

**Health & Safety Executive  
HM Nuclear Installations Inspectorate**

**AWE plc's strategy  
for the decommissioning of its  
nuclear licensed sites**

A review by HM Nuclear Installations Inspectorate

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## Foreword

This report sets out the findings of a review by the Health and Safety Executive's Nuclear Installations Inspectorate (NII), in consultation with the Environment Agency, of the decommissioning strategy for the nuclear sites operated by Atomic Weapons Establishment (AWE) plc. It has been undertaken in accordance with the Government White Paper, "Review of Radioactive Waste Management Policy: Final Conclusions" (Cm 2919) published in 1995.

This report considers the Aldermaston and Burghfield sites in Berkshire for which AWE plc holds the nuclear site licences. It focuses, however, on the Aldermaston site, as the vast majority of the nuclear liabilities are associated with that site.

The review considers AWE's strategy in relation to regulatory guidance, the underlying assumptions made, and whether the plans are comprehensive and appropriate. AWE's internal mechanisms to quantify the tasks and the necessary liability provisions are reviewed.

Our overall conclusion is that, based on current knowledge, the strategies proposed by AWE for the decommissioning and remediation of its sites are generally appropriate, so far as they have been defined. There are several areas, however, where AWE needs to develop its strategies before the next quinquennial review. We intend to review the situation again in five years time to ensure that progress with the strategies is being maintained and that they remain appropriate should new information change current assumptions. We welcome the fact that AWE has identified proactive management of its liabilities as a major driver to the success of the company, and we will continue to work with AWE as part of our routine regulatory work to encourage delivery of the programmes.

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# 1 INTRODUCTION

1 The White Paper (Cm 2919) (Ref 1) on radioactive waste management policy states in paragraph 124 that: “The Government believes that, in general, the process of decommissioning nuclear plants should be undertaken as soon as it is reasonably practicable to do so, taking account of all relevant factors. In future, it will ask all nuclear operators to draw up strategies for decommissioning their redundant plant. These will need to include justification of the timetables proposed and demonstration of the adequacy of the financial provision being made to implement the strategies.”

2 The White Paper concludes that there are a number of potentially feasible and acceptable decommissioning strategies for nuclear power stations and other nuclear facilities available to the operator. To ensure that the operators’ decommissioning strategies remain soundly based as circumstances change, the White Paper places a requirement (in paragraphs 126, 127 and 183) that the Health and Safety Executive (HSE) reviews these strategies quinquennially, in consultation with the environment agencies. HSE asked HM Nuclear Installations Inspectorate (NII) to undertake the reviews on its behalf. NII is one of the specialist inspectorates of the HSE.

3 The White Paper records the importance of ensuring that appropriate financial arrangements are in place to cover the cost of decommissioning nuclear facilities and concludes that segregated funds should be established for those parts of the industry that are privatised. In the case of the Atomic Weapons Establishment, the work that created the liabilities was carried out for the Government, and the sites and facilities are owned by the Ministry of Defence (MoD). They are operated, however, by AWE plc under a ‘Government-Owned Contractor Operated’ (GOCO) arrangement. Although the financial provision for state owned industry is not contained in segregated funds, NII expects state owned industry to describe the corresponding funding arrangements in their quinquennial review submission (Ref 2).

4 Licensees’ plans for decommissioning are subject to regular revision as knowledge and circumstances develop. Each licensee’s arrangements for decommissioning are reviewed once every five years and each review considers the technical adequacy of these plans as well as the costs associated with their implementation.

5 This report presents the outcome of NII’s quinquennial review of the decommissioning strategy of AWE plc as described in documentation submitted to NII in November 2001. It addresses the nuclear liabilities on the Aldermaston and Burghfield nuclear licensed sites.

6 The report is structured as follows:

- Section 2 provides background information to the review with a summary of the decommissioning strategy for each site;
- Section 3 presents the findings of the review;

- Section 4 presents the overall conclusions.

## **2 BACKGROUND INFORMATION**

### **2.1 Work required of HSE**

7 The White Paper on radioactive waste management policy identifies two specific aspects of decommissioning for independent review. These are the 'strategy' (i.e. the overall approach and programme) for the work and 'provisioning' (i.e. the funding). HSE was given the task of reviewing the decommissioning strategies of each nuclear operator on a five-year cycle which, by inference, includes the arrangements for funding.

8 This review has been undertaken in consultation with the Environment Agency. Although Cm 2919 does not specifically require publication of the outcome of quinquennial reviews such as this one, the document clearly envisaged that the findings would be reported.

9 The breadth, extent and detail of the review process are not specified in the White Paper. NII has interpreted this task in the manner described in the internal guidance for inspectors, which has been published on the HSE/NSD web site (Ref 2). This review has considered whether AWE's decommissioning strategy is:

- appropriate;
- plausible, realistic, technically practicable and appropriately timed;
- comprehensive; and
- appropriately costed.

10 NII has interpreted "decommissioning" as being "the set of actions taken at the end of a nuclear facility's operational life to take it permanently out of service with adequate regard for the health and safety of workers and the public and the protection of the environment. The ultimate aim of decommissioning is to make the site available for other purposes" (Ref 2). This review has therefore considered AWE's strategies for the decommissioning of its redundant nuclear facilities, the management of radioactive wastes, and the restoration of contaminated ground.

### **2.2 Legislative background**

11 The main legislation governing the safety of nuclear installations in the UK is the Health and Safety at Work etc Act 1974 (HSWA 74) (Ref 3) and the associated relevant statutory provisions of the Nuclear Installations Act 1965 (as amended) (Ref 4). Under the Nuclear Installations Act 1965 (NIA 65), no site may be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence has been granted by the HSE. The NII is the part of HSE responsible for

administering this licensing function and enforcing NIA 65 and HSWA 74 on nuclear sites.

12 NIA 65 provides HSE with powers to attach conditions to the licence in respect of safety and in respect to the management of nuclear matter, which includes radioactive waste. HSWA 74 provides the regulatory powers to enforce these conditions. The original standard licence conditions are reproduced in Ref 5. In 1999, an additional licence condition was introduced which addresses the control of a licensee's organisational change related to the management of safety.

13 Licence Condition 35 requires that adequate arrangements are made and implemented for the decommissioning of any plant or process that may affect safety, and that adequate arrangements are made for the production and implementation of decommissioning programmes for each plant. Furthermore, the licensee is required to provide adequate documentation to justify the safety of proposed decommissioning and, where appropriate, provide this documentation to the HSE. By these provisions, NII has the power to require each licensee to supply it with the details and programmes of its decommissioning proposals. This information is supplied to HSE under the terms of HSWA 74 and hence has certain restrictions on disclosure.

14 The routine regulation of licensees' decommissioning work by the NII relates generally to individual plants and facilities. This is overlain on complex sites by a site-wide programme that prioritises the work and ensures the maintenance of facilities on which other plants will subsequently depend for their decommissioning. Each licensee's operating arrangements are regulated by NII and incorporate good practice. They are designed to satisfy the obligation placed on the licensee by the conditions attached by the nuclear site licence. NII's expectation is that these arrangements would include:

- for any new plant, the preparation of an outline decommissioning plan which shows that the design of the plant will facilitate its safe decommissioning and dismantling;
- minimising the generation of waste and contamination of plant during the active commissioning, operational and decommissioning phases of the plant;
- plant operations to take due account of the need to decommission and to make and retain adequate plant records;
- prior to the end of the operational phase of the plant, the preparation of detailed decommissioning plans; and
- the undertaking of decommissioning work in accordance with an adequate safety case. If NII so specifies, consent is required before decommissioning work can be started.

15 The authorisation of discharges and disposal of radioactive waste arising from operations and decommissioning is regulated by the relevant environment agency

under the terms of the Radioactive Substances Act 1993 (Ref 6). The management of nuclear matter (including radioactive waste) on nuclear licensed sites is regulated by NII. Formal administrative arrangements (Refs 7 and 8) ensure that NII and the environment agencies work closely together to ensure compliance with requirements.

16 In addition to these regulatory activities, and as part of the quinquennial review, NII has examined AWE's activities in two other areas:

- first, to consider the adequacy of the long term plans for the eventual removal of all the nuclear liabilities from the two licensed sites;
- second, to consider briefly the arrangements for funding AWE's liabilities so that the work may proceed.

17 The Nuclear Installations Act 1965 places significant obligations and responsibilities on the licensee. Under current legislation, the licensee's period of responsibility does not end until the HSE is able to declare that there is no danger from ionising radiations from anything on the licensed site (Sections 3(6) and 5(3) of NIA 65). It is assumed that the licensee will ultimately wish to be relieved of these responsibilities after the useful life of the nuclear installation has ended, and will plan the decommissioning of individual sites to achieve this.

## **2.3 Regulatory guidance**

18 NII has produced internal guidance for inspectors entitled "Decommissioning on Nuclear Licensed Sites" (Ref 2). The objectives of the guidance are to draw together those aspects of legislation, Government policy and international standards which are relevant to the work of NII in regulating decommissioning, and to provide a framework for the inspection and assessment of decommissioning on a consistent basis.

19 NII has four fundamental expectations for decommissioning, which should be met so far as is reasonably practicable. These expectations, which are consistent with current Government policy, are as follows:

- in general decommissioning should be carried out as soon as is reasonably practicable, taking account of all relevant factors;
- hazards associated with the plant or site should be reduced in a progressive and systematic manner;
- full use should be made of existing routes for the disposal of radioactive waste; and
- the remaining radioactive material and radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long term solution.

20 NII has also produced internal guidance for inspectors entitled “Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites” (Ref 9) which complements the guidance on decommissioning.

21 NII has two additional fundamental expectations concerning the management of radioactive materials and radioactive waste on nuclear licensed sites, which should also be met so far as is reasonably practicable. These are:

- the production of radioactive waste should be avoided. Where radioactive waste is unavoidable, its production should be minimised;
- radioactive material and radioactive waste should be managed safely throughout its life cycle in a manner that is consistent with modern standards.

22 The HSE/NSD web site (Ref 10) has a more detailed discussion of these fundamental expectations and other topics. This review of AWE’s strategy has been undertaken in accordance with the NII guidance.

## **2.4 AWE sites**

23 The Atomic Weapons Establishment has been providing and maintaining the warheads for the UK’s nuclear deterrent for more than 50 years. AWE’s priority role over the next 20 to 30 years will be to maintain the Trident warheads safely and effectively in service. This work is centred at the two sites for which AWE plc holds the nuclear site licences for the 25-year government-owned-contractor-operated (GOCO) contract with MoD. These sites are Aldermaston and Burghfield in Berkshire.

24 AWE Aldermaston is the headquarters of the company’s operations, and is located near the village of Aldermaston. It was originally a military airfield and has an area of just under 900 acres. Operations started there in 1950, at which time AWE was part of the United Kingdom Atomic Energy Authority. Ownership and management of the site was transferred to MoD in 1973. The activities on the site include: research and development; manufacture and storage of weapons components; waste processing, storage and disposition; and building decontamination and maintenance. The activities at Aldermaston include work with radioactive and fissile material as well as explosives and toxic materials.

25 The Burghfield site is about 250 acres in size and is located seven miles east of Aldermaston. It was originally established as a Royal Ordnance Factory for the manufacture of munitions and later became part of the AWE in 1987. Assembly and disassembly of weapons are the principal work activities at the Burghfield site. The shipment of weapons and weapons components are other associated activities.

26 As part of a rationalisation programme, production at AWE Cardiff was stopped in 1997. That site provided component-manufacturing support for the nuclear weapons programme, and the work was transferred to Aldermaston and Burghfield. The Cardiff site has subsequently been decommissioned. AWE also withdrew in 1997 from the Foulness site near Southend-on-Sea in Essex. That site

undertook work with conventional explosives and conducted non-nuclear experiments.

27 As a result of AWE's past and continuing operations there is a variety of nuclear liabilities, the vast majority of which are associated with the Aldermaston site. The liabilities at Aldermaston include: various production facilities (some of which are already shut down and are being decommissioned); two research reactors (one of which is already shutdown and from which the fuel has been removed and dispatched off-site); waste treatment facilities and associated stores; and support facilities such as laboratories. There are also various solid and liquid radioactive wastes, in the category known as Intermediate Level Waste (ILW), resulting from past operations and decommissioning activities. Most of these are in an unconditioned form. AWE's liabilities estimate also includes the requirement to dispose of Low Level Waste (LLW) and to remediate contaminated ground (see para 120).

28 Uranium, plutonium and tritium are the principal radionuclides in the waste streams, although there are small quantities of waste containing cobalt and caesium from the maintenance of the shutdown reactor. The decommissioning work should be achievable by the adaptation of well-understood techniques which are commonly used in the nuclear industry world-wide, and should not pose any unusual or unique technical challenges. Nuclear liabilities at Burghfield are small, including some ground contamination.

## **2.5 Financial liabilities and funding**

29 Aldermaston and Burghfield are government-owned facilities under the overall control of MoD. As with other UK Government-owned facilities, the future decommissioning costs will be met by the Government of the day. As such, there is no build-up of decommissioning funds to finance this future liability as is generally required for privately owned companies holding nuclear site licences.

30 AWE has estimated the cost of decommissioning, waste management and environmental restoration to be £2.56 billion (undiscounted, at 2001 values) which is broken down as follows:

- |                             |              |
|-----------------------------|--------------|
| • Decommissioning           | £890 million |
| • Waste management          | £750 million |
| • Environmental remediation | £280 million |
| • Capital projects          | £100 million |
| • Other                     | £30 million  |
| • Contingency               | £510 million |

31 The decommissioning costs of £890 million consist of the following components:

- Current Decommissioning Projects                      £323 million
- Decommissioning of existing facilities                      £308 million
- Decommissioning of proposed new plants                      £56 million
- Engineering services                      £49 million
- Facility management                      £155 million

32 Decommissioning costs for new plant are proportionately less than for older plant since they are to be designed to accommodate decommissioning.

## **2.6 Context of the review**

33 There have been several external developments before and since Cm 2919 (Ref 1) was issued in 1995 which have affected AWE's operations and liabilities, or have the potential to affect them in the future. Some of the most significant of these developments are discussed below.

### ***The Rock Characterisation Facility decision***

34 In 1997, the then Secretary of State for the Environment upheld Cumbria County Council's decision to refuse planning permission for an underground Rock Characterisation Facility at Sellafield. Prior to that decision, it had been generally assumed in the nuclear industry that a future disposal facility for the category of radioactive waste termed 'Intermediate Level Waste' (ILW) would be operational around 2012. The decision effectively delayed the availability of a disposal facility and this initiated a review by NII of the storage of ILW in the UK which was published in 1998 (Ref 11).

35 One of the main conclusions of the NII review was that waste management strategies which defer the retrieval and conditioning of raw waste pending the early availability of a disposal facility may need to be reconsidered as they may no longer be tenable. AWE's assumptions concerning the availability of a long-term management solution for ILW are discussed later in this report.

### ***Consultation Document 'Managing Radioactive Wastes Safely'***

36 In September 2001, the UK Government and the Devolved Administrations published a consultation document entitled 'Managing Radioactive Waste Safely' (Ref 12), the purpose of which was to launch a national debate leading to a decision on how to manage radioactive waste in the long term. The consultation document summarises the main options for the long-term management of ILW and states that all options are being considered by the Government, except where they have been ruled out by international agreements or treaties. The document sets down a five stage programme of actions leading to a chosen option for radioactive waste management by 2006 followed up, if necessary, by legislation in 2007. Some of the issues raised by this consultation document are discussed later in this report in the context of AWE's strategies. The consultation period ended in March 2002 and the

government is currently establishing a new Committee on Radioactive Waste Management (CoRWM) to recommend a radioactive waste strategy to the government and devolved administrations following appropriate stakeholder consultation.

### ***AWE licensing and relicensing***

37 The AWE sites are owned by MoD which managed operations until 1993. As a government department, MoD had Crown immunity from the licensing requirements of the NIA 65 (Ref 4). Furthermore, the provisions of RSA 93 (Ref 6) did not apply at that time and the Environment Agency (EA) issued Letters of Agreement for the disposal of radioactive wastes under pseudo-RSA 93 arrangements.

38 The Government decided to introduce modern management practices at AWE sites, and the AWE Act 1991 (Ref 13) paved the way for civilian contractor management. In April 1993, MoD placed a management contract with Hunting BRAE Ltd in respect of the sites at Aldermaston, Burghfield, Cardiff and Foulness. Hunting-BRAE Ltd was the major shareholder of AWE plc which employed the workforce. Under the terms of the 1991 Act, Hunting BRAE Ltd was initially treated as a government body and it was exempt from the nuclear site licensing regime. However, the AWE sites were brought within the ambit of RSA 93 and were subject to independent regulation by EA.

39 HSE took the opportunity to establish a benchmark with the new management and carried out in 1993-94 an extensive review of safety at the Aldermaston, Burghfield, Cardiff and Foulness sites. This culminated in a report published in October 1994 (Ref 14). A key recommendation of this report was that Hunting-BRAE's exemption from the licensing requirements of NIA 65 should be removed. The Minister of State for Defence Procurement accepted that Aldermaston and Burghfield should be licensed and an amendment (Ref 15) was made to the AWE 1991 Act to bring this about. The activities at Cardiff and Foulness did not come within the definition of licensable activities in NIA 65 (Ref 6) and therefore these sites were not licensed.

40 In July 1997 nuclear site licences came into effect for the AWE sites at Aldermaston and Burghfield. Hunting-BRAE's application for the licences was based on the NII guidance provided in Nuclear Site Licences – Notes for Applicants (Ref 5). The licences were granted by HSE after extensive assessment and inspections by NII inspectors, and the consideration of the views of public bodies and others. The activities on the site did not change as a result of licensing, however it brought enhanced regulatory control by NII, in line with that applying to civil nuclear licensed sites. A report describing the work of NII leading to the granting of the first nuclear site licences was published in 1997 (Ref 16).

41 Hunting-BRAE's management contract expired on 31 March 2000, and the MoD wanted to achieve a position which enabled AWE plc to run the sites in the future. Following a tendering process, it was announced that AWE Management Limited (AWEML) had been appointed to provide management and financial expertise to AWE plc, which was to operate the sites from 1 April 2000. NII's

involvement in the tendering process was limited to ensuring that AWE plc, as the new proposed operating organisation from 1 April 2000, was potentially licensable.

42 AWE plc submitted an application on 20 December 1999 for nuclear site licences for Aldermaston and Burghfield based on the HSE guidance in Ref 5. As nuclear site licences cannot be transferred, the changeover in the management of the sites necessitated the revocation of the nuclear site licences formally held by Hunting-BRAE Ltd and the granting of new licences to the new operator, AWE plc. The new licences came into effect on 1 April 2000. The work undertaken by NII to ensure itself that AWE plc was a suitable body to be licensed and had the potential to operate the site in a manner consistent with the requirements of NIA 65, was published in May 2000 (Ref 17).

43 HSE recognised that the licensing of a new contractor to operate the AWE sites would be of public interest. To provide reassurance, HSE therefore agreed to provide Ministers with reports on the safety performance of the new management contractors after 3 months and after 12 months following licensing. These were published in July 2000 and June 2001 respectively (Refs 18 and 19).

### ***NII regulatory action since 1993***

44 As stated previously, HSE undertook a comprehensive review of the management of health and safety at AWE sites in 1993-94 (Ref 14). The review was structured around eight health and safety topics, one of which was waste and decommissioning. One of the overall conclusions was that the problems facing AWE in relation to waste and decommissioning were not dissimilar to those at other nuclear sites. AWE had recognised the importance of waste and decommissioning activities and had given them a higher priority in the period before the review. However, the organisation was behind some other parts of the nuclear industry in addressing the issues in a number of important areas.

45 This conclusion led to a number of recommendations in the 1994 report concerned with waste management and decommissioning. These included the need to produce a comprehensive waste management strategy and to further develop the existing decommissioning plans. Facilities also needed to be developed for the treatment of ILW into a state of passive safety.

46 AWE subsequently worked to develop its health and safety arrangements, not only to close out the recommendations of the review, but to satisfy the requirements for nuclear site licensing. By July 1997, when the first licences were issued, all but one of the HSE's 64 recommendations from the 1993/4 review had been addressed satisfactorily. The outstanding recommendation related to waste storage, and the agreed way forward was changed from the refurbishment of existing stores to the provision of a new one, which is now operational.

47 The progress that Hunting-BRAE had made in the development and implementation of its decommissioning and waste management arrangements by the time of licensing in 1997 is described in Ref 16. By that time a 10-year programme for the potentially more hazardous facilities on the Aldermaston site, and facility-specific plans for three high priority decommissioning projects, had been produced.

A waste management strategy had also been prepared, and plans were in place to improve the storage conditions of certain waste streams.

48 At the time of licensing in 1997, NII recognised that there were a number of areas where there were opportunities for further improvement, including the need to progress the strategies and programmes for dealing with redundant facilities and radioactive wastes. A summary of NII experience of regulating the AWE sites when Hunting-BRAE Ltd held the licences is given in Ref 17 which was published in May 2000. The overall conclusion of that report was that Hunting-BRAE, as the first licensee, showed a strong and positive attitude to the management of safety. However, it had been necessary for NII to take explicit action to stimulate progress with the decommissioning of redundant facilities and the management of radioactive waste.

49 It was also concluded in Ref 17 that, while there had been good progress in developing a long term strategy for dealing with radioactive waste, there were two projects for which progress had been disappointing due to delays in sanctioning the projects and general resourcing issues. As a result of these delays, NII issued a number of licence instruments (specifications) in relation to a project to retrieve and immobilise waste sludges from some elderly tanks. These licence instruments have the effect of preventing further accumulations being made in these tanks and require the retrieval, conditioning and packaging of the wastes by specific timescales for long-term on-site storage in a state of passive safety.

50 Further licence instruments were issued relating to the treatment of solid alpha ILW by specific dates, which by implication require the provision of new ILW treatment facilities. The dates in these licence instruments were based on information provided by the incoming licensee.

51 There are currently seven formal licence instruments in place relating to sludge tanks, future production arisings and legacy wastes which were issued when Hunting-BRAE was the licensee. These have been carried over from the previous licence and the current management is bound by these regulatory requirements as long as they remain in force.

52 Prior to the issue of the new site licence in April 2000, NII received revised decommissioning and waste management strategies from the proposed new management. The waste management and decommissioning initiatives undertaken by the new management around that time are described in Ref 17. In April 2000 NII formally approved, under Licence Condition 35, a site-wide 10-year decommissioning plan as well as three facility-specific plans which had been produced by the new management team. This means that NII has regulatory control over these plans which cannot be changed without NII agreement. NII has recently approved amended plans which have been updated in line with developments.

## **OSPAR**

53 In July 2002, the Government issued a strategy after consultation (Ref 20) which described how the UK will implement the agreements reached at the 1998 Ministerial meeting of the OSPAR Commission. One of the main aims of the

strategy is that there will be progressive reductions in concentrations of radionuclides in the marine environment resulting from radioactive discharge, such that by 2020 they add close-to-zero to historic levels. The strategy includes proposals for discharge reductions from the defence sector (which includes the AWE sites), and projected liquid effluent discharge profiles up to 2020. The Government intends to revise and reissue the strategy at periods of about 4 years.

## **2.7 The AWE submission**

54 This review has been based on AWE's quinquennial review submission dated November 2001. The submission has been produced by AWE's Environmental Programmes Group (EPG) and is divided roughly equally between decommissioning, waste management, and site remediation. The submission consisted of an overview document supported by a series of documents covering specific topics in more detail. The overview document describes the policies, strategies and funding provisions put in place for the decommissioning of AWE sites up to site closure. The supporting documents address in more detail aspects such as: the decommissioning, waste management, and environmental policies; the option assessment methodology; the decommissioning, waste and environmental strategies; the decommissioning techniques; the liabilities estimate procedure; and an outline of the assumptions and uncertainties.

## **2.8 Overview of the site strategies**

55 The following paragraphs present an overview of the strategies for the Aldermaston and Burghfield sites covering the main features. A more detailed discussion of specific aspects is given in the findings section of this report.

### ***The Aldermaston strategy***

56 The 1998 Strategic Defence Review states that Trident will be maintained as a deterrent for up to 30 years. Therefore, it is assumed in the AWE decommissioning strategy that weapons refurbishment for the Trident programme will continue until 2028, followed by a 10 year period to allow for weapon retirement. After this time, the current Trident facilities will be available for decommissioning. (It should be noted that a number of facilities are already undergoing decommissioning, and the decommissioning of others will start before the site operational phase is assumed to come to an end at around 2040). The dismantling of non-reactor facilities will generally be completed approximately 30 years after operations come to an end, and within 60 years for reactors (though the latter timescale is under review). It is assumed that all decommissioning activities on the site will be complete by 2060.

57 AWE's planning assumption is that a disposal route (or some other national long-term management solution) will become available between 2040 and 2140, with 2080 as the most likely date. It is also assumed that the ILW stores will be operational for at least 10 years after the disposal route becomes available. Based on these planning assumptions, conditioned wastes would not be removed from the site until about 100 years from now. A long-term objective is that the contaminated ground would be remediated to levels that will enable the site to be re-used.

## ***The Burghfield strategy***

58 Burghfield is an operational site and there are no significant decommissioning operations taking place at present. The nature of the operations at Burghfield involve the handling of fully sealed radioactive components which limits the potential for contamination of plant or facilities. For Burghfield it is expected that once operations cease, decommissioning can proceed in a manner similar to that employed on non-active facilities.

59 The timescale for the decommissioning of Burghfield has not been established, as it is dependent on the Government's defence policy. Due to the work carried out in the past, there is some limited ground contamination on the site. The AWE environmental remediation programme includes a requirement to deal with Burghfield and this will reduce ground contamination to levels that will enable the site to be redeveloped following the eventual completion of the decommissioning programme.

60 Although NII's assessment has taken account of the Burghfield site, the remainder of this report will focus on Aldermaston, as the vast majority of AWE's nuclear liabilities are associated with that site.

## **3 THE REVIEW**

### **3.1 The review process**

61 The technical assessment has considered AWE's site strategies and supporting information in relation to NII's internal guidance for decommissioning and waste management (Refs 2 and 9). AWE's submission has been assessed by NII to:

- consider AWE's general approach, in particular, with regard to the fundamental expectations set down in NII guidance;
- examine the assumptions upon which the site strategies and liabilities estimate are based to determine their validity;
- review AWE's methodology, to determine its overall adequacy to maintain acceptable strategies for the sites; and
- examine AWE's detailed justification of the site strategies.

62 NII's assessment process included consideration of AWE's quinquennial review submission and supporting documents in their entirety and targeted sampling of supplementary information at AWE's headquarters at Aldermaston. The targeted sampling included consideration of aspects such as:

- corporate arrangements, for example, those for maintaining the site strategies and the liabilities estimate;
- AWE's management tools;

- detailed site decommissioning and waste management programmes;
- facility-specific documents such as optioneering studies; and
- data sheets, such as facility waste and cost data.

63 The assessment process included visits to the Aldermaston site to obtain further data and to visit ongoing decommissioning projects, existing waste management facilities, operational production facilities, and plants in care and maintenance.

## **3.2 Findings**

### ***Government policy issues***

64 A number of waste management issues of particular relevance to AWE will be influenced by the outcome of the policy development work mentioned in para 36. These include the long-term management of the categories of radioactive waste termed 'Low Level Waste' (LLW) and 'Intermediate Level Waste' (ILW). The management of ILW, in particular, is important to AWE as it currently needs to develop the design of new facilities for the treatment of this material. However, the current situation concerning government policy is contributing to the delays to the development of the required facilities. (The topic is discussed further in paras 97-102).

65 In July 2001 the Radioactive Waste Management Advisory Committee (RWMAC) published its advice to Ministers on the MoD's radioactive waste management and practices (Ref 21). RWMAC commented on the significant progress that had been made towards improving the packaging and storage of ILW at Aldermaston. However, RWMAC also noted 'But not only is there no clear Government policy on long term radioactive waste management, including the possibility of deep underground storage or disposal, the current hiatus prevents effective consideration by regulators and operators of timescales (for example those for packaging and storage) and ancillary issues such as conditioning and the passive safety of wastes.'

66 In June 2002, a report was published of a joint study by RWMAC and the Nuclear Safety Advisory Committee (NuSAC) (Ref 22). This study was concerned with current arrangements and requirements for the conditioning and storage of ILW in the UK. The report discussed the status of Government policy in some length and recommended that 'Government take the earliest possible opportunity to develop and state its policy for the conditioning, packaging and storage of ILW'. As part of its submission to the joint RWMAC/NuSAC study, NII commented on the need for policy clarification on issues such as the timescales over which conditioned radioactive waste may need to be stored on nuclear licensed sites. NII believes that the Government's commitment to clarification of policy will help to resolve some of the uncertainties surrounding the requirements for on-site storage, such as the waste package specifications and the longevity of buildings.

67 NII's conclusion is that the continuing lack of clear Government policy on certain aspects of the management of radioactive waste introduces a significant uncertainty for some parts of AWE's restoration strategies and liabilities estimates. NII therefore concurs with the joint RWMAC/NuSAC view that the Government should take the earliest possible opportunity to develop and state its policy, and welcomes the Government's recent commitment to consider the scope for speeding up the timescale for the development of the policy.

### ***AWE's decommissioning policy and objectives***

68 AWE's Strategic Plan identifies proactive stewardship of its environmental liabilities as a major driver to the success of the company. To this effect, the Environmental Programmes Group (EPG) has been created to manage all decommissioning, waste management and site remediation issues in an integrated way across both the Aldermaston and Burghfield sites. EPG's main purpose is to systematically and progressively reduce the level of hazard on the sites and to minimise the risk of release of hazardous material from facilities and areas of the site which are no longer needed to support the weapons programme.

69 The AWE decommissioning policy is to decommission redundant nuclear facilities as soon as is reasonably practicable, subject to safety considerations and to cost effectiveness. This includes the management and, where possible, the disposal of wastes. The long term overall aim is to make each site available for alternative use assuming that, at some stage in the future, the Government will no longer need the sites to maintain a nuclear weapons capability. The practical application of this policy is discussed in more detail later in this report.

### ***Decommissioning programme***

70 The overall timescales for the decommissioning of the Aldermaston site have previously been presented in paras 56 and 57. These planning timescales will clearly be influenced by any changes in the Government's policies on defence and radioactive waste treatment. Nevertheless, as noted in para 52, NII has recently approved an updated 10-year site-wide decommissioning plan.

71 A full life decommissioning programme extending to 2094 includes the decommissioning of all nuclear facilities, current and future, at the Aldermaston and Burghfield sites. This programme currently exists in spreadsheet form and indicates the decommissioning phases for each facility. AWE recognises that the programme needs further development and this work is already underway.

72 The decommissioning programme is formulated with the aim of systematically and progressively reducing hazards on the site. To achieve this, each radioactive facility is categorised in terms of hazard. The hazard associated with a facility is one of the more important considerations in the prioritisation of decommissioning projects, though this does not preclude low hazard facilities being decommissioned early. It was the policy in the past, however, to defer the decommissioning of many redundant facilities. At the present time, there are a number of redundant facilities which have been in the Surveillance and Maintenance phase for many years, and others that have ceased operations but for which Initial Decommissioning has not

been carried out (these decommissioning terms are explained in para 83). NII would therefore welcome an acceleration of the decommissioning programme by reducing periods of deferral, if this is found to be reasonably practicable. NII recognises, however, that in some cases it may be preferable on safety grounds to defer final demolition until a group of facilities can be demolished together. AWE has stated that it is keen to reduce the periods of deferral because of the associated high costs of facility management.

73 In the case of the reactor facilities, the current strategy is to defer final decommissioning (for 45 years with effect from 1988) to allow for radioactive decay. However, AWE plans to undertake substantial decommissioning work on the reactor facilities before the deferral period commences. This strategy is currently under review by AWE, and NII will consider the outcome of this work at the next quinquennial review.

### ***Outline Decommissioning Plans (ODPs)***

74 At the time of the quinquennial review submission, ODPs existed for all active facilities, but a major exercise to update all ODPs that commenced in 2000 was not complete. However, all ODPs have now been updated.

75 ODPs include initial estimates of costs and waste arisings and cover aspects such as the operational history of the facility, the inventory of radioactive and hazardous materials, options and methods for decommissioning, timing of decommissioning, safety, required documentation, and constraints. Samples of the ODPs were examined by NII as part of the quinquennial review assessment. The ODPs are developed into more detail as the decommissioning of a particular facility approaches.

76 The input data to the estimates rely heavily on expert judgement and AWE recognises that there may be inconsistencies between different projects as a result. In addition, due to working practices before the site was licensed, records of costs and man-hours spent on specific tasks were not compiled. NII therefore welcomes the fact that AWE is actively reviewing the various cost estimation models as currently used in the nuclear industry and that trials using cost models are ongoing. The adoption of a computer-based cost model will eliminate subjective expert judgement and inconsistencies from the liabilities estimate. Other improvements include the implementation of a work breakdown structure for funding and cost collection within decommissioning projects, improved procedures for producing ODPs, and the implementation of strategic planning tools. NII welcomes these developments and expects them to be fully implemented well before the next quinquennial review.

### ***Decommissioning and radioactive waste inventory***

77 A waste inventory has been produced for the purposes of the quinquennial review in the form of 'Waste Management Datasheets.' These cover legacy wastes (i.e. historic wastes accumulated from previous operations), operational wastes (from existing and future facilities), and decommissioning wastes. The Waste Management Datasheets provide total volumes of each generic waste stream.

78 'Facility Waste and Cost Datasheets' have also been compiled which provide information on the volume of waste produced, and the associated cost, from the four main decommissioning projects currently in progress. The estimates for future waste arisings are stated to be conservative and based on experience to date.

79 The waste estimates for future decommissioning projects are based on the Outline Decommissioning Plans. For plants not yet built, decommissioning waste arisings are given as broad estimates. In both cases, the inventories are stated to be conservative estimates which will be revised as the data is refined.

80 In its submission, AWE has identified the need to improve the waste estimates to reduce the uncertainties in the liabilities estimate. The methodology for waste estimation is being considered in conjunction with the review of cost estimates and NII will be monitoring progress.

81 NII notes that the waste inventory for the quinquennial review has been produced independently of AWE's contribution to the UK Radioactive Waste Inventory that is compiled on behalf of the Department of the Environment, Food and Rural Affairs (DEFRA). There is a lack of consistency between the two inventories in terms of defined waste streams and quantities. In particular, it is not possible to relate waste streams included in the quinquennial review with those in the UK inventory. Furthermore, there are some waste streams in the quinquennial review which are not identified in the UK inventory. NII considers that both the quinquennial process and the UK inventory are strategic exercises used for planning purposes by nuclear operators, NIREX and the Government, and should therefore be consistent. The importance of providing a complete and accurate contribution to the UK inventory has also been noted by RWMAC (Ref 23).

82 AWE has now changed its procedures such that the AWE contribution to the UK Radioactive Waste Inventory will in future be based on the ODP waste estimates, and the Waste Compliance Officer will be responsible for all future estimates of waste arisings for the UK Inventory and the quinquennial review.

### ***Decommissioning stages***

83 The basic decommissioning approach defined by AWE consists of the following five phases commencing on completion of post-operational clean out (POCO):

- Initial Decommissioning: This extends the traditional POCO and seeks where necessary, to upgrade the existing services and to remove or fix loose radioactive materials so that further decommissioning may be optimally scheduled. Initial decommissioning can be useful where it is beneficial to defer later stages of decommissioning and is primarily applied in projects with significant beta-gamma activity. It may also be applicable to alpha active plants, where there is a need to minimise risk on a wide range of projects simultaneously prior to proceeding with full dismantling in specific areas;
- Surveillance and Maintenance (S&M): This comprises the supervision of the plant up to the commencement of the dismantling phase. The activities

in this phase include the operation and maintenance of equipment, building structure, and monitoring regimes that are necessary to ensure the adequacy of radiological containment whilst recognising that significant radioactive inventories may still be present;

- **Dismantling:** This phase requires the removal of the plant and equipment followed by the decontamination of the building structure to leave the building shell with minimal residual activity. Wherever practicable, wastes generated from dismantling should be segregated and allocated to the appropriate waste category. After completion of dismantling the vast majority of the remaining structures will be suitable for free release;
- **Care and Maintenance (C&M):** Supervision of the building shell at minimal cost, ensuring that no hazard is presented to individuals, adjacent plant, or the environment;
- **Demolition:** Final demolition of the building structure, using predominantly conventional techniques. Demolition represents the end point of the decommissioning stage for a given facility.

84 The timing, duration and work programme of each phase is determined on a case-by-case basis by a multi-attribute analysis which is heavily weighted towards environmental, safety and health attributes. Much depends on the type of facility and the associated dose rates.

85 Issues considered in the multi-attribute studies include: the hazard remaining (hazard category); the condition of the facility services and structure; available resources; costs, including any financial benefits of deferment; and logistics. In general it is the intention to undertake the more active phases of decommissioning (Initial Decommissioning Phase and Dismantling) as soon as possible. Deferment of these phases is only considered if the hazard is considered to be acceptably low and there are perceived benefits from deferral.

86 In nuclear operations, it is conventional to include the period of POCO prior to the onset of decommissioning as part of the operational life of the facility. In the case of the majority of the facilities at AWE, however, the extent to which normal operational methods are applicable to POCO is limited. As stated previously, a number of facilities have ceased operations and have not yet undergone Initial Decommissioning. NII would therefore welcome a reduction in the deferral periods.

### ***Decommissioning methods***

87 Decommissioning projects at AWE which have reached the dismantling phase are all redundant tritium and plutonium facilities consisting of contaminated gloveboxes and associated plant and drains. Gloveboxes are of various sizes, some very large, and contain a variety of equipment. Methods of dismantling are constrained by both the size of the facilities and the available space. The optioneering procedure has resulted in the preference for manual dismantling by suited operators within a ventilated containment enclosure using standard cold

cutting techniques (saws). This is a tried and tested technique at AWE and will be used for the next few years.

88 The dismantling of alpha-contaminated facilities by manual methods is slow and, although radiation exposure is low, there are risks to the operators from contamination resulting from tears to the suits as well as from operator fatigue. In order to increase the rate of dismantling and to reduce the risks to operators, AWE is assessing the feasibility of implementing faster cutting techniques, for example plasma arc and diamond wire cutting, and the application of remote technology and machine-assisted technology. These techniques are commonly used in the nuclear industry world-wide (and other industries) and are well understood. It is the means of application to the particular facility and environment at AWE that has to be developed.

89 Depending on the levels of contamination, cut items need to be monitored prior to packaging to ensure that the fissile limit in a drum is not exceeded. AWE is currently investing in monitors capable of handling larger cut items than is possible at the current time. This will reduce the amount of manual cutting required and hence reduce operator exposure and improve productivity. AWE expects that the use of these monitors, together with the introduction of faster cutting techniques, could reduce the duration of size reduction operations by a factor of ten. NII strongly supports these developments which have the potential to significantly speed up the decommissioning of individual facilities and reduce the collective dose to operators.

90 Decommissioning of the reactor facilities and management of the small quantity of legacy beta-gamma wastes will, depending on the timing, probably require more use of remote operations or some form of machine assistance in order to ensure that doses are ALARP and to optimise productivity. These will be developed at the appropriate time where necessary.

91 AWE has completed optioneering and ALARP studies for the current decommissioning projects. The preferred strategy in the first decommissioning phase is to fix loose contamination on surfaces, rather than to decontaminate. The choice between fixing contamination and decontamination clearly has implications for radioactive waste arisings. NII notes that AWE is currently evaluating a decontamination system on two decommissioning projects and is also considering other techniques for reducing waste arisings. NII welcomes these developments but recognises that a possible constraint in the choice of decontamination methods is the requirement of the Environment Agency to reduce discharges to the environment.

### ***Waste management – general considerations***

92 The Environmental Programmes Group is responsible for developing and implementing the strategy for the management of radioactive waste. The objective is to integrate waste management with all other activities on the site. To assist this aim a high-level Environmental Programmes Group Management Plan is produced and reviewed annually. This plan addresses decommissioning projects and waste management activities over the next 10 years and allows the identification of facilities which will soon be redundant. It covers decommissioning, waste management, and environmental remediation projects.

93 AWE has used the ALPS strategic planning tool (under licence from Serco Group plc) to integrate the management of wastes across the site, taking account of interactions between facilities. It is proposed to develop this package in 2003/4 to provide a comprehensive decommissioning and waste management strategic planning tool. This will replace the use of bespoke spreadsheets by a quality assured computer application, thereby improving the consistencies and auditability of the liabilities estimates, and will raise the standard of the management tool to the level used elsewhere in the nuclear industry. NII supports this approach.

94 Prior to re-licensing (April 2000) there were no strong incentives in place for minimising waste generation, as part of the contractual arrangements between MoD and the previous licensee. Various waste minimisation initiatives have since been implemented, or are being considered, including improved classification, assaying, segregation, size reduction and decontamination of wastes. NII strongly welcomes these developments. It is, however, one of NII's fundamental expectations that the production of radioactive waste should be avoided, and where radioactive waste is unavoidable, its production should be minimised. NII therefore believes that AWE should give further consideration to the scope for reducing the production of both primary and secondary wastes on the site, and should demonstrate that the production of such wastes has been reduced so far as is reasonably practicable.

95 Licence Condition 32 also requires AWE to minimise the quantity of radioactive waste accumulated on the site at any time. AWE should review the wastes accumulated in its facilities and consider whether disposal/treatment routes already exist (or could be established without undue effort), in which case the wastes should be removed from the site as soon as is reasonably practicable.

96 AWE has categorised radioactive wastes into generic waste streams primarily on the basis of the similarity of their management strategy. The more significant of these generic waste streams are discussed in the following sections.

#### ***Solid alpha contaminated intermediate level waste (ILW)***

97 Most of the ILW generated on the Aldermaston site is alpha contaminated material arising from operations and decommissioning. The majority of this waste arises from decommissioning activities. Alpha contaminated ILW is the most significant waste arising on the Aldermaston site and the total volume (existing and future), would be about 5,000m<sup>3</sup> if it was conditioned into NIREX-approved containers.

98 Significant quantities of alpha ILW are currently stored on the Aldermaston site in several stores in an unconditioned form. Some of the storage conditions do not meet modern standards and a programme is in place to transfer the wastes concerned to acceptable stores. All of these waste drums will be over-drummed by December 2003 thereby improving their containment, and will be transferred to the alternative stores by March 2004.

99 The longer-term strategy is to process the material into a condition suitable for long-term storage on-site which will require new ILW treatment facilities, the specification for which is currently being developed.

100 There are currently three licence instruments in force relating to alpha contaminated ILW wastes. One licence instrument specifies that after 1 January 2004, no ILW generated from two operational facilities is to be accumulated or stored on the site unless it has been immobilised and contained within suitable containers within 3 months of it being dispatched from these facilities. The other two relate to inspection, sentencing, volume reduction and packaging of legacy waste. These require, in effect, that 130 drums of legacy waste should be packaged by December 2005, and that 670 drums should be packaged by December 2006. It is disappointing to find that the licensee is not in a position to meet fully these specifications. In part, this is because the licensee management team has been concentrating on operational safety issues e.g. replacement of flammable pallets in ILW waste stores. Also, because the licensee management team take the view that the stored ILW waste is a lower hazard than other issues on the site, they have been concentrating resources into other areas.

101 NII is in discussions with the licensee with the intention of ensuring that these wastes, some of which have been in drum stores since the 1960s, are treated with an appropriate priority. NII recognises that the licensee has made significant progress across a range of waste and decommissioning areas. However, NII's policy remains that such waste should be made passively safe and, although the licensee argues that the drum stores represent an adequate level of passive safety, continued storage in its present condition for further decades is not considered acceptable. NII recognises that the position has now been further complicated by strategy development work which will be undertaken by the NDA for such wastes at other licensed sites, the outcome of which may influence options to be adopted by the licensee in treatment of these wastes.

102 The licensee is validating existing stores for a lifetime of 100 years. Storage in existing containers is not acceptable for such a period. Since some of the materials were placed in drums in the 1960s, NII will require that these be treated before being placed in store for any extended period.

### ***Tritiated solid wastes***

103 There are a number of tritium waste streams for which the strategies have been reviewed relatively recently by AWE. Further work, however, is required to establish a firm waste route for some of these materials. AWE is currently considering the options for additional on-site storage capacity for such wastes, and a firm date will be provided once the strategy has been finalised.

### ***Solid beta gamma ILW***

104 The operation of one of the reactors has given rise to quantities of neutron activated materials and further material will arise as a result of future decommissioning. The current strategy is for an extended period of Surveillance and Maintenance (45 years with effect from 1988), however the strategy is under review. There is no purpose built store for waste of this type on the Aldermaston site, and the future infrastructure requirements will be determined by the outcome of the options assessment.

### ***Solid low level waste (LLW)***

105 LLW generated on both AWE sites is mostly alpha or tritium contaminated material arising from operations and decommissioning. The estimated conditioned volume of future arisings is 25,000m<sup>3</sup> over the lifetime of the sites.

106 The current management strategy for LLW waste is to send this material to the UK LLW disposal facility at Drigg (operated by BNFL), though a small quantity is transferred to UKAEA Winfrith for volume reduction in a facility operated by AEA-Technology, prior to disposal at Drigg. Some of the waste will not meet the acceptance criteria for Drigg due to the plutonium content. In such cases, the wastes will be stored in a manner suitable for long-term storage to await the availability of an off-site management route.

107 The strategy assumes that Drigg will be available for the disposal of LLW until its closure in about 2040 and, thereafter there will be an alternative national LLW disposal facility. The availability of a disposal route for LLW after Drigg closes is a risk to the AWE strategy, however AWE is not alone in this situation as this is a national issue. Options for the management of LLW in the longer term will be considered as part of the Government's consultation process described in para 36.

### ***Oils***

108 AWE has a legacy of 15 to 20 m<sup>3</sup> of contaminated or potentially contaminated oils. A Best Practicable Environmental Option (BPEO) study has been undertaken which concludes that the majority of the oil should be sent to a commercial incineration company for disposal, subject to the agreement of the Environment Agency. Some oils, however, are unlikely to meet the conditions for acceptance at such an incinerator and will require an alternative strategy which is yet to be developed. Although AWE has made progress with the development with its strategy for oils, it needs to provide firm programme dates for the resolution of this issue.

### ***Pyrochemical materials***

109 There are approximately 4 tonnes of pyrochemical materials, (chloride salts containing varying amounts of plutonium), which have been generated from plutonium recovery operations. This waste is currently stored in a variety of packages. The preferred option is to repack for safe storage in effectively a passively safe form and to store for 15 years before deciding on a final waste management option.

### ***Containment spheres***

110 These are spheres internally contaminated with fissile material for which management options are being considered.

### ***Sea disposal drums***

111 There are approximately 700 drums of waste stored at Aldermaston which were originally designed for sea disposal (sea disposal was discontinued by the UK

in 1982). The sea dump drums are mostly filled with Plutonium Contaminated Material (PCM) but there are also drums containing uranium-contaminated waste and others with tritiated waste. These consist of a waste drum grouted into an outer drum. The current strategy is to extract the inner ILW drum and to dispose of the LLW component of the overall drum at Drigg. This work is scheduled to start in 2009, though this date might be brought forward. The reference strategy in the quinquennial review submission states that the work depends on availability of the new ILW facilities, however an alternative strategy is being considered.

### **Sludges**

112 Significant volumes (over 400m<sup>3</sup> in 20 tanks) of low active sludges containing small amounts of alpha activity have been stored on the Aldermaston site for over 30 years. One of these tanks developed a pinhole leak. AWE has taken steps to improve the containment of the tanks and the static loading has been reduced by draining off the supernate. An extensive programme of non-destructive examination has given better confidence in the tank integrity. NII has previously issued three licence instruments in relation to these sludges. The purpose of the first licence instrument was to prevent further accumulation of the sludges in the tanks and this has been complied with. The purpose of the second and third licence instruments was to expedite the removal of the sludge so that these can all be treated into a state of passive safety. The requirements of the second licence instrument have been achieved ahead of programme and, in fact, have been exceeded, in that two sludge tanks have been emptied and the waste immobilised and sent to Drigg for disposal. The third licence instrument requires all the sludge to have been immobilised by 2007. A contract has been placed for the immobilisation of this waste and a new cementation rig has been ordered. Work on the contract is well advanced and sludge immobilisation is expected to commence later in 2003 and to be completed within 3 years.

### **High volume low active waste (HVLAW)**

113 The quinquennial review documentation does not describe the strategy for the management of the large volumes of very low active waste which will arise from decommissioning and land remediation. AWE has termed this waste High Volume Low Active Waste (HVLAW) to distinguish it from Very Low Level Waste (VLLW). (The latter term is used in Cmnd 2919 (Ref 1) for the small volumes of very low active waste produced by non-nuclear industries, hospitals etc).

114 Current Government policy (Ref 1) discourages the use of landfill sites for the disposal of the large quantities of very low active waste that will arise from the nuclear industry. Furthermore, disposal of large volumes of this material at BNFL plc's LLW disposal site at Drigg is impracticable as it would be a very inefficient and an unreasonably costly use of this resource. AWE needs to develop a strategy for this material, although NII recognises that this is a significant uncertainty affecting the UK nuclear industry in general. AWE is aware of these uncertainties and has recently participated in an industry-wide initiative to raise the profile of the topic. RWMAC has also identified this as a significant issue for the nuclear industry for which a solution needs to be established (Ref 24).

## ***Liquid wastes***

115 The existing management arrangement is to collect effluent by a site-wide piped collection system and to remove fissile material by a flocculation process. The resulting sludge is stored on-site awaiting sentencing and appropriate treatment. The treated effluent is discharged to the River Thames via the Pangbourne pipeline.

116 The EA requires AWE to cease discharges via the Pangbourne pipeline by 31 March 2005, by which time an alternative management arrangement for liquid wastes needs to be in place. The proposed new strategy is to collect liquid wastes from each facility in tankers, thereby allowing the existing collection system to be decommissioned. The tankers will transport the wastes to a new plant which will treat the liquid by evaporation and reverse osmosis. NII is monitoring AWE's progress with the new facility which will be subject to the regulatory controls for new plants.

117 The move to containerised collection of aqueous waste has been made possible only because AWE has taken steps to minimise waste arisings. This has been one of the main successes in AWE's waste minimisation initiatives. As the piped collection system is made redundant, AWE has commenced decommissioning far earlier than required under the NII-approved 10-year programme.

118 There are liquid effluents stored on the Aldermaston site which have relatively low levels of tritium contamination. A tritium strategy has been completed and this includes various options for treating and disposal of this waste stream, which comprises a tank of lightly tritiated water and another tank of more highly tritiated, but still low level waste, water. An exercise has commenced to dispose of the lightly tritiated water. Proposals have been formulated and agreement reached with the EA for the treatment and disposal of the second tank as part of the sludge immobilisation programme.

119 The closure of the Pangbourne pipeline and the proposed new arrangements for the management of liquid wastes on-site will be AWE's main contributions to the achievement of the OSPAR strategy which is discussed further in paras 137 and 138. In fact the UK Strategy for Radioactive Discharges 2001-2020 (Ref 20) states that "liquid waste discharges at AWE are expected to reduce to extremely low levels after the introduction of the new Aqueous Waste Treatment Plant and the closure of the Pangebourne Pipeline in 2005."

## ***Management and remediation of contaminated ground***

120 Aldermaston has operated as a nuclear site for more than 50 years and, before that, was a military airfield. Some previous practices would not be considered acceptable compared to modern-day standards, and consequently there are a number of legacy issues on (and off) the licensed site which need to be addressed. These legacy issues have been described in various public information leaflets published by AWE on its web site, and include solvent, plutonium, tritium and mercury contamination at various locations on the site. The leaflets outline the steps that AWE has already taken to tackle these legacy issues, and the licensee's future plans, so far as they have been defined.

121 The Environmental Projects Group has responsibility for the identification and characterisation of environmental contamination and the management of contaminated land, including off-site areas. Estimates of the extent of contaminated land have been produced, both on and off the licensed site. Of necessity, assumptions (believed by AWE to be conservative) have been made to arrive at these estimates. A site-wide characterisation exercise is being undertaken to improve these estimates and to establish the nature of the contamination. The areas of site that were judged by AWE to have some degree of ground contamination have been surveyed and this constitutes some 30% of the Aldermaston site. These surveys have shown that the radiological contamination is not as widespread, and is of lower concentration, than previously anticipated. To date, some 70% of the ground has been surveyed. The quantity of material that will need to be managed will be very large, although it is expected to be of low radiological significance, falling into AWE's category termed High Volume Low Active Waste.

122 A prioritised environmental remediation programme has been agreed between AWE and the regulators for completion over the next 5 years, and NII will be monitoring progress. NII recognises the steps that the licensee has taken in recent years to address ground contamination and other environmental issues. However, at present time there is no comprehensive, long-term strategy for the management of contaminated land on the Aldermaston site. Such a strategy therefore needs to be developed, addressing the legacies on a case-by-case basis, the approach depending on the particular circumstances for each instance of contamination. The preferred option(s) and timescales for remediation need be justified by means of detailed optioneering studies, taking account of all relevant factors.

123 NII considers radioactively contaminated ground on a nuclear licensed site to be an accumulation of radioactive waste, it follows therefore that the licensee should manage contaminated ground in accordance with the conditions of the site licence. NII expects licensees to develop and maintain a safety case for the management of all radioactively contaminated ground on the licensed site, and considers such a safety case to be particularly important where the preferred option is to defer remediation (Ref 9). NII's expectation is that a safety case dealing with radioactively contaminated ground will be submitted by AWE as part of the next periodic review of safety cases for the Aldermaston site, as required under Licence Condition 15.

124 The long-term aim is to make the sites available for alternative use. Whether or not delicensing will be achievable will depend on the extent of ground contamination discovered and the practicability and economics of successful remediation. In the case of the Aldermaston site, contamination may prevent whole site delicensing but, in the case of Burghfield, it is expected that delicensing will be achievable.

125 NII also notes that the Government is reviewing decommissioning policy with the aim of updating statements in Cm 2919 (Ref 1), and one topic being addressed is the decommissioning end point. This clearly has implications for the extent of decommissioning and the quantity of resulting wastes which could potentially impact on licensee's strategies and liabilities estimates.

### ***Completeness of the strategy***

126 AWE's strategy covers facility decommissioning, wastes (including existing and predicted future arisings), new waste management facilities, and the remediation of contaminated ground. NII believes that AWE's strategy is comprehensive in terms of the extent to which it addresses nuclear liabilities. Some liabilities, however, will need further characterisation and additional work is required to establish a firm strategy for some materials e.g. various solid and liquid wastes (in particular solid alpha contaminated ILW), and contaminated ground.

127 AWE correctly concentrated on radioactive waste and contamination in its submission. NII believes that it would help to inform the consultation process if more detail was provided on chemical waste and contamination in the next submission.

### ***Assumptions concerning the availability of an off-site management route for ILW***

128 The decommissioning strategy and programme is based on the assumption that a disposal facility (or some other long term management solution) for ILW, and LLW not acceptable to Drigg, will be available between 2040 and 2140, with 2080 as the most likely date. It is assumed that waste will be transferred to the facility within 10 years of the facility becoming operational. Within this time frame, the present storage provisions and proposed new stores are adequate. If on-site storage of wastes beyond 2080 is required, additional stores may be required. AWE has already committed to building another ILW store, to be operational by 2006, and the decommissioning and liabilities estimate includes provision for three more up to 2040.

129 NII notes that the timing of the availability of a disposal route and the associated costs are uncertainties applying to all nuclear operators, and that the new Committee on Radioactive Waste Management will be given the task of recommending a long-term ILW management strategy to the Government, following stakeholder consultation.

### ***Progress with decommissioning and systematic reduction of hazard***

130 Two of NII's fundamental expectations with respect to decommissioning and waste management are firstly, that hazards associated with the plant should be reduced in a progressive and systematic manner, and secondly, that radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long term solution. In 1999, NII published a review of the storage of ILW in the UK (Ref 11) in which it was noted that all the ILW stored at Aldermaston is in the unconditioned form (although it is contained within AWE-approved waste packages). The situation remains essentially the same.

131 Hazard potential will reduce when "legacy" wastes and other nuclear materials are retrieved from their current locations, treated to render them passively safe, then transferred to interim stores until a long term management solution is available. The current situation for the most significant waste streams has been discussed in earlier sections of this report.

132 In the case of decommissioning, there has been tendency in the past to defer the decommissioning of redundant facilities, sometimes with minimal post operational clean out. A 10-year plan, however, has been agreed with NII for the major decommissioning projects for which progress has been generally as scheduled with no major problems regarding the strategy or methods employed. An additional facility has been completely decommissioned to the ground slab.

133 NII has recently formally agreed an amendment to the approved 10-year decommissioning plan which was first approved when the sites were relicensed in April 2000. One major facility will not be released for decommissioning on the timescales previously assumed, for operational reasons, and this is now reflected in the amended 10-year plan. Other less significant changes have been made to the plan to more accurately reflect what will happen over the coming decade. The new plan remains challenging, but NII believes that it can be delivered if the current level of resource is maintained.

### **Safety**

134 The decommissioning of redundant nuclear facilities at AWE primarily presents risks to the operators rather than to the public or to the environment. In the case of facilities contaminated with plutonium, dismantling operations are undertaken manually by workers wearing pressurised suits, and doses are expected to be very low. Working arrangements are not yet specified for beta-gamma facilities to be decommissioned in the future, but account will be given for the higher levels of beta-gamma and neutron activity and the related dose levels compared to alpha facilities.

### **Management and organisation**

135 In June 2001, NII published a report on the performance of AWE plc as a licensee twelve months after the relicensing of the Aldermaston and Burghfield sites (Ref 19). NII's overall conclusion at that time was that AWE's performance had been satisfactory and demonstrated that the licensee had successfully managed health and safety. The new contractor had not only built on the strengths of the previous contractor but had also undertaken some initiatives to improve safety performance and progress in the areas of waste management and decommissioning. NII has continued to monitor the performance of the licensee in the two years or so since that report was published, and this overall conclusion is still valid.

136 The achievement of AWE's current programmes depends on the continued availability of suitably qualified and experienced personnel. AWE recognises, however, that the recruitment and retention of staff is a significant risk to the 10-year programme. Recruitment difficulties are being experienced for a number of disciplines. This issue is not unique to AWE as a problem exists for the industry as a whole, particularly those licensees with continuing and increasing decommissioning and waste management programmes.

### **Authorisations for discharges/disposals and OSPAR**

137 The Government has issued a strategy for liquid radioactive waste discharges (Ref 20) which shows how the UK intends to meet its obligations under the OSPAR

agreement. The Government has also stated that it will apply similar principles to aerial discharges in the future. It has also published draft statutory guidance to the Environment Agency on the interpretation of OSPAR in relation to the granting of discharge authorisations.

138 The closure of the Pangbourne pipeline and the proposed new arrangements for the management of liquid wastes on-site will be AWE's main contributions to the achievement of the OSPAR strategy. There is however a potential conflict between the objective of progressive reductions of discharges over the next 20 years and AWE's aim of a continuing and increasing programme of decommissioning and waste treatment at Aldermaston. In NII's view, there will need to be flexibility in the application of the Government objective to reduce discharges in relation to decommissioning and waste treatment if a progressive reduction of hazard is to be achieved. Too restrictive discharge requirements could have implications on safety and costs by delaying projects.

### ***Research and development***

139 Unlike some other complex nuclear sites in the UK, none of AWE's current or future decommissioning projects poses major technical challenges or requires novel solutions to be developed. The techniques are commonly used in the nuclear industry world-wide (and in other industries). It is the means of application to the particular facility and environment at AWE that has to be developed. AWE is, however, currently sponsoring research in number of areas including oil treatment, decommissioning size reduction techniques, waste minimisation and land remediation techniques.

140 AWE has recognised the need to keep up-to-date in decommissioning experience and R&D throughout the world. The Company is a participant in the European Commission Framework 5 Thematic Network on decommissioning, together with the majority of nuclear operators in the European Union (and the Applicant Countries). It also co-operates with other nuclear operators (BNFL, UKAEA and with the similar Los Alamos nuclear site in the USA) in benchmarking exercises and the sharing of experience. It participates in the SAFEGROUNDS project (Ref 25) to develop guidance on good practices and options for the management of contaminated ground. NII supports AWE's liaison with other organisations and believes that the scope for increasing this collaboration should be considered.

### ***Records***

141 Conditions 6 and 25 of the nuclear site licence require the licensee to make and preserve adequate records. These include records of the amount and location of all radioactive material and the operation history of nuclear plant. Decommissioning experience throughout the world has shown the importance of adequate records in supporting decommissioning projects.

142 Well-established document management systems are in place at AWE for the control of issues and document storage, and there is a system dedicated to waste management and decommissioning projects. Records management, however, is an

area identified in AWE's quinquennial review documentation as needing some improvement.

### ***Consultation with general public and interested parties***

143 AWE aims to have an open communications strategy. It has a local liaison committee and a range of information is available on its web site including annual reports on safety and environmental performance. AWE intends to publish a public information leaflet on its decommissioning strategy. The regulators encourage these initiatives since it is believed that the involvement of stakeholders, especially the public, is essential to the long-term success of decommissioning and waste management strategies. To support this, AWE should make publicly available as much information as possible on decommissioning, subject to any disclosure restrictions on grounds of national security.

### ***Costing the liabilities***

144 The "full life" decommissioning costs have been estimated in the following way: a). the costs of current decommissioning projects are based on project budgets included in the approved 10-year decommissioning plan; b). future decommissioning projects (beyond the 10 year plan) are costed based on the Outline Decommissioning Plans (ODPs); c). facilities for which an ODP does not exist are costed by factoring from their capital costs (or from the costs of decommissioning a similar facility).

145 The resulting costs are developed in a bespoke spreadsheet which gives, for each facility, the timing and duration of decommissioning and the cost of each decommissioning phase. Organisational costs (for example, the cost of corporate management, licence compliance and site monitoring) are included in the overhead provision and a contingency is applied to the total cost. The cost of maintaining an organisation after operations have ceased (assumed to be around 2058), and while the site is primarily a waste store, are also included. AWE notes, however, that this figure is uncertain. Costs of security are not presently incorporated in the liabilities estimate but will be included in future revisions.

146 At the time of the NII assessment, the spreadsheets were not official company documents and had not been subject to QA arrangements (for example, checking and verification). In addition, the storage and ownership of this information needed to be formalised and a mechanism for review of the datasheets initiated. These issues have been recognised by AWE and the spreadsheets have now been issued in a formally approved company document.

147 AWE practice is to set short term budgets (2 to 3 years) for decommissioning projects with a view to maintaining the required team of suitably qualified and experienced personnel (as opposed to costs based on a rigorous analysis of tasks). Although there is some merit in the present approach, for the longer term NII considers it preferable that costs should be based on task analysis and site interactions. Various costing systems are now being evaluated and the use of a computer-based modelling system for cost estimation will improve the cost estimation for future decommissioning projects. A work breakdown system is being

evaluated to assist in the recording of actual task costs. This will lead to the establishment of more reliable cost estimation based on actual costs incurred.

148 NII has approved the 10-year decommissioning programmes but has no direct influence on funding. As part of the normal commercial pressures, AWE's aim is to reduce expenditure. NII considers that the introduction of more efficient working practices as discussed in paras 88-89 would contribute in this area.

149 The initiatives underway to gather improved cost data will facilitate a better understanding of the make-up of decommissioning costs. AWE then proposes to target high cost areas with the intention of reducing costs. For example, significant savings are expected to be possible by accelerating a decommissioning programme to reduce the periods of surveillance/care and maintenance, where feasible (these costs can account for about 30% of the cost of decommissioning a facility). NII strongly supports initiatives of this sort which may speed up decommissioning.

### ***Funding and management contract***

150 AWE plc submitted an application to HSE for a nuclear site licence for Aldermaston and Burghfield in December 1999. Before granting a licence, HSE needs to be satisfied that the applicant has the necessary financial resources to discharge obligations and liabilities as required by the Nuclear Installations Act 1965 (as amended) (Ref 4). These include the safe management of radioactive waste and the decommissioning of nuclear facilities on the site.

151 The work undertaken by NII prior to relicensing is outlined in Ref 17 which covers matters such as contractual arrangements, AWE's Safety Management Prospectus, the company's financial standing, and the funding for decommissioning and waste management. It was noted in that report that MoD had provided an assurance that, as regards the funding levels for decommissioning and waste management, the management contractor was committed to meeting all identified decommissioning and waste management requirements known at the point of bidding. (MoD however retains the liability for LLW disposal to Drigg and for future charges for disposal of ILW). To the extent that regulatory requirements imposed on AWE plc increased the commitment associated with decommissioning and waste management beyond that contemplated in the contract, the associated additional costs would fall to MoD. In view of the work done by NII prior to relicensing, and the assurances provided by MoD, a detailed assessment of the funding arrangements has not been undertaken as part of this quinquennial review.

152 The initial contract awarded covered a ten-year period from April 2000. Subsequently, an extension of the contract from 10 to 25 years has been offered by MoD, accepted by AWE Management Limited, and announced in January 2003. The MoD decision to offer the extension was based on the successful performance of the contractor during the initial two and a half years of the 10-year contract.

153 An important factor in the new management arrangements is a partnering agreement between AWE plc and MoD to facilitate the efficient delivery of MoD's requirements. As part of the contract, the licensee is required to put forward a number of Performance Measures to MoD. These measures form part of the

Performance Evaluation Plan (PEP) and are the means that the licensee demonstrates continuous improvement. The measures represent important parts of the AWE plc's business activities, and each is designed to make an assessment of how well the company performs when undertaking these activities. Among the measures in the Year 3 (2002-2003) PEP are the following, relating to the Environmental Programmes Group activities: a). the emptying of ILW from an elderly facility which does not meet modern standards; progress with the closure of the Pangbourne pipeline; progress with the decommissioning of a major facility; progress with a Geographical Information System (a tool to assist the management of contaminated land).

154 NII welcomes the extension of the licensee's contract because, in principle, this should enable a better focus on medium and long term decommissioning and waste management issues, and should facilitate the further development of the strategy beyond the first 10 years.

#### **4 CONCLUSIONS**

155 This section draws together the issues identified in section 3, discusses their significance in the context of AWE's current site strategies and the liabilities estimate, and draws overall conclusions.

156 The requirement to undertake a review of decommissioning strategy has caused AWE to systematically assess its decommissioning liabilities and to begin to develop a process of strategic planning for their long-term management. Recognising the scale of the liabilities, NII considers that a good start has been made and supports the proposals that AWE has in hand for the development of the process.

157 AWE's submission is generally considered to cover the key issues associated with the Aldermaston and Burghfield sites, although it is noted that the long-term future of the sites is not well defined at the present time. NII believes that AWE has considered a comprehensive list of liabilities covering all nuclear facilities, waste arisings and contaminated land at the Aldermaston and Burghfield sites, based on current knowledge. Some liabilities, however, require further characterisation.

158 A decommissioning programme extending to 2094 has been produced which covers the decommissioning of all nuclear facilities on the Aldermaston and Burghfield sites, which shows that by 2023 about half of the current AWE facilities will have been decommissioned.

159 During the preparation of the quinquennial review submission, AWE recognised that the information and process for the production of the programme, cost and waste estimates were unlikely to be judged sufficiently robust by NII. AWE's submission therefore identified a number of areas for improvement. These are being actively pursued and the licensee has already made significant progress. This should reduce uncertainties in the liabilities estimate.

160 On becoming the nuclear licensee in April 2000, AWE inherited a legacy of old buildings, nuclear facilities, radioactive wastes and contaminated land. Some of

the buildings have been in Surveillance and Maintenance for many years and others have ceased operation. Consequently NII would welcome an acceleration of the decommissioning programme, if this is found to be reasonably practicable. NII understands that AWE intends to gain a better understanding of the make up of decommissioning costs and to target the high costs areas which may include a reduction of the periods of Surveillance and Maintenance. NII strongly encourages such initiatives. NII also strongly supports AWE's work to develop and implement decommissioning techniques and facilities which have the potential to significantly speed up the rate of decommissioning and reduce the collective dose to operators.

161 AWE has developed strategies for the management of most, but not all, wastes streams on the site. NII believes that AWE has made good progress with the project to retrieve and condition sludges from the old tanks and understands that the dates in the relevant licence instruments are expected to be met. NII, however, is disappointed with the current situation concerning alpha contaminated solid ILW and is currently in discussions with the licensee with the intention of ensuring that these wastes will be treated with an appropriate priority.

162 AWE's submission is unclear about the timescale associated with the strategies for some waste streams. NII expectation is that the next quinquennial review submission should include waste management programmes covering all wastes, and any new facilities required, with clear planning timescales.

163 The waste inventory provided for the purpose of the quinquennial review has been produced independently of AWE's contribution to the UK Radioactive Waste Inventory which is compiled on behalf of DEFRA. These two inventories are not consistent and this is being rectified.

164 Although AWE has made good progress with various waste minimisation initiatives on the Aldermaston site, NII believes that AWE needs to give further consideration to the scope for reducing the production of both primary and secondary wastes. AWE should also review the wastes accumulated in its facilities and consider whether disposal/treatment routes already exist (or could be established without undue effort), in which case the wastes should be removed as soon as is reasonably practicable.

165 The decommissioning work should be achievable by the adoption of well-understood techniques which are commonly used in the nuclear industry worldwide, and should not pose any unusual or unique technical challenges. NII welcomes AWE's evaluation of decontamination techniques which have the potential to reduce future arisings of solid wastes.

166 NII has formally approved under the site licence a 10-year decommissioning programme and three separate programmes covering the major decommissioning projects. Progress has generally been as scheduled with no major problems regarding the strategy or methods employed. The decommissioning dates for one facility have been put back for operational reasons which NII has accepted.

167 The assumptions on which the decommissioning liabilities are managed and costed are clearly laid out in AWE's submission. All of these contain inherent

uncertainties which could impact on AWE's strategies and liabilities estimate in the future, a number of which are not wholly under AWE's control. These issues have been recognised by AWE, and their impacts are being addressed by the introduction of the improved planning tools.

168 A significant uncertainty is lack of clarity on certain aspects of Government policy, in particular the long-term management option for ILW. Other risks and uncertainties include: social factors; funding; the availability of suitably experienced personnel; the Government's defence policy; the implementation of the OSPAR agreement; the disposal of LLW and high volume low active waste; and the decommissioning end point.

169 NII's overall conclusion is that the strategy proposed by AWE is generally appropriate, as far as it has been defined. The scope of the strategy for both sites is believed to be comprehensive, although for some liabilities further work is required to develop the management strategy. The overall strategy is generally sufficiently flexible to be adapted to take account of changing circumstances.

170 There are several areas where AWE needs to develop its strategy before the next quinquennial review and significant progress is already being made. NII will progress these issues with AWE as part of its routine regulatory work. AWE's liabilities do not pose any unusual or unique challenges therefore the uncertainties in the liabilities estimate are less compared to some other licensed sites. There are however a number of other risks and uncertainties associated with the site strategies and liabilities estimate, which are not wholly within AWE's control. NII believes that AWE's liabilities cost estimate at this stage is acceptable based on current knowledge, and this will be improved by the introduction of better management tools. A future increase in the liabilities estimate, however, cannot be ruled out.

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