The full implementation of these measures, taken together with the revisions to budgetary systems and accounting noted earlier, should improve the cost-effectiveness of the disposal options selected. For example, the National Audit Office have identified opportunities for increased disposal income, and reduced storage costs. For the equipments examined in detail as part of this study, Annex A details the potential for extra sales income of the order of £8 million with reduced storage costs of around £1.5 million. While these numbers are indicative, and dependent on a range of assumptions that are subject to refinement, they illustrate the scope for improvement that exists in the disposal of stored equipments.

4.29 The Department should routinely forecast major equipment disposals of all categories and incorporate their projections in high level Service Management Plans. Where the Department consider the 2 year advance notification period to be unreasonable, mutually agreeable notification timescales should be established.

- The sale potential of all surplus major equipments should be thoroughly assessed at the same time as equipments are evaluated for alternative uses.

- Taking into consideration the disposal option selected, the Department should systematically weigh up the costs and benefits of continuing maintenance and anti-deterioration work.

- The Department should aim to shorten the time it takes to identify and dispose of surplus equipment.

There is scope for the Department to make significant improvements to their disposal strategy.
Annex A

Estimate of savings arising from alternative disposal action

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Calculation</th>
<th>Saving (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tucano Trainer Aircraft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Department recommended the sale of 15 Tucano aircraft in April 1996 based on a formal Investment Appraisal. However, the National Audit Office consider that in the light of earlier Departmental appraisals, the forecast need for Tucanos until 2010, and current assumptions of aircraft fatigue, the Department could instead dispose of up to 30 aircraft without placing the training task at risk. Savings have been calculated on the premise that:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. <strong>Increased volume of sales</strong></td>
<td>30 a/c @ £0.25m</td>
<td>£7.5m</td>
</tr>
<tr>
<td></td>
<td>less 15 a/c @ £0.25m</td>
<td>saving £3.75m</td>
</tr>
<tr>
<td>2. <strong>Fewer modifications</strong></td>
<td>30 a/c @ £38,760</td>
<td>£1.16m</td>
</tr>
<tr>
<td></td>
<td>less 15 a/c @ £38,760</td>
<td>saving £0.58m</td>
</tr>
<tr>
<td>3. <strong>Shorter storage period</strong></td>
<td>30 a/c @ £42,218</td>
<td>£1.27m</td>
</tr>
<tr>
<td></td>
<td>less 15 a/c @ £42,218</td>
<td>saving £0.58m</td>
</tr>
<tr>
<td><strong>Total savings</strong></td>
<td>sub total saving</td>
<td>£5.6m</td>
</tr>
</tbody>
</table>

| **Gazelle Helicopters** | | |
| As a result of the introduction of the Defence Helicopter Flying School, 75 per cent of the Gazelle fleet have been declared surplus and available for disposal. Rather than undertaking a spares recovery programme as originally intended by the Department, the National Audit Office consider that a higher level of return could be achieved through disposal by sale. | | |
| 1. **Sale instead of spares recovery** | 50 a/c @ £150,000 | £7.5m |
| | less 50 a/c @ £100,000 | saving £2.5m |
| **Total savings** | sub total saving | £2.5m |

| **Hercules Tankers** | | |
| The Department declared four Hercules aircraft available for disposal and the DSA have commenced marketing work. However, as a direct result of not undertaking restoration work to the aircraft, the Department may have lost the opportunity to maximise the sales potential of disposal. | | |
| 1. **Sale following restoration work** | sale revenue | £8.0m |
| | less cost of restoration | saving £0.2m |
| **Total savings** | subtotal savings | £1.8m |

**Total savings** £9.9m

Source of Data:
Note 1: Estimates provided by Disposal Sales Agency.
Note 2: Estimates provided by Tucano Support Authority.
Note 3: Estimates provided by storage facility.
Note 4: Estimates provided by Helicopter Support Authority.
Note 5: The figures used for sale revenues for all equipments are based on estimates provided by the Disposal Sales Agency, which in turn are based on current market conditions. In some cases, market values may vary for individual equipments and the revenue achieved may be lower than estimated. In the case of Gazelle, should the sale value fall below £100,000 per aircraft the Department would opt for spares recovery instead of sale.
Annex B

The National Audit Office’s use of Cognitive Mapping

1. In examining the Department’s approach to defence equipment storage, the National Audit Office employed an analytical technique known as Cognitive Mapping to understand how the Department make decisions on equipment storage and disposal. The technique is well established, having originally been used within the field of Operational Research, and now used more generally as a methodology for mapping individuals’ perceptions of organisational functions.

2. The starting point for this work was to identify the key decision-makers involved in the chain of command for equipment storage and disposal. The list, which was agreed with the Department, comprised 13 key officials including Central Plans staff from all three Services, Equipment Support Authorities from all three Services, Storage Organisations, the Disposal Sales Agency, Equipment Disposal Committees and Top Level Budget (TLB) holders. Separate interviews were then undertaken with each of the key players so that Cognitive Maps could be drawn up.

3. The technique required Departmental staff to describe the activities that they undertook to achieve their goals - in this case relating to equipment storage and/or disposal - and to highlight the factors that they felt influenced their ability to do so. These elements were represented graphically during the course of each interview as a map linking activities and the influences on those activities. For example, the interviewee may have been responsible for generating information for another member of staff and may have found this easy because of a new computer system. These two related factors would be connected by a line to represent that one has an influence on the achievement of the other. An illustration of a Cognitive Map is provided on the next page.

4. The results assisted the National Audit Office in the following areas:
   - in mapping the organisational structure of the Department with regard to equipment storage and disposal;
   - in developing an understanding of the responsibilities and accountabilities of each of the players involved;
   - in identifying the incentives and disincentives at play in decision-making; and
   - in identifying the tensions in the decision-making system.
Cognitive Map generated by Vehicle Depot Manager at Ashchurch

Main objective: Receive, store, maintain and issue vehicles cost-effectively (100 per cent of job)

Key: (-) those factors that have a negative influence on the achievement of key objectives

This map highlights the main influences on the depot manager in fulfilling the central goal of his work (outlined at the top). Many of the themes brought out in this map were mirrored in the responses from the other key players interviewed.
## Annex C

### Case study equipments examined by the National Audit Office

<table>
<thead>
<tr>
<th>No.</th>
<th>Equipment</th>
<th>Number in store</th>
<th>Storage location</th>
<th>Storage reason and comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tucano aircraft</td>
<td>44</td>
<td>RAF Shawbury (CHE storage)</td>
<td>As a result of reductions in the training task and the need to retain an attrition reserve, between 40-50 Tucanos have been held in store for the past four years. This Report concluded that the Department could reduce storage costs and increase revenues through the earlier sale of greater numbers of surplus Tucano aircraft.</td>
</tr>
<tr>
<td>2</td>
<td>Gazelle helicopters</td>
<td>32</td>
<td>RAF Shawbury &amp; NARO Fleetlands (CHE storage)</td>
<td>The formation of the Defence Helicopter Flying School resulted in significant reductions to the Gazelle fleet and existing aircraft declared as non-effective. The Department have been faced with a range of disposal opportunities that have had to be addressed in a relatively short space of time. In some areas the Department could have undertaken more thorough and robust Investment Appraisals in doing this.</td>
</tr>
<tr>
<td>3</td>
<td>Wessex helicopters</td>
<td>13</td>
<td>RAF Shawbury (CHE storage)</td>
<td>The Wessex fleet is currently undergoing a reduction in size and will in part be replaced by Sea King helicopters and by the formation of the Defence Helicopter Flying School. The Department have successfully disposed of surplus Wessex in Hong Kong as part of a “hot sales” agreement - thus minimising pre-disposal storage costs. Lessons from this experience could usefully be drawn across to current disposal opportunities.</td>
</tr>
<tr>
<td>4</td>
<td>Hercules tanker aircraft</td>
<td>4</td>
<td>Marshall of Cambridge premises (stored outside)</td>
<td>Previously converted Hercules tankers ceased active flying towards the beginning of 1996 and were placed at contractor premises for storage (as existing RAF facilities were not large enough to accommodate them). Several unsuccessful attempts have been made to dispose through sale. Strong indications are that the Department could increase its net sale revenue through undertaking some essential restoration work.</td>
</tr>
<tr>
<td>5</td>
<td>RB44 heavy utility trucks</td>
<td>318</td>
<td>BVD Ashchurch (depot storage - no CHE or heating)</td>
<td>318 RB44s have remained in storage at Ashchurch for 4-6 years whilst the Department have explored technical problems presented by the braking system (found after production vehicles were delivered and accepted “off-contract”). A technical solution has been identified and modified RB44s will be rolled-out to the Army during 1998.</td>
</tr>
</tbody>
</table>

continued…
<table>
<thead>
<tr>
<th>No.</th>
<th>Equipment</th>
<th>Number in store</th>
<th>Storage location</th>
<th>Storage reason and comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Truck Utility Light &amp; Truck Utility Medium &quot;Land Rovers&quot;</td>
<td>687</td>
<td>BVD Ashchurch</td>
<td>During the middle of 1996 production Land Rovers were delivered to the Army's storage depot in Ashchurch. Soon after, reliability problems were discovered which halted further deliveries until the contractor could demonstrate that reliability targets could be met. These in part were satisfied. Contract negotiations are underway with Land Rover to recover the costs of storage after delivery.</td>
</tr>
<tr>
<td>7</td>
<td>FV430 series Armoured Vehicles</td>
<td>269</td>
<td>BVD Ashchurch</td>
<td>Most FV430 vehicles have been in store for over three years and have remained there as a fatigue management tool pending the introduction of the Multi Role Armoured Vehicle (MRAV) in 2007. Many of these vehicles however are very old and offer a very low prospect of ever being returned to Service before disposal unless, as has been the case in the past, they have been required for warlike operations.</td>
</tr>
<tr>
<td>8</td>
<td>HMS Intrepid Landing Platform Dock</td>
<td>1</td>
<td>Portsmouth Naval Base (docked)</td>
<td>HMS Intrepid, one of two LPD vessels was placed in storage (in a state of &quot;extended readiness&quot;) in 1990 and is expected to remain so until 2001. The storage decision was a pragmatic approach to cost reduction whilst still achieving the required capability. However, significant doubts have been raised over Intrepid's ability to meet formal readiness targets and the Department may need to re-consider the current declaration.</td>
</tr>
<tr>
<td>9</td>
<td>Upholder Class submarines</td>
<td>4</td>
<td>VSEL premises Barrow-in-Furness (docked)</td>
<td>In 1994 the Department withdrew four Upholder Class submarines from Service as part of a savings measure for the 1993 Defence Programme. The Department's current strategy - to sell all four submarines to the same buyer - has now been successful with the Canadian Government's recent decision to lease all four submarines for eight years.</td>
</tr>
<tr>
<td>10</td>
<td>Nuclear submarines</td>
<td>11</td>
<td>Rosyth Royal Dockyard &amp; Devonport Naval Base (docked)</td>
<td>Eleven nuclear submarines are currently held in store awaiting their safe disposal, planned to commence in 15 years once the residual radio-activity in the reactor compartment of each vessel has subsided to an acceptable level. Problems remain with the final disposal because of halted plans to build a nuclear waste repository in Sellafield. This may have a costly impact on the future storage task, particularly as more nuclear submarines come out of Service.</td>
</tr>
</tbody>
</table>

Note: CHE = Controlled Humidity Environment