



Health and Safety Executive  
HM Nuclear Installations Inspectorate

**BAE SYSTEMS Marine Ltd's  
strategy for the decommissioning  
of the Barrow nuclear licensed site**

A Review by HM Nuclear Installations Inspectorate

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Health and Safety Executive  
Nuclear Safety Directorate Information Centre  
Room 004, St Peters' House  
Balliol Road  
Bootle  
Merseyside L20 3LZ

Tel: 0151 951 4103

Fax: 0151951 4004

E:mail: <mailto:nsd.library@hse.gsi.gov.uk>

## 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 Barrow nuclear licensed site. The site is operated by BAE Systems Marine Ltd (BAES) within a commercial dockyard. The work carried out on the licensed site is in support of the Ministry of Defence's (MoD) nuclear submarine programme. The company is the prime contractor for the design, build and in-service support of new nuclear submarines. The review has been undertaken in accordance with the Government White Paper, "Review of Radioactive Waste Management Policy: Final Conclusions" (Cm 2919) published in 1995.

The review considers BAES's strategy in relation to regulatory guidance, the underlying assumptions made, and whether the plans are comprehensive and appropriate. BAES's approach to quantifying the tasks and the necessary liability provisions is reviewed.

Our overall conclusion is that, based on current knowledge, the strategy proposed by BAES for the decommissioning of the Barrow site is generally appropriate, so far as it has been defined. BAES intends to review the strategy on a regular basis to ensure that it remains valid. NII intends to review the situation again in five years time to ensure that it remains appropriate should new information change current assumptions.

Laurence Williams  
Director of Nuclear Safety and  
HM Chief Inspector of Nuclear Installations  
Health and Safety Executive  
St Peter's House  
Balliol Road  
Bootle  
Merseyside  
L20 3LZ

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# 1 INTRODUCTION

1 Government Policy set down in the 1995 White Paper “Review of Radioactive Waste Management Policy: Final Conclusions,” Cmnd 2919 requires nuclear operators to draw up strategies for the decommissioning of their redundant plant, including justification of the timescales proposed and the adequacy of the financial provision (Ref 1). To ensure that the operators decommissioning strategies remain soundly based as circumstances change, the White Paper places a requirement that the Health and Safety Executive (HSE) reviews these strategies quinquennially, in consultation with the environment agencies. The HSE asked HM Nuclear Installations Inspectorate (NII) to undertake the reviews on its behalf. The NII is one of the specialist inspectorates of the HSE.

2 This report presents the outcome of NII’s quinquennial review of the decommissioning strategy of BAE SYSTEMS Marine Ltd (BAES) for the nuclear licensed site at Barrow-in-Furness in Cumbria.

3 The report is structured as follows:

- Section 2 provides background information to the review with a summary of the decommissioning strategy for the site;
- Section 3 presents the review;
- Section 4 presents the overall conclusions.

## 2 BACKGROUND INFORMATION

### 2.1 Work required of HSE

4 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 (Ref 2), which has been published on the HSE web site. NII has examined the licensee’s strategy with two main objectives:

- first, to consider the adequacy of the plans for the eventual removal of all the nuclear liabilities from the Barrow nuclear licensed site; and
- second, to consider briefly the arrangements for funding the liabilities so that the work may proceed.

5 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 the licensee’s strategy for the decommissioning of its redundant nuclear facilities and the management of radioactive wastes.

## **2.2 Legislative background**

6 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 (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 that part of the HSE that is responsible for administering this licensing function and enforcing NIA 65 and HSWA 74 on nuclear sites.

7 NII's regulatory responsibilities on nuclear licensed sites include the regulation of the licensee's decommissioning activities, and activities associated with the on-site management of nuclear material and radioactive wastes. The relevant environment agency (i.e. the Environment Agency in England and Wales, and the Scottish Environmental Protection Agency in Scotland) is responsible for regulating discharges to the environment and the disposal of radioactive wastes on or from nuclear licensed sites, under the terms of the Radioactive Substances Act 1993 (Ref 5). Formal administrative arrangements (Refs 6 and 7) ensure that the NII and the environment agencies work closely together to ensure compliance with requirements.

8 NIA 65 provides HSE with powers to attach conditions to the licence in respect of safety and with respect to the management of nuclear matter, which includes radioactive waste. HSWA 74 provides the regulatory powers to enforce these conditions. The standard licence conditions are reproduced in Ref 8. All the licence conditions apply to decommissioning and the management of nuclear material and radioactive wastes. However, a number of licence conditions are particularly relevant to such activities, and these are discussed further in Refs 2 and 9.

9 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 where practicable.

## **2.3 Regulatory guidance**

10 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.

11 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.

12 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.

13 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.

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

## **2.4 The Barrow nuclear licensed site**

15 BAES operates a nuclear licensed site within a commercial shipyard at Barrow-in-Furness, Cumbria. The work carried out on the licensed site is primarily the building, testing and commissioning of nuclear submarines in support of the Ministry of Defence (MoD's) nuclear submarine programme. The company is the prime contractor for the new Astute class of submarine and is responsible for the design, build and initial in-service support of three new submarines. The first two submarines are under construction, however no radioactive waste is expected to be produced for a few years.

16 The nuclear licensed site largely consists of the Devonshire Dock Complex. This includes:

- the Devonshire Dock Hall (which provides undercover construction facilities);
- the Ship Lift (which allows completed vessels to be lowered into, and lifted out of, the water);

- the New Core Facility (used for the storage of fuel modules etc); and,
- wet docks and auxiliary buildings.

17 In comparison with some other nuclear licensed sites in the UK, the Barrow site is compact and contains only small amounts of radioactive materials, which are associated with the commissioning of submarine nuclear reactors. The radioactive inventories at Barrow are very low because the reactors are either new or have been operated for only short periods. The majority of activity on the site is short-lived, the dominant radionuclides likely to be encountered during decommissioning, depending on the radionuclide decay period before decommissioning, being tritium in the form of tritiated water and cobalt-60 collected in ion exchange resins.

## **2.5 Context of the review**

18 There have been several external developments since Cm 2919 (Ref 1) was issued in 1995. These include the Government's proposals for developing policy for the management of solid radioactive waste (Ref 11), the proposal to establish the Nuclear Decommissioning Authority (Ref 12), the UK strategy for radioactive waste discharges (Ref 13), and the Government's proposed revision to the UK nuclear decommissioning policy (Ref 14). In general, these developments are of less significance to BAES's decommissioning strategy, compared to the strategies of some other licensees in the UK, due to the nature of the decommissioning tasks which will eventually be required at the Barrow site. However, those external factors which may impact BAES's strategy are discussed later, where appropriate, in the findings section of this report.

19 The Government's consultation document on the revised UK decommissioning policy proposes that the existing quinquennial review process should continue for those licensees such as BAES, which will remain outside the remit of the Nuclear Decommissioning Authority (NDA). Alternative arrangements are planned for the BNFL and UKAEA site strategies which will come under the control of the NDA (Ref 14).

## **3 THE TECHNICAL REVIEW**

### **3.1 The review process**

20 The technical assessment has considered the licensee's strategy and supporting information in relation to NII's internal guidance for decommissioning and waste management (Refs 2 and 9). The submission has been assessed by:

- consideration of BAES's general approach, in particular, with regard to the fundamental expectations set down in NII guidance; and
- examination of the assumptions upon which the site strategy is based to determine their validity.

21 The review process also involved meetings with BAES staff during which further data was obtained, and visits to those operational facilities, which will eventually be decommissioned.

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

22 BAES's decommissioning policy states that: "facilities shall be appropriately decommissioned as soon as practicable after they have been declared no longer fit for purpose or after they have been deemed to be surplus to requirements." The decommissioning strategy does not include a programme for the decommissioning of individual facilities, however it states that one of the purposes of the plan is to demonstrate that the licensee is committed to decommissioning redundant facilities at the earliest opportunity. The strategy also states that a principal objective is to dispense with the need for expensive care and maintenance of redundant facilities.

23 This approach is consistent with the Government's existing and proposed Government policies (Refs 1 and 14), noting that there is no radiological benefit from delaying decommissioning due to the low radioactive inventories.

24 As stated in para 15, the licensee is contracted to build and commission three Astute class submarines, which means that the facilities on the site will remain in operation for the foreseeable future (though decisions are awaited as to whether some facilities should be replaced (see para 28)). Their role thereafter will depend on the Government's submarine policy. However, given the nature of these facilities, decommissioning could be started at any time once they are declared redundant, subject to the availability of funding and disposal routes.

### ***Decommissioning plan***

25 A decommissioning plan for the nuclear licensed site has been produced by a specialist consultant on behalf of the licensee. It covers all facilities on the licensed site that could comprise a radiological hazard, and other facilities which do not require radiological decommissioning, but whose decommissioning must be undertaken in a controlled manner to minimise any threat to nuclear safety functions.

26 The plan describes the overall strategy for decommissioning, and includes further details for individual facilities in a series of appendices. The topics covered in the plan include the following: the expected radioactive and hazardous inventories (in general terms); the decommissioning tasks to be carried out; a consideration of the decommissioning methods; various options for the extent of decommissioning for individual facilities; and the waste routes. The plan specifically considers the decommissioning of the following facilities:

- **New Core Facility.** This facility is not expected to contain radioactive contamination at the time of decommissioning, based on existing operational survey data. The plan assumes that the facility is free from radioactive contamination and that only conventional (non-radioactive) wastes will be produced. (The intention is to confirm this by detailed surveys prior to decommissioning);

- Core Load House. This building is also assumed to be free of radioactive contamination, based on operational experience;
- Nuclear Facilities Barge. This facility has treated primary reactor circuit effluents. The plan assumes that its decommissioning will give rise to solid and liquid radioactive wastes;
- Radiochemistry Laboratory. Only a small area of the laboratories employs, or has employed, radioactive materials. Based on operational experience, the plan assumes that decommissioning of this facility will give rise to very low volumes of Low Level Waste (LLW), the majority of the decommissioning waste is expected to be conventional waste;
- Active Drains Shore Facility. The plan assumes that the tanks and process pipework associated with this facility will be disposed of as LLW, unless monitoring at the time of decommissioning shows that the waste is suitable for free release;
- Primary Effluent Tanks. The plan assumes that these tanks will be disposed of as LLW, unless monitoring at the time of decommissioning shows that the waste is suitable for free release.

27 The plan is intended to provide a framework for the development of safety cases, safety management systems, quality assurance and decommissioning work packages. At the current time the plan is presented at a general level, but identifies the requirement for more detailed studies to be undertaken for individual facilities prior to decommissioning. This more detailed work would include aspects such as: preparation of an in-depth hazardous inventory; the development of decommissioning risk assessments and method statements; and the production of Best Practicable Environmental Option (BPEO) and Best Practicable Means (BPM) studies. In view of the nature of the decommissioning tasks on the site, this approach is considered to be acceptable. BAES intends to review the plan on an annual basis to ensure that the initial assumptions, and costs underpinning it, remain valid.

28 Decisions are awaited whether the Nuclear Facilities Barge and Primary Effluent Tanks referred to in para 26 should be refurbished or replaced with new on-shore facilities to support the Astute class build programme. If it was decided to provide new facilities then the existing plant would be available for decommissioning. A revision to the Discharge Authorisation would be required for the disposal of the relatively small quantities of resulting wastes.

### ***Decommissioning methods and safety of decommissioning***

29 NII expects that redundant facilities will be decommissioned using previously proven conventional techniques. No novel techniques will need to be developed and no unusual safety issues are expected to be encountered, largely due to the low radioactive inventory.

### ***Decommissioning stages***

30 The licensee had defined three stages of decommissioning based on IAEA decommissioning principles, and has introduced a further stage (Stage 0). Stages 1 and 2 will be amalgamated wherever possible. The stages are:

- Stage 0. This stage covers enabling work such as the preparation of detailed decommissioning plans, safety documentation, detailed radiological surveys, and surveys of services that may require upgrading to support decommissioning;
- Stage 1. Safe Enclosure and Surveillance. This is the period between cessation of operations and active decommissioning;
- Stage 2. This stage covers the removal and disposal of any active equipment and known contamination;
- Stage 3. Decontamination and dismantling of the plant up to free release of the site for non-nuclear use (unrestricted release). This covers the demolition of facilities considered to be unsuitable for reuse.

31 The strategy includes two options for the decommissioning of the New Core Facility, the Core Load Facility, and the Radiochemistry Laboratory. These are: decommissioning following removal of all the conventional plant and their associated mechanical and electrical systems followed by civil demolition to the base slab; and decommissioning following removal of the minimum conventional plant to agreed clearance criteria followed by unrestricted re-use. Decommissioning cost estimates have been produced for both options.

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

32 As well as decontamination and decommissioning of redundant plant, the strategy takes account of the eventual need for a full site survey for both radiological and conventional contamination, together with the associated documentation. The objective of the survey is to fully characterise the status of the site to provide evidence that it can be delicensed at the relevant time. There is no allowance in the overall decommissioning cost estimate for the remediation of any additional radiological or conventional contamination. It is noted, however, that there is no evidence that contamination resulting from operations on the site is likely to be a significant issue at the time of delicensing.

### ***Management of decommissioning***

33 There is no decommissioning underway at the current time, and there are no facilities on the site which have been declared redundant and are awaiting decommissioning. The licensee recognises that the decommissioning of nuclear facilities is a specialist task, which is generally outside the scope of the company's experience. BAES identifies the likely need to employ contractors to undertake the physical decommissioning work, as well as specialist consultants to prepare decommissioning plans etc. NII has no objection in principle to the use of specialist

contractors, in fact NII recognises that contractors can provide valuable skills and experience to supplement those of the licensee. However, the licensee needs to be in control of nuclear safety at all time, and needs to have the capability to act as an intelligent customer for work which is contracted out.

### ***Decommissioning end point and delicensing***

34 The objective is to decommission the site to a “brown field” to enable it to be delicensed for future use as a commercial shipyard or other industrial use. The existing facilities will either be decommissioned to ground slab, or will be decommissioned to the extent that allows re-use. These objectives are consistent with the proposals in the Government’s consultation document on decommissioning policy (Ref 14).

35 The sediment within the docks, and the infill material brought ashore as part of a construction project in the 1980s, are known to contain detectable levels of radioactivity, the source of which is believed to be discharges from Sellafield, weapons testing and Chernobyl, not the operations on the site. Sections 396b and 5(3)(a) of NIA65 contain a requirement for “no danger” and “cease to be any danger” from ionising radiations from anything on the site or that part of the site considered for delicensing. So far the courts have not considered the meaning of “no danger” and too strict an interpretation of this criterion could result in difficulties with the eventual delicensing of some sites, including parts of the Barrow site. HSE therefore intends to publicly consult on the interpretation of “no danger” to ensure that there is no harm to people or the environment but, at the same time, avoiding unnecessary restrictions on the re-use of land.

### ***Routine discharges***

36 The licensee has applied for a revision to the Discharge Authorisation granted by the EA under the terms of the Radioactive Substances Act 1993 (Ref 5). The EA has recently published an Explanatory Document (Ref 15) to assist public consultation on proposals for the future regulation of the disposal of liquid, aerial and solid radioactive waste from the site. This document states that whilst liquid and effluent discharges from the site have historically been at very low levels, the improvements to plant and systems which are proposed by the licensee would mean that discharges resulting from the Astute build programme are likely to be below the level of regulatory concern. The arisings of solid wastes from normal operations are also expected to be very low. EA recognises however that there may be a need in future for discharges to increase as a result of decommissioning of redundant plants, subject to Best Practicable Environmental Option and Best Practicable Means assessments. It should be noted that the EA would expect any decommissioning (and legacy) wastes to be segregated and accounted for separately if arising at the same time as ongoing operational wastes.

### ***Management of decommissioning wastes***

37 Decommissioning is predicted to generate relatively small quantities of radioactive wastes, based on the assumptions concerning the expected degree of radioactive contamination outlined in para 26. The bulk of the solid waste from decommissioning is expected to be free release. Eighty tonnes of LLW are

estimated to be produced, which will be sent for disposal at the Drigg disposal site in Cumbria. Small arisings of liquid effluent will also be produced. All waste disposals will be in accordance with the Discharge Authorisation granted by the Environment Agency at the relevant time. A future variation to the Discharge Authorisation however will be required for the disposal of decommissioning wastes, as the licensee's application to the EA referred to in the previous paragraph does not include decommissioning wastes.

### ***Legacy wastes***

38 Relatively small quantities of "legacy" wastes have accumulated on the site as a result of previous operations. These include ion exchange resins, detector equipment and radiochemistry calibration sources/standards. NII has encouraged the licensee to dispose of these wastes, noting that the storage of wastes on site when a disposal route exists is not in accordance with Government policy (Ref 1). EA proposes to set LLW disposal limits in the revised Discharge Authorisation to allow these wastes to be disposed of (Ref 15). These limits will be time-limited to the end of 2004, which means the licensee must dispose of the waste before that date.

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

39 The Government expects that the decommissioning strategies of licensees should take account of the views of stakeholders (Ref 14). NII therefore expects BAES to ensure that stakeholders' views have been taken into account in its next quinquennial review submission.

### ***Decommissioning cost estimate***

40 BAES has estimated indicative costs for the proposed decommissioning of each facility with the potential to constitute a radiological hazard, including the associated safety case, safety management, waste disposal costs, and site surveys. BAES's worst case estimate, based on the assumption that all the facilities under consideration will be found to contain some levels of residual contamination or will require to be demolished to some extent, is that the total cost of radiological decommissioning of the Barrow site is in the region of £1/2 million. This decommissioning cost is low in comparison with the decommissioning costs for some nuclear licensed sites in the UK and NII believes that this is largely a reflection of the low radioactive inventory on the Barrow site and the small number of facilities which have the potential for radioactive contamination.

41 BAES recognises that there is some uncertainty associated with this cost estimate and that the strategy will require routine periodic review and update. The costing information will be subject to annual review and escalation by use of appropriate indexes. The technical aspects of the individual facility plans will be subject to review and revalidation/amendment every three years to take account of developments in technology and industry best practice.

42 The strategy states that MoD has an irreducible responsibility for nuclear matter in the Naval Nuclear Propulsion Programme.

## 4 CONCLUSIONS

43 This section draws together the issues identified in sections 2 and 3, discusses their significance in the context of the site strategy and draws overall conclusions.

44 BAES has provided a description of the general principles it will follow when it carries out detailed planning for decommissioning of its nuclear site. It has not provided information on the programme, however the stated approach is to begin decommissioning shortly after the shutdown of the facilities. The decommissioning timescales depend on the nuclear submarine programme, however given appropriate resources, decommissioning of the facilities at Barrow could start at any time following shutdown as there is no radiological benefit from decay.

45 In comparison to many other nuclear licensed sites in the UK, the BAES site contains only a small number of facilities which will, or may, require radiological decommissioning, and the radioactive inventory at the time of decommissioning is expected to be low. Decommissioning is not expected to pose any significant or unusual hazard, should be achievable by established methods, and should not pose any significant technical challenges. The wastes resulting from decommissioning are expected to be mainly free release material and relatively small volumes of low level waste. BAES expects to use its existing authorised disposal routes, or if necessary apply for new authorisations.

46 There is currently some uncertainty concerning the eventual delicensing of the site as a result of detectable radiation in infill material from offsite sources. HSE's forthcoming public consultation on the criteria for "no danger" is relevant to this issue.

47 BAES recognises that there is some uncertainty associated with the strategy and has stated that the costing information will be subject to annual review and that the technical aspects of the individual facility plans will be subject to review every three years. MoD has agreed with BAES that the nuclear decommissioning liabilities for the Barrow site reside with the Ministry of Defence. Issues arising from this quinquennial review will be progressed with the licensee as part of NII's routine regulatory work.

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