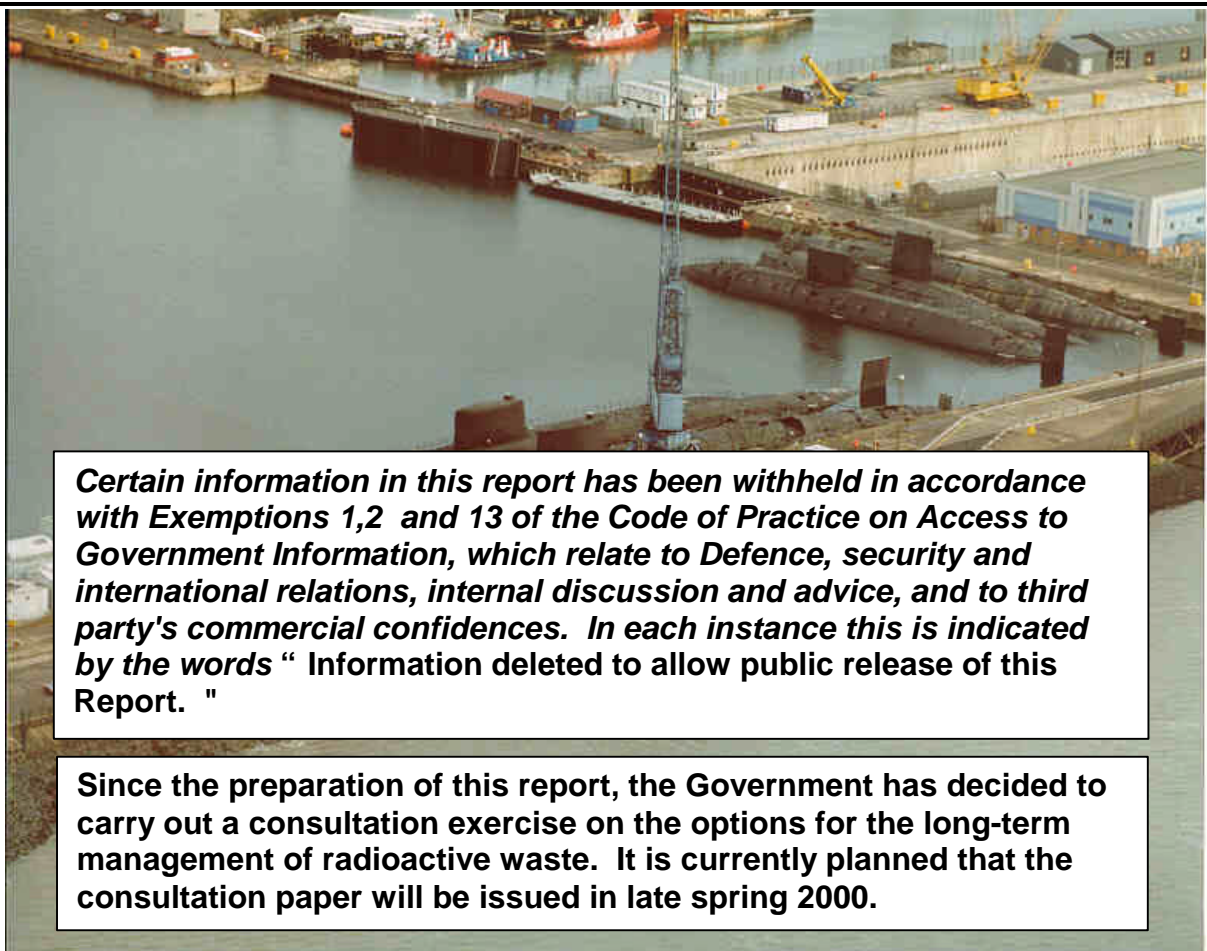


THE ISOLUS INVESTIGATION

A REVIEW OF OPTIONS FOR
INTERIM STORAGE OF REACTOR COMPARTMENTS AND ASSOCIATED HULL
AND STRUCTURE OF UK NUCLEAR SUBMARINES
FOLLOWING THEIR WITHDRAWAL FROM SERVICE
AND PENDING FINAL DISPOSAL

CONCEPT PHASE REPORT - ISSUE 1 - 26 MAY 1999
EDITED FOR PUBLIC RELEASE – 20 APRIL 2000

by The Ships Support Agency, Foxhill, Bath, BA1 5AB



Certain information in this report has been withheld in accordance with Exemptions 1,2 and 13 of the Code of Practice on Access to Government Information, which relate to Defence, security and international relations, internal discussion and advice, and to third party's commercial confidences. In each instance this is indicated by the words " Information deleted to allow public release of this Report. "

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THE ISOLUS STUDY

CONCEPT PHASE REPORT - ISSUE 1 - 26 MAY 1999 EDITED FOR PUBLIC RELEASE – 20 APRIL 2000

CONTENTS

<u>Subject</u>	<u>Page</u>
<u>EXECUTIVE SUMMARY</u>	3
INTRODUCTION	3
CONSTRAINTS.....	3
OPTIMUM STORAGE PERIOD	3
PUBLIC PERCEPTION	3
OPTIONS CONSIDERED	4
Afloat Storage.....	4
Land Storage	4
COMPARISON OF VIABLE OPTIONS.....	5
BRDL PROPOSAL	5
CONCLUSIONS	6
RECOMMENDATIONS.....	6
<u>OVERVIEW REPORT</u>	7
INTRODUCTION	7
AIMS	7
SCOPE	7
BACKGROUND	8
CONSTRAINTS	9
CRITERIA FOR ASSESSMENT OF OPTIONS	9
PRIMARY CRITERIA.....	9
CRITICAL SUCCESS FACTORS	9
OVERVIEW OF LEGISLATIVE AND REGULATORY ISSUES	10
THE CURRENT REGIME	10
The Nuclear Installations Act 1965 (NIA65).....	10
The Radioactive Substances Act 1993 (RSA93).....	10
POSSIBLE FUTURE DEVELOPMENTS	11
OVERVIEW OF PUBLIC PRESENTATION ISSUES	12
VIEWS OF THE PRESSURE GROUPS	12
Greenpeace	12
Friends of the Earth (FoE), Scotland	13
Scottish CND.....	13
Plymouth Nuclear Dump Information Group (DIG).....	13
[Information deleted to allow public release of this Report.].....	13

IMPLICATIONS FOR FUTURE OPTIONS	13
Continued Afloat Storage	13
Land Storage	14
Planning for indefinite storage	15
PREREQUISITES FOR STORAGE	16
OPTIMUM STORAGE PERIOD	16
DISPOSAL OF RESIDUAL HULL AND STRUCTURE	17
REVIEW OF INTERIM STORAGE OPTIONS.....	18
INTERIM STORAGE OPTIONS TO BE INVESTIGATED.....	18
AFLOAT STORAGE OF INTACT SUBMARINES	18
Current Position - Temporary Afloat Storage.....	18
Constraints on continuing Afloat Storage at current locations	19
Definition of options for interim storage of intact submarines afloat	19
Assessment of intact afloat-storage site options	20
AFLOAT STORAGE OF CROPPED SUBMARINE HULLS.....	21
Definition of Option	21
Assessment of Option.....	21
CONTINUING SHORTCOMINGS OF AFLOAT STORAGE AS A POLICY	22
LAND STORAGE	23
Definition of Land Storage Options	23
Assessment of Land Storage Options.....	24
BRDL Unsolicited Proposal	25
DEVELOPMENT OF AN INTERIM STORAGE STRATEGY	25
COMPARISON OF THROUGH-LIFE COSTS.....	27
COMPARISON OF VIABLE OPTIONS (PEST ANALYSIS).....	28
PROCUREMENT STRATEGY	29
SCOPE FOR PPPI	29
PROCUREMENT IMPLEMENTATION.....	29
Initiation of PPPI.....	29
Development of Public Sector Comparitor (PSC)	29
CONCLUSIONS	31
RECOMMENDATIONS	33
REFERENCES FOR OVERVIEW REPORT	35

ANNEXES:

- A. TERMS OF REFERENCE FOR ISOLUS INVESTIGATION
- B. STORAGE OF LAID UP SUBMARINES - A HISTORICAL NARRATIVE
- C. ASSESSMENT CRITERIA
- D. NOTES ON PRESSURE GROUPS
- E. NATURAL DECAY OF RADIOACTIVE ISOTOPES
- F. AFLOAT STORAGE OF INTACT SUBMARINE
- G. LAND STORAGE
- H. COMPARISON OF OPTIONS - PEST ANALYSIS
- I. USING ACCOUNTING AS AN AID TO DECISION MAKING

EXECUTIVE SUMMARY

INTRODUCTION

1. Ministerial approval was given in February 1998 to proceed with an in-house study into options for the interim storage of decommissioned nuclear submarines. The study was initiated because:
 - a. the expected completion date for the national Deep Waste Repository* has been delayed and is now not expected before 2040;
 - b. full capacity of the existing storage areas in Devonport and Rosyth will be reached in 2012; and,
 - c. MoD is criticised in the 1997 report by the Radioactive Waste Management Advisory Committee (RWMAC) as being perceived as having “no policy”, and this view has been supported by rising criticism in the media.

CONSTRAINTS

2. In considering the options available for the interim storage of the decommissioned nuclear submarines, there are two underlying constraints:
 - a. Storage is needed until at least 2040 before the radioactive waste can be sent to the national Deep Waste Repository* for final disposal.
 - b. The Rosyth Dockyard Sale Agreement precludes the berthing of any laid-up submarines which have not been defuelled at Rosyth.

OPTIMUM STORAGE PERIOD

3. Considerable benefit accrues from the current policy of storing the submarines for 30 years prior to disposal. However, there is significant additional advantage in storing for 60 years to optimise the gains in terms of a lower volume of radioactive waste for disposal and substantially reducing the dose burden to the break-up workforce.

PUBLIC PERCEPTION

4. The views of the environmental pressure groups, the public and the media must be recognised. Whatever the technical arguments, the preferred solution must stand up to public scrutiny if it is to obtain the necessary support for implementation. The third report of the House of Lords Select Committee on Science and Technology endorses this view.

* Refer to statement on long-term management of radioactive waste on front cover of this report

EXECUTIVE SUMMARY (CONTINUED)

OPTIONS CONSIDERED

5. The interim-storage options considered in this report fall into two categories: afloat and land storage.

Afloat Storage

6. The current afloat storage site in 3 Basin at Devonport will be full by 2012. Thereafter, to continue with a policy of afloat storage of laid-up submarines, two possible options were considered:

a. Alternative afloat storage sites were assessed: at Naval Dockyards, Naval Bases, Commercial Dockyards and remote sites. This assessment considered physical suitability, security of the site, likely reaction by the local population, and infrastructure available to support daily checks, annual maintenance and 10 yearly dockings. Following this assessment, the preferred alternative afloat storage venue is 4 Basin at Devonport.

b. Cropping of future hulls, to reduce the size of the vessel for afloat storage, would extend the capacity of the existing Devonport storage area, but only until 2025. Further, the cost of "cropping" would be similar to the cost of separating a Reactor Compartment for land storage, but there would be little saving in subsequent maintenance costs and none of the other disadvantages of afloat storage would be resolved. This option therefore was dismissed.

Land Storage

7. Four options for land storage were assessed:

a. Storage of intact submarines was dismissed as non-viable, having no tangible cost or environmental advantages over other land or afloat storage options.

b. Storage of separated Reactor Compartments is considered viable. It would:

(1) provide a safe, robust method for storing the radioactive waste, and significantly reduce future maintenance costs;

(2) retain the flexibility to adapt to alternative disposal initiatives in the future; and,

(3) permit early recycling of the residual hull and structure, and demonstrate a positive intent to deal with the waste storage problem.

c. Storage of Primary Reactor Plant components as unpackaged Intermediate Level Waste is considered a viable option. It would allow early disposal of the Reactor Compartment structure and reduce the storage space needed. However, because the majority of the processing is conducted immediately, this option has less flexibility for the future. Measures would also be necessary to reduce the dose burden to a tolerable level and reduce the volume of Low Level Waste requiring disposal.

EXECUTIVE SUMMARY (CONTINUED)

d. Storage of Intermediate Level Waste packaged ready for disposal offers little advantage in the absence of an available disposal facility* before 2040 because it would be unnecessarily dose intensive and costly, and it would remove all future flexibility. These issues would need to be addressed if this option were raised by Industry as part of a Public/Private Partnership Initiative (PPPI).

COMPARISON OF VIABLE OPTIONS

8. The four viable options addressed in the paper are:
- a. continued afloat storage at 3 and 4 Basin Devonport and at Rosyth;
 - b. land storage of separated Reactor Compartments;
 - c. land storage of Primary Plant components as unpackaged Intermediate Level Waste;
 - d. land storage of packaged Intermediate Level Waste.
9. These four options were compared by using a “PEST” analysis, which weighted each of the **P**rice/**C**ost, **E**nvironmental, **S**ocial/**P**olitical and **T**echnical parameters. The result of the analysis shows land storage of the separated Reactor Compartments to be the preferred option.
10. This result recognises that creation of a land storage facility, even on existing MoD sites, may be presentationally difficult. [Information deleted to allow public release of this Report.] The preferred storage option would be consistent with this proposal.
11. The analysis also highlights that, although additional space for afloat-storage could be found after 3 Basin at Devonport reaches its capacity, the shortcomings of afloat-storage would remain. These include an increasing maintenance burden, increasing visual environmental impact and adverse public perception, and a higher long-term cost than any of the short-listed land-storage options.
12. The financial analysis undertaken shows that there would be advantage in early implementation of the land storage option. This would avoid nugatory spend on afloat lay-up preparations and 10-yearly maintenance dockings which are due in the next few years, and it would minimise the risk of additional expenditure associated with delaying land-store processing of the submarines already laid-up at Rosyth.

BRDL PROPOSAL

13. During Phase 1 of the ISOLUS investigation BRDL has tabled a proposal [Information deleted to allow public release of this Report.]. There are several significant potential benefits in this proposal but there are also a number of issues which require to be de-risked before it can proceed; discussions with the Company are continuing.

* Refer to statement on long-term management of radioactive waste on front cover of this report

EXECUTIVE SUMMARY (CONTINUED)

CONCLUSIONS

14. The conclusions of the study are summarised as follows:
- a. Land storage of the separated Reactor Compartment is the favoured option, and there would be cost savings from its early implementation.
 - b. Land storage of Primary Plant components as unpackaged Intermediate Level Waste and land storage of packaged Intermediate Level Waste are each technically feasible and worthy of further consideration, particularly in a PPPI context.
 - c. Afloat storage should be considered only as a 'stop-gap' (but the necessary additional storage space could be found after 2012 if this option is chosen).
 - d. The optimum storage period is 60 years.
 - e. The chosen storage strategy should not be reliant on the realisation of a Deep Waste Repository *
 - f. There is advantage in pursuing the BRDL proposal [Information deleted to allow public release of this Report.].

RECOMMENDATIONS

15. The main recommendations are:
- a. to pursue a land storage strategy of 60 years storage before disposal, implemented as soon as possible; and,
 - b. to set up an adequately resourced project team for Phase 2 of the study:
 - (1) to refine the land-store site options and develop the Reactor Compartment land-storage option as a Public Sector Comparitor;
 - (2) to seek PPPI proposals;
 - (3) to develop an Invitation-to-Tender for the Development phase to follow Phase 2; and,
 - (4) to de-risk and implement the BRDL proposal [Information deleted to allow public release of this Report.].

* Refer to statement on long-term management of radioactive waste on front cover of this report

THE ISOLUS INVESTIGATION

OVERVIEW REPORT

INTRODUCTION

16. Ministerial approval¹ was given in February 1998 to commence an in-house investigation of the options for interim storage of the Reactor Compartments (RCs) and associated hull and structure of UK nuclear submarines following their withdrawal from service. USofS directed that, in addition to considering the options for Interim Land-Storage, the study should investigate alternative venues for Afloat Storage.

AIMS

17. The aims of this report are:
- a. to present the results of Phase 1 of the ISOLUS investigation which reviews viable options for interim storage of the radio-active waste in UK nuclear submarines prior to final disposal in the Deep Waste Repository *; and,
 - b. to make appropriate recommendations for Phase 2.

SCOPE

18. The range of options to be considered led to the study being divided initially into two phases as follows:
- a. Phase 1 (Viability). Phase 1, the subject of this report, is equivalent to the Concept Phase of the McKinsey Procurement cycle. It has reviewed all practicable options for interim storage of the radioactive waste in nuclear submarines withdrawn from service, it has eliminated those which merited no further consideration and it has ranked those which are worthy of deeper study. Possible sites for implementation of the viable options for such storage are identified and assessed, but options for processes which lead to ultimate disposal of the radioactive waste and disposal or recycling of the remainder of the submarine are considered only to the extent that they influence the rationale behind the storage options. Conclusions are drawn regarding the preferred way ahead and recommendations are made for work to be addressed during Phase 2.

¹ Reference A, in response to reference B.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

b. Phase 2 (Feasibility). If authorised on the basis of this report, Phase 2 (which will be equivalent to the Assessment Phase of the McKinsey Procurement cycle) will implement the recommendations of this Report.

19. The Terms of Reference for the Study are at Annex A.

BACKGROUND

20. Following abandonment of sea-dumping for the disposal of Intermediate Level Waste (ILW), and since the Defuel, De-equip and Lay-up Preparation (DDL²) of Dreadnought in Chatham in 1982², MoD's policy for the disposal of laid-up nuclear submarines has included temporary storage afloat for at least 30 years following the DDL². This policy allows the mean background radioactivity within the RC to decay prior to dismantling of the Primary Plant, and it reduces the quantity of ILW requiring final disposal in the national Deep Waste Repository ^{*},³, originally planned to become available about 2007-2012.

21. The need to reduce long term cost, and the potential logistical difficulties of maintaining increasing numbers of submarines stored afloat, led to various studies over the period 1988-1995 which indicated that there may be potential savings in the longer term if RCs are cut out and stored ashore prior to final disposal.

22. It will be noted that, in addition to the period of interim storage, the whole disposal process typically would involve: breaking and recycling the residual hull and structure; dismantling the Primary Plant; packaging the ILW and the Low Level Waste (LLW) for disposal; and transport of the packaged waste to the Deep Waste Repository ¹ (ILW) or to Drigg (LLW). There is scope for undertaking some of this process prior to storage.

23. To date, no decision has been made to reject or pursue the development of a Land-Storage option, but the recent, significant set-back in the development programme for the NIREX national Deep Waste Repository facility ^{*},⁴ led to approval for a review of alternatives to the current policy.

24. A fuller narrative of the historical background to the ISOLUS Study is at Annex B.

² Dreadnought was subsequently moved to Rosyth in 1983.

³ The national Deep Waste Repository ^{*} is sponsored by the Department of Environment, Transport and Regions (DETR) for the benefit of the whole UK Nuclear Industry. MoD expects to use some 8% of its capacity.

⁴ This setback gave rise to concerns which are reflected in reference C and in the submission at reference B. In particular, paragraph 37 of the covering report of reference C, while generally complimentary about the MoD's waste management strategy and its management of the laid-up hulls afloat, observed that lack of decision on the future management options (continued Afloat Storage, or cutting out of the Reactor Compartment which would then be stored on land) "has led to a public perception that the Royal Navy policy on this issue is to have no policy". RWMAC advised that "a clear policy should be established at an early date and published".

^{*} Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

CONSTRAINTS

25. Disposal Options. The ultimate aim is disposal of the radio-active waste. The only disposal option currently planned is land disposal in a Deep Waste Repository* when available ... [Information deleted to allow public release of this Report.]. Sea-dumping is not an option under the terms of the London Sea Dumping Convention, and disposal abroad is unacceptable.
26. Requirement for Interim Storage. Until such time as a final disposal route becomes available, all ILW from laid-up RN submarines will need to be stored on an interim basis. For planning purposes DG(Nuc) and BNFL are assuming currently that the proposed UK Deep Waste Repository* for ILW will become available in 2040⁵. No reason is seen to disagree with this assumption, and therefore all the options examined in this paper assume a requirement for interim storage of the ILW at least until that date.
27. Afloat Storage at Rosyth. The Dockyard Sale Agreement precludes the berthing of any laid-up submarines which have not been defuelled at Rosyth. Renown, the last submarine currently planned to defuel and decommission at the Dockyard, is due to complete in 2000.

CRITERIA FOR ASSESSMENT OF OPTIONS

PRIMARY CRITERIA

28. Each Interim Storage option encompasses a number of possible site and process options which have been assessed to determine their acceptability and rank them in order of preference. To narrow the options prior to a more rigorous analysis of the remainder, a preliminary subjective assessment has been undertaken, by exception, against three primary criteria (Viability, Socio-Political considerations, and Finance aspects). Each of these criteria embraces a range of issues, outlined briefly in Annex C. The issues relating to Legislation and Regulation, and to Public Presentation, have a significant bearing on all the options and are discussed at greater length below (paragraphs 30 - 53).

CRITICAL SUCCESS FACTORS

29. From the foregoing criteria, the following set of "Critical Success Factors" and "Success Factors" have been derived as a basis for an objective and systematic evaluation of the more viable options using a "PEST" analysis (Price, Environmental impact, Socio-political considerations, Technical issues). These factors are defined more fully in Annex C:

⁵ Reference D

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

- a. Under Critical Success Factors:
- (1) Price (Cost) covers affordability and vulnerability to cost escalation risks;
 - (2) Environmental Impact covers physical and visual acceptability;
 - (3) Social / Political Issues cover acceptability to local population and to pressure groups;
 - (4) Technical Issues cover maintainability; long-term sustainability; dose rate burden; flexibility to adapt; and ease of compliance with current and possible future Legislative and Regulatory requirements.
- b. Additional Success Factors cover alignment with the disposal policy adopted by Nuclear Industry, and adaptability to the optimum storage period.

OVERVIEW OF LEGISLATIVE AND REGULATORY ISSUES

THE CURRENT REGIME

The Nuclear Installations Act 1965 (NIA65)

30. Currently, when a submarine is withdrawn from service, defuel and lay-up preparation is conducted by the dockyard company on a licensed site, this DDLP activity being regulated by the Nuclear Installations Inspectorate (NII) under the Nuclear Installations Act 1965 (NIA65).

31. Subsequently, when the submarines are laid up in afloat storage, control passes to MoD and Crown Exemption from NIA65 applies. Instead, MoD is subject to a regime of self-regulation as prescribed by the Chairman of the Naval Nuclear Test and Safety Panel (CNNTSP). Self-regulation is managed under Naval Base Authorisations which are written in lieu of NIA65 “as if the Act applied”. Self-regulation is the only option available while MoD retains control of the submarines and Crown Exemption from NIA65 continues.

The Radioactive Substances Act 1993 (RSA93)

32. With regard to the Radioactive Substances Act 1993 (RSA93), while the laid-up submarines were not classified as radioactive waste, regulation under RSA93 was not appropriate (irrespective of Crown Exemption from RSA93). However, the MoD wishes to make the management of decommissioned nuclear submarines laid up in interim storage as open as possible. To achieve this it has now declared the submarines as radioactive waste⁶,

⁶ Reference E

OVERVIEW REPORT (CONTINUED)

allowing RSA93 to apply in principal, although Crown Exemption will still pertain⁷. Such external regulation, under Letters of Agreement drawn up between the MoD and the Environmental Agencies, will allow a more open approach to decommissioned submarine management to be adopted, countering some occasional criticism from other sources.

33. At Devonport the submarines are stored in an area (3 Basin) owned and managed by the MoD. In Rosyth, the Main Basin is owned by the company but the control of the submarines remains with the MoD. The control issue is fundamental; if Letters of Agreement are to be used to form the basis of external regulation MoD must be able to demonstrate managerial control of the vessels.

POSSIBLE FUTURE DEVELOPMENTS

34. The current regulatory position can continue while MoD retains day-to-day control of the submarines during interim storage. The effect of removing Crown Exemption from RSA93 (which is expected by about 2005) would be minimal as it will be necessary only to replace the Letters of Agreement with Formal Authorisations under RSA93.

35. However, the retention of day-to-day control could be incompatible with possible PPPI solutions (covering storage and subsequent disposal), and it is therefore necessary to consider the effects of passing control to a contractor.

36. With a contractor having control, the current interpretation of the legislation⁸ requires the storage to be on a Nuclear Licensed Site⁹, with “accumulation” regulated under NIA65, and disposal of material from the site regulated under RSA93.

37. The possibility of MoD losing Crown Exemption from NIA65 cannot be ignored but the likelihood is assessed to be only moderate in the next 10 years or so. The implications of such action for MoD would be very onerous in areas of activity, other than storage, where control could not easily be passed to a contractor, and it is therefore a route which MoD would not welcome¹⁰.

38. Without Crown Exemption from NIA65, the choices for interim storage would be for MoD either to retain control and itself become a licensee, or to pass control to a contractor

⁷ Crown exemption is given at Section 42 of RSA93. This applies to Premises which are occupied on behalf of the Crown for naval, military or air force purposes. Premises are defined at Section 47 of RSA93 and “includes any land, whether covered by buildings or not, including any place underground and any land covered by water”. If however, notwithstanding Crown exemption, interdepartmental arrangements are put in place in lieu of formal Registrations and Authorisations, Section 42 sub-section (6) of RSA93 requires the Chief Inspector to make these known to public and local authorities in accordance with Section 18 of the RSA93.

⁸ NIA65 applies to “*the storage, processing or disposal of nuclear fuel or of bulk quantities of other radioactive matter, being matter which has been produced or irradiated in the course of the production or use of nuclear fuel*”.

⁹ If there were advantages in avoiding the need for a Nuclear Site Licence, an argument might be made to regulate what is clearly a waste management process by the legislation primarily intended for this purpose (RSA 1993) rather than one which is aimed at nuclear safety (NIA 1965), but this is outwith the scope of this investigation and will not be discussed further in this report.

¹⁰ In-service submarines are not covered by NIA65, their reactors being “comprised in a means of transport”.

OVERVIEW REPORT (CONTINUED)

who would need to become a licensee. The following considerations would be relevant and would militate against both afloat storage and MoD retaining control of the waste:

- a. NIA65 states that “*a nuclear site licence shall not be granted to any person other than a body corporate and shall not be transferable*”. The MoD has never applied for a nuclear site licence and at present there is no mechanism for creating a body corporate within the organisation.
- b. Creating a site licence is expensive and could be a problem if the site were an area of open water where the boundary would be difficult to identify.
- c. De-licensing the site is also costly and, for afloat storage, would be complicated by the fact that a body of water has been licensed.
- d. At the end of the storage period, subsequent dismantling and packaging would need to be undertaken by a contractor on a Nuclear Licensed Site, control having been relinquished by the MoD.

39. The impact of these issues for afloat and land storage are discussed in Annexes F and G.

OVERVIEW OF PUBLIC PRESENTATION ISSUES

VIEWS OF THE PRESSURE GROUPS

40. It would be naïve to underestimate the influence that Pressure Groups, in particular Greenpeace, have on Government and, indeed, on International Policy regarding waste management and disposal. Greenpeace were instrumental in preventing the Sea Disposal of HMS Dreadnought, and continued to be at the forefront of the campaign to stop sea dumping of what they deem to be hazardous waste. (Brent Spar is another example.)

41. Annex D summarises the policy and views of Greenpeace International, and other influential Pressure Groups, and it discusses the implications of those views for the interim storage options investigated in this report. It is based on papers written by members of the various organisations, their individual Internet Web Sites, and comments made in the National Press. The following paragraphs highlight the views which are most relevant to the interim storage of radioactive waste in laid-up submarines.

Greenpeace

42. Greenpeace policy, while deploring the creation of radioactive waste in the first place, nevertheless recognises reality. It favours the *storage* of low, intermediate and high level

OVERVIEW REPORT (CONTINUED)

radioactive waste *at its site of origin*, to lessen the likelihood of lax management in the future. By implication dry storage is seen as preferable to afloat storage because it is more amenable to effective “management” of the waste.

43. Public consultation is strongly advocated by Greenpeace at every stage of developing a waste disposal strategy and it often points to public opinion to reinforce its anti waste-dump stance.

Friends of the Earth (FoE), Scotland

44. To a great extent FoE Scotland echoes the Greenpeace antipathy to “dumping”, particularly in Scotland.

Scottish CND

45. Scottish CND appears high on emotion but low on fact, and in general criticises without offering alternative solutions of its own.

Plymouth Nuclear Dump Information Group (DIG)

46. DIG is a voluntary, non-party-political pressure group which formed in 1988 when the MoD “*planned to build a radioactive waste storage dump in the City of Plymouth*”. Its stated aim is to research and inform on issues related to military radioactive wastes and materials in Plymouth and it seems keen to be seen to be developing a balanced view on these issues.

47. Behind this, DIG’s prime aim seems to be to remove the laid-up submarines from Plymouth.

48. In adopting this stance it prefers a “store and monitor” strategy, advocating a secure remote coastal site with the prospect of storing the reactor sections of the submarines intact in dry, above ground, monitorable conditions at either a new designated site or at an existing civil nuclear location well away from any centre of population.

[Information deleted to allow public release of this report.]

49. [Information deleted to allow public release of this report.]

IMPLICATIONS FOR FUTURE OPTIONS

“The importance of public acceptability is widely recognised: ... however well founded the safety case in the view of experts, no progress would be made without public acceptability.”

House of Lords Select Committee Report, March 1999 (reference F)

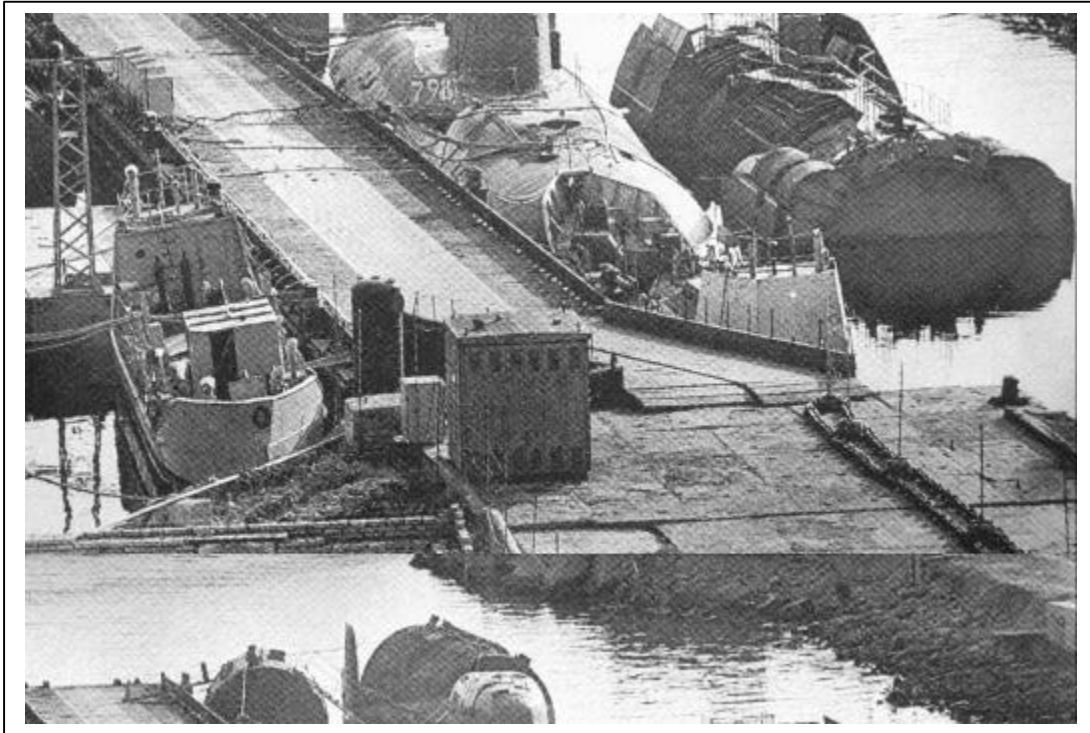
Continued Afloat Storage

50. Afloat storage is disliked by all the Pressure Groups for various reasons, not least because of images such as in Figure 1. Proposals to use afloat storage sites away from the

OVERVIEW REPORT (CONTINUED)

location of the currently laid-up submarines (Rosyth and Devonport) probably would be opposed vigorously, primarily on grounds of possible lax management in future, having been “dumped” and therefore “out-of-sight, out-of-mind”.

Figure 1 - Russian “hulks” in afloat storage.

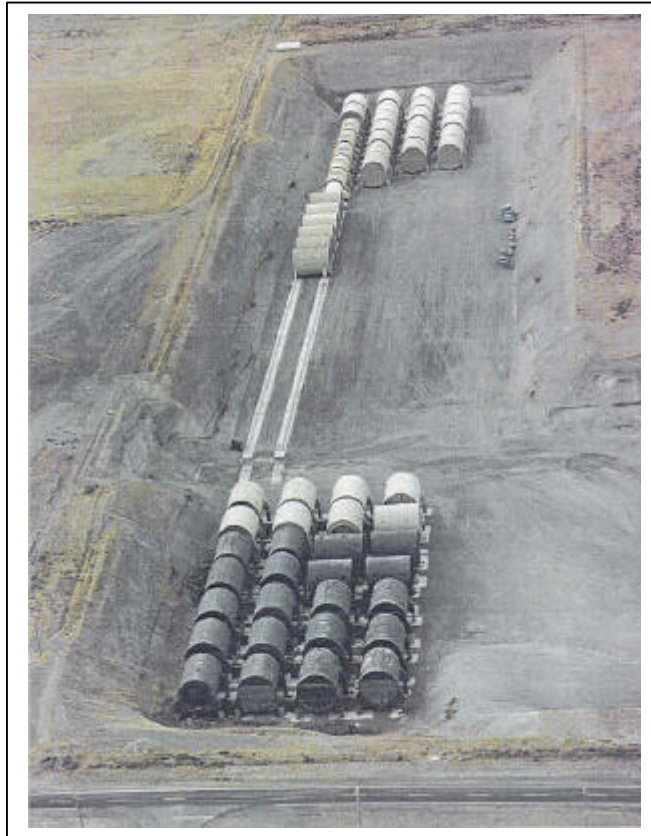


Land Storage

51. The land storage of Reactor Compartments at sites where the waste was generated appears to be generally in line with the views of many of the pressure groups, including Greenpeace. In Devonport this strategy would attract objections from DIG, although it supports the general concept of land storage (away from centres of population) as illustrated in Figure 2.

OVERVIEW REPORT (CONTINUED)

Figure 2 - Land storage of Reactor Compartments from US submarines.



Planning for indefinite storage

52. It is possible that a tide of opinion is rising against the DETR sponsored Nuclear Waste Repository concept and the risk must be recognised that it could be delayed beyond the present planning-assumption date of 2040. It could be argued that an interim storage and disposal strategy which relies solely on the realisation of the Deep Waste Repository * is unrealistic.

53. It would not be sensible at this stage to rule out a Deep Waste Repository *, but it would be prudent to adopt an interim storage strategy which is flexible enough to adapt to either:

- a. store-and-monitor for an optimum decay period (or until a disposal route exists, if longer), then break up and dispose of the radioactive waste; or,
- b. store-and-monitor for the foreseeable future.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

PREREQUISITES FOR STORAGE

54. Defuelling. For consistency when identifying the work associated with preparing a submarine for storage, it has been assumed for each option that all work on Primary Systems and Plant contained in the current DDLP package has been completed as a prerequisite, ie the Primary Plant has been defuelled and all systems drained. This work is common both to Land Storage and the Afloat Storage options, and for either it would need to be undertaken as soon as possible after withdrawal of the submarine from service. For consistency of comparison it has been assumed also that the hull-cut for defuelling has been re-welded and the submarine undocked. A cost for defuelling is, however, included in the cost comparisons.

55. Decontamination of Primary Circuit. Whether decontamination of the primary circuit is necessary prior to storage preparation may be debated on the grounds of “ALARP”. The present policy, on quantified cost-benefit arguments, is that MODIX, a decontamination process, is *not* carried out for boats undergoing DDLP in preparation for lay-up afloat. Similar arguments would apply to preparing an intact RC for land storage (provided it were intended to store the RC for a period in excess of 30 years before further processing) because the majority of the work involved in cutting out the RC is done outside the RC and there is little dose related benefit in carrying out decontamination. However, for land storage options involving dismantling of the Primary Plant, decontamination would need to be included in the preparatory work unless the submarine had already been decontaminated¹¹ or had been stored afloat for 30 years or more.

OPTIMUM STORAGE PERIOD

56. As well as being unavoidable while awaiting the availability of a Deep Waste Repository *, a policy of interim storage prior to disposal brings benefits as discussed below. It is now recognised that 30 year storage (on land or afloat) may be insufficient to optimise these benefits.

57. During a period of interim storage the quantity of ILW, and the level of radioactivity associated with the Primary Plant will diminish. The dose burden accrued by the workforce, the quantity of ILW and the packaging requirements for the ILW will depend on the duration of interim storage, and on when the other activities in the disposal process are undertaken.

58. Annex E discusses the natural decay of the radioactive isotopes within the reactor compartments of nuclear submarines following their withdrawal from service. For the following reasons it concludes that the optimum interim storage period is about 60 years:

- a. The dose-burden associated with dismantling the Primary Plant is largely governed by the mean background radioactivity within the RC which, in turn, is

¹¹ Dreadnought and those submarines withdrawn from service while in refit were decontaminated prior to lay-up.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

dependent primarily on the isotopes deposited in the primary circuit. These deposits comprise mainly Cobalt-60 which has a half-life of 5.3 years. Beyond about 30-40 years of decay there is minimal further gain, radioactivity then being dominated by isotopes with very long half-lives.

b. A 30-year storage period allows the short-lived Intermediate Level Waste (ILW) to decay to Low Level Waste (LLW), substantially reducing the quantities of waste requiring disposal in a national Deep Repository.

c. A storage period of about 50 years will be required before the submarine's remaining ILW can be disposed of to the repository in two 4 metre boxes. Before this time, the shielding requirement is such that either a greater number of 4 metre boxes would be required per submarine, or a further storage period for the waste within the container would be necessary before it could be shipped to the repository.

d. After a storage period of 60 years there would no longer be a requirement to separate the Stainless Steel Cladding from the RPV by machining before disposing of the RPV as Low Level Waste.

e. Continuing storage from 30 years to 60 years will allow a sufficient further reduction in activity in the RPV to reduce the dose burden associated with its dismantling by a factor of about 10.

DISPOSAL OF RESIDUAL HULL AND STRUCTURE

59. Controls on both radioactive and toxic discharges to the environment are under constant review (for example, the OSPAR¹² agreement is pressing to reduce all radioactive discharges virtually to zero by 2020). There is therefore some risk that breaking-up and recycling of the residual hull and structure will become more expensive in the future because of the need to comply with increasingly stringent environmental regulations for disposal of non-nuclear hazardous waste.

60. Land storage (which allows early recycling) would be less susceptible to such risk than would afloat storage (which requires recycling to be deferred until the end of the storage period).

¹² The agreement relates to any process which will create waste discharges eg dismantling processes, effluent treatment plant discharges, gaseous discharges such as Tritium.

OVERVIEW REPORT (CONTINUED)

REVIEW OF INTERIM STORAGE OPTIONS

INTERIM STORAGE OPTIONS TO BE INVESTIGATED

61. Since the mid-1980s a number of interim storage possibilities have been mooted, and some were dismissed from further consideration, being either unsustainable or wholly impracticable. These included storage on the sea bed, which was rejected, as outlined in Annex B, for reasons of excessive cost and adverse public perception, together with some security concerns. These reasons remain valid and the option has not been considered further.

62. There remain the following technically-feasible interim storage options to be examined in this Study. Some are readily dismissed; others are worthy of more detailed consideration. Each is considered separately below.

- a. Afloat Storage of Intact Submarines. This is the existing solution but, to store submarines laid up after about 2012, an alternative to the current afloat storage venue in 3 Basin at Devonport would need to be found.
- b. Afloat Storage of “cropped” submarine hull. One constraint on Afloat Storage is the limited availability of non-tidal berths. Suitable cropping of the submarine hull to reduce its length prior to storage would ease this constraint for a limited period.
- c. Land Storage. There is a range of possible Land Storage options depending on how much of the disposal process (see paragraph 22, above) is undertaken prior to storage. They are:
 - (1) storage of intact submarine on land;
 - (2) storage of separated reactor compartments on land;
 - (3) land storage of primary-plant components (RPV + PST)¹³ as unpackaged ILW;
 - (4) storage of packaged ILW on land.

AFLOAT STORAGE OF INTACT SUBMARINES

Current Position - Temporary Afloat Storage

63. Eleven submarines have already been withdrawn from service. Seven are berthed in the Main Basin at Rosyth; four in 3 and 5 Basins¹⁴ at Devonport. One at each location is yet to be defuelled and prepared for storage.

¹³ Reactor Pressure Vessel (RPV) Primary Shield Tank (PST).

OVERVIEW REPORT (CONTINUED)

64. In addition to annual maintenance afloat, the laid-up submarines are programmed to be docked for maintenance at 10-yearly intervals, with the expectation of a significantly more extensive workpackage for the 30-year docking¹⁵ because substantial repair of the main-ballast-tank structure may be needed following inspection.

65. The current interpretation of the relevant legislation suggests that the 10-yearly dockings of submarines laid-up afloat must be undertaken on a Nuclear Licensed Site¹⁶. To date, however, it has not been necessary to test whether this is a valid constraint because the venues for Dreadnought's first 10-year docking and the dockings planned for other laid-up submarines in the next few years are anyway covered by existing nuclear site licences.

Constraints on continuing Afloat Storage at current locations

66. At Devonport. The Long Term Berthing Plan¹⁷ (which highlights the need for additional berths to be found for decommissioned submarines once 3 Basin at Devonport is filled), states that, if space is allowed for tugs to manoeuvre submarines safely within the basin, the limit will be reached in 2008, or earlier if SDR initiatives so dictate. However, the Master Rigger at Devonport assesses¹⁸ [information deleted to allow public release of this Report¹⁹] indicates that [the] limit will be reached in 2012. The analysis for this report assumes that the latter date will apply.

67. At Rosyth. The size of the Main Basin at Rosyth is sufficient to accommodate a considerable number of additional hulls with little impact on BRDL's business in the short term. However, the capacity limit has not been determined because the Dockyard Sale Agreement currently precludes berthing at Rosyth any further laid-up submarines after nuclear refitting work ceases there.

Definition of options for interim storage of intact submarines afloat

68. An interim storage strategy based solely on continuation afloat storage of intact submarines would require the foregoing constraints to be overcome. Depending on whether or not the current policy of laying up submarines in the defuelling dockyard is to continue, there are two possible courses of action to consider:

- a. If the current policy were to continue, sufficient additional basin space or tidal berths or moorings²⁰ would need to be found at Devonport to accommodate the growing fleet of laid-up submarines (assuming that the defuelling capability at Rosyth will cease following defuel of Renown and refit of HMS SPARTAN).

¹⁴ Valiant is in 5 Basin pending DDLP and lay-up in 3 Basin.

¹⁵ The original plan was for the submarines to be broken-up at the 30-year point, when the National Deep Waste Repository * would have been available.

¹⁶ The laid-up submarines themselves could be considered as "premises adapted for the purpose of storage of nuclear material" and, during the docking period, they would not be under day-to-day control of the MoD.

¹⁷ Reference H.

¹⁸ Reference G.

¹⁹ [Footnote deleted to allow public release of this Report.]

²⁰ A "mooring" is away from the shore at a buoy; a "berth" is alongside a jetty.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

- b. Alternatively, if the current policy were to be changed, afloat storage may be possible at suitable tidal or non-tidal berths or moorings away from the location of defuelling. For this to include Rosyth would require amendment of the Dockyard Sale Agreement and would be very difficult presentationally.
69. The afloat storage site options to support these courses of action are:
- a. additional non-tidal berthing space at Devonport, possibly in 5 Basin;
 - b. berthing in a tidal basin (4 Basin) at Devonport;
 - c. berthing alongside in naval base, in tidal water;
 - d. tidal mooring (not alongside) in vicinity of naval base;
 - e. berthing in non-naval yard, tidal or non-tidal;
 - f. remote tidal mooring (not alongside);
 - g. preparation and lay-up at Rosyth of boats defuelled elsewhere;
 - h. berthing at Rosyth on completion of DDLP elsewhere;
 - i. continuation of DDLPs at Rosyth;

Assessment of intact afloat-storage site options

70. The afloat storage site options listed in paragraph 69 are discussed and assessed in Annex F. The result of the assessment (against the criteria listed in Annex C) may be summarised as follows:

- a. For a variety of reasons the options at paragraphs 69a, and e - i are dismissed, being either non-viable, or significantly less viable and more costly than the other options, at paragraphs 69b - d. In particular, it is noted that the views of the SNP and FoE Scotland could militate against long term continuation of afloat storage for the submarines currently laid-up in Rosyth and any proposals to increase the number of submarines laid up north of the border. Afloat storage is unlikely to be a commercially attractive venture for a private yard but this alternative could be considered if proposed by Industry. Berthing in 4 Basin at Devonport (paragraph 69b) is the favoured option *if* the afloat storage policy is required to continue after 2012, and it is noted that preliminary action has been taken already at Devonport to this effect. This basin has the capacity to store a further 11 vessels²¹ which will provide storage space until 2037. However, although considered to be the best solution to the problem of diminishing storage space for laid-up submarines, it should be noted that this basin is in constant use and therefore the “opportunity costs” associated with utilising it for the storage of laid-up submarines are likely to be very high.
- b. Other options considered possibly viable were moorings and sea-wall berths (paragraphs 69c and d), but only in the vicinity of Devonport Naval Base because of greater public perception and security problems elsewhere. However, these options do have the following significant disadvantages.

²¹ Reference I.

OVERVIEW REPORT (CONTINUED)

(1) The viability of moorings is questionable, even in the vicinity of Naval Bases, on grounds of public perception and security.

(2) Tidal berths are likely to be presentationally more acceptable, and maintenance of the submarines would be easier and less costly than at off-shore moorings. However, the “opportunity costs” associated with occupying alongside berths which could be used profitably for other purposes might turn out to be more than assumed for this investigation, making berthing no cheaper and perhaps even more expensive than mooring.

(3) Additionally, significant difficulties are foreseen in delineating an area of tidal water as a Nuclear Licensed Site should this become necessary as a result of changes to the legislative requirements. (Paragraphs 38b and c refer.)

71. Although Annex F identifies solutions to the problem of limited afloat storage space, the shortcomings of afloat storage as a strategy for the future (most notably adverse public perception, and the increasing burden and cost of upkeep) still remain. These are discussed below at paragraph 78 - 80.

AFLOAT STORAGE OF CROPPED SUBMARINE HULLS

Definition of Option

72. Afloat storage of “cropped” hulls is an option which addresses the two issues of diminishing afloat storage space and the increasing docking load associated with afloat storage of the intact hulls. The lay-up preparation would entail: removal of the ballast tanks and the ends of the pressure hull; removal of a substantial proportion of the internal equipment to achieve the required buoyancy and stability; and blanking of the remaining pressure hull and bulkheads.

73. For the purpose of comparing costs it is assumed that:

- a. the option would be adopted only for future hulls (existing laid-up hulls would remain intact); and,
- b. without the relatively light ballast tank structure docking of the cropped hull for upkeep would be needed only 30-yearly at the cost (£3m) of a current 10-year docking.

Assessment of Option

74. This option provides little advantage because the problem of finding additional afloat storage space would be postponed not resolved. With a mix of the current laid-up hulls and future cropped hulls, 3 Basin at Devonport would provide storage space only until 2025, after which alternative storage space would still need to be found.

OVERVIEW REPORT (CONTINUED)

75. In the long term, when the cumulative costs are discounted at 6%, the increased cost of preparation in the early years, which is similar to the cost of preparing an RC for intact land storage, largely negates the reduced cost of upkeep in later years.

76. In addition, the following disadvantages of afloat storage would remain or be aggravated.

a. The present afloat storage strategy has received criticism from a number of groups and committees as being “no strategy”. It is unlikely that the removal of forward and after sections, prior to continuation of what is essentially the same strategy would do anything to counter this accusation.

b. The resulting floating “hulk” would present a far more austere appearance than an intact vessel in a Naval Base, possibly increasing public concern.

c. Although technically this option is sound, it may be difficult to persuade pressure groups and the general public that this novel approach to afloat storage presents no additional hazards.

d. At the end of storage, docking for break-up and disposal of the remaining hull and structure would still be required.

77. The option thus represents the “worst of both worlds”: it would suffer from many of the disadvantages of afloat storage combined with the high set-up costs of the land storage options. It is dismissed from further consideration.

CONTINUING SHORTCOMINGS OF AFLOAT STORAGE AS A POLICY

78. Afloat storage had a number of benefits when the planned interim storage period was limited to 30 years. It has very low start-up costs and the maintenance liability over this time period is relatively low. Dreadnought would have commenced break up and disposal at the 30-year point, alleviating the storage space problem and countering the criticism that afloat storage is “no policy”.

79. Afloat storage beyond 30 years is more problematic. As well as the cost of 30-year dockings, and the need to find more storage space for increasing numbers of laid-up vessels, discussed above, there are a number of more intractable shortcomings:

a. Criticism from the Public could be expected to worsen because of the increasing visual environmental impact and a growing perception that Afloat Storage is the final solution.

b. The “opportunity costs” will increase as the laid-up submarines occupy more and more berths at the expense of other utilisation.

OVERVIEW REPORT (CONTINUED)

c. The impact of the 10-year and 30-year dockings on the rolling docking programme would become an increasing, and possibly insupportable, burden on the docking facilities and associated infrastructure, which are often operating at full capacity in support of the fleet.

80. These shortcomings are likely to become increasingly intolerable as the number of laid-up submarines and the length of time in storage increases, and any further delay to the availability of the national Deep Waste Repository * would aggravate this effect²². The significance of this “time-sensitivity” is such that very long-term afloat storage cannot be regarded as practicable. Afloat storage therefore must be seen only as a stop-gap solution pending development of an alternative strategy for interim storage prior to final disposal.

LAND STORAGE

81. Given the limitations of afloat storage as a long term solution it is necessary to look for acceptable alternatives which are less time-sensitive, no more expensive in terms of long-term cost and radiation dose rates, and which present a credible and low risk disposal strategy. It would also be an advantage if the solution was flexible enough to adapt to new disposal or storage strategies which may develop in the future.

Definition of Land Storage Options

82. A large proportion of the continuing costs associated with afloat storage are incurred through preserving the ability of the laid-up submarines to float and ensuring that corrosion is kept under control. Simply taking the submarines out of the water would remove this problem and eliminate the requirement to find new afloat storage space.

83. Annex G examines the following possible land storage options, for each of which the scope of the preparatory work and the requirements of the storage site will be significantly different:

- a. Land Storage of Intact Submarine. Storage of the complete submarine on land would eliminate the need for much of the afloat-lay-up preparation work, and the need for periodic docking during the period of storage.
- b. Land Storage of Separated Reactor Compartment. Separating the RC for storage intact as a sealed unit requires no significant work inside the RC other than defuelling and it allows early disposal of the residual hull and structure. This is the solution adopted in the USA and France.

²² By 2040, the current planning date for availability of the national Deep Waste Repository *, Dreadnought will have been laid up for about 60 years, twice as long as the lay-up period originally intended.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

- c. Land Storage of Primary Plant components. As an alternative to storing intact RCs it would be possible to dismantle the Primary Plant into its major components (Reactor Pressure Vessel (RPV), Steam Generators, etc) prior to storage. Whether each component would be classified as ILW, LLW or “suitable for free release” would depend largely on the level of radioactivity remaining in the primary circuit.
- d. Land Storage of Packaged Waste. It also would be possible to go even further by dismantling the Primary Plant and packaging the ILW completely prior to storage.
84. [Information deleted to allow public release of this Report.]

Assessment of Land Storage Options

85. Of the options listed in paragraph 83, the first is assessed as non-viable.
86. The option at paragraph 83.d is feasible but it would be difficult to demonstrate that it satisfies the “ALARP” principle for dose rate and, in the absence of a disposal route for ILW before 2040, it appears to offer little advantage. If raised as a future PPPI proposal these issues would need to be addressed.
87. Both the other options (83.b and 83.c) have a number of significant advantages:
- a. Both options offer low risk against changes to legislation in the future, namely the likely removal of Crown exemption from the two Acts which set the legal requirements for Nuclear Installations and Radioactive Substances, RSA93 and NIA65.
- b. Both options appear reasonably commensurate with the “store and monitor” strategy favoured by many of the Environmental Pressure Groups including Greenpeace.
- c. Both options will be less affected by delays to the Deep Waste Repository *. Year-on-year maintenance costs involved in these options are relatively constant over time, for this reason they are far less time sensitive than afloat storage.
- d. Both of these options would result in early recycling of the majority of the vessel. This would considerably reduce the maintenance requirement, and it would find favour with environmental pressure groups, which advocate early recycling to reduce the drain on the earth’s resources.
- e. Both options counter the criticism that the MoD has a “do nothing” policy.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

88. Comparing these two options (83.b and 83.c), although it may be easier to identify a suitable land-store site for RPV/PSTs²³, Land Storage of intact RCs (83.b) is considered better than Land Storage of RPV/PSTs (83.c) for the following reasons:

- a. Aggressive decontamination of the primary plant would not be required.
- b. It is less dose intensive.
- c. It offer greater long-term flexibility, as it can take advantage of future advances in dismantling techniques or changes to disposal strategy i.e. it is possible that the RC itself could become the disposal package eliminating the requirement for break up and packaging of its radioactive waste.
- d. It is broadly in line with the UK Nuclear Industry's 3 phase decommissioning strategy, being closely aligned to phase 2 which dismantles the facility down to the reactor's biological shield²⁴ prior to the interim storage "safestore" period.
- e. A simple "Dutch barn" storage facility would suffice.

89. If land storage is the preferred interim storage solution it will be necessary to undertake further work to identify specific sites for Land Storage²⁵ and derive detailed costs in order to obtain a Public Sector Comparitor for PPPI proposals (paragraph 103).
[Information deleted to allow public release of this Report.]

BRDL Unsolicited Proposal

90. [Information deleted to allow public release of this Report.]

DEVELOPMENT OF AN INTERIM STORAGE STRATEGY

91. The ISOLUS investigation has been undertaken against the background of an afloat storage policy which has been implemented over a period of nearly 20 years. Therefore, in addition to defining the interim storage policy for future submarines, it is necessary to consider the optimum strategy for implementation of that policy with regard to existing laid-up submarines.

²³ A store for 3-4 RPV/PSTs already exists at Rosyth, in RD66 (the AWAF).

²⁴ The RCs shielded bulkheads and pressure hull make up the biological shield of a Nuclear Submarine.

²⁵ A Land-Store site is likely to be more acceptable to the public in an area which gains benefit from nuclear work. In addition, plans for storage on an already licensed site, whether for intact RCs or for RPV/PSTs, would be least susceptible to planning difficulties, especially if an existing ILW store could be utilised.

OVERVIEW REPORT (CONTINUED)

92. By about 2002, a number of 10-yearly dockings will be in hand or imminent for maintenance of the eleven submarines laid-up afloat at Rosyth and at Devonport. Also, from about that date, the nuclear capability at Rosyth will be drawing to an end, with all future defuelling to be undertaken at Devonport. Therefore, if practical difficulties can be overcome, it would be advantageous to achieve early implementation of a land storage option for the laid-up submarines as follows:

At Rosyth.

a. It should be possible, within the BRDL estate, to make land-storage space available for the separated RCs of the seven redundant submarines currently berthed at Rosyth²⁶. Urgent initiation of such a strategy would enable the necessary land storage preparations to be undertaken in lieu of the DDLP of Renown, the second 10-year docking of Dreadnought, and the first 10-year dockings of the other five vessels, which would have significant cost and public perception advantages. Otherwise, in addition to continued afloat maintenance cost, there is a risk of incurring: either additional cost to maintain a capability for nuclear work (not defuelling) at BRDL; or (if the nuclear capability at Rosyth is lost following cessation of nuclear work there) additional expenditure for removal of the Rosyth submarines to a Nuclear Licensed Site elsewhere for processing.

b. Further, it should be noted that continued afloat-storage of the existing submarines at Rosyth will give rise to difficulties once the nuclear capability is lost. The 10-yearly maintenance dockings will still require a dock on a nuclear licensed site. Although this license would not require the same stringent standards required by a nuclear refuelling dock, it will still require some degree of nuclear capability to be retained in the Yard.

At Devonport.

c. Although there is no obvious land store site within the DML estate, it would be advantageous if a limited or temporary site could be found in order that the land store programme in Devonport could commence as soon as possible. Considerable savings could be made against the forthcoming DDLPs of Valiant and the twelfth vessel, due to decommission in [Information deleted to allow public release of this Report.]. Other savings could be made against the three 10-yearly dockings due at Devonport prior to 2003, given that, subject to survey, it should be possible to waive these dockings if, instead, preparation for land storage is planned to start within 2-3 years.

²⁶ However BRDL is understood not to support this way forward, preferring their own proposal (paragraph 114).

OVERVIEW REPORT (CONTINUED)

COMPARISON OF THROUGH-LIFE COSTS

93. Cost models have been developed for a number of illustrative scenarios to compare the through-life costs of various afloat and land storage options considered in this investigation. Appendix H1 defines the programme assumptions up to the end of the Astute Class; the effect of continuing the SSN programme beyond Astute is modelled on the assumption of maintaining a fleet of 10 SSNs. The cost assumptions are defined in Appendix H2. *It should be noted that the costs used take no account of risk, growth, profit or VAT.*

94. Land storage was costed on the basis of storing separated RCs. Other land storage options were not included, either because they are ruled out for reasons other than cost, or because they are based on innovative proposals from Industry the costs for which have not been examined in sufficient detail for their use in this comparison. However, the relative costs of such options are discussed in qualitative terms in the text where appropriate.

95. The following key points are highlighted from the results of the cost-comparisons, summarised in Appendix H3:

- a. Despite greater costs in the early years, the total cumulative cost of land storage falls significantly below that of afloat storage in the long-term, and, *provided the implementation programme is not delayed too long*, the cross-over point should be well before the planned availability date of the national Deep Waste Repository*.
- b. In order to gain maximum benefit from land storage it must be adopted for existing and future hulls.
- c. The earlier a land-store programme is implemented, the lower will be the long term cumulative cost.
- d. If land storage cannot be implemented immediately, then, as well as the nugatory costs which would be incurred (for laying-up vessels temporarily, and for continued dockings and maintenance afloat), there could be a risk of other additional costs associated with processing the Rosyth hulls after planned nuclear work ceases at the Yard (see paragraph 92.a).
- e. Up to about 2050, terminating or continuing the SSN programme beyond lay-up of the last Astute Class in ... [Information deleted to allow public release of this Report] ... has negligible effect on any option, whatever the discount rate. The PEST analysis in Annex H (which examines costs up to 2049) ignores any disposals beyond Astute Class.

* Refer to statement on long-term management of radioactive waste on front cover of this report

OVERVIEW REPORT (CONTINUED)

COMPARISON OF VIABLE OPTIONS (PEST ANALYSIS)

96. Having ruled out the less viable options in Annexes F and G, a more rigorous “PEST” analysis of the remaining four options is undertaken in Annex H. This assesses each option, and allocates a mark against Critical Success Factors (described in paragraph 29) covering **Price** (*20 marks maximum*), **Environmental impact** (*18 marks*), **Socio-political considerations** (*40 marks*), and **Technical issues** (*22 marks*). This mark takes account of the degree of “success” and the relative importance of the factor being considered. Other important Success Factors are taken into account but are not allocated a mark.

97. The following Table summarises the total marks awarded to each of the viable options as a result of the PEST analysis in Annex H, ranking them in order of preference:

VIABLE OPTIONS	TOTAL MARKS, OUT OF 100
Land Storage of Intact Reactor Compartments	86
Land Storage of RPV/PST	69
Land Storage of Packaged Waste	58
Afloat Storage	43

98. On completion of the initial PEST analysis, Annex H identifies also the **Strengths**, **Weaknesses**, **Opportunities** and **Threats** of each option. This “SWOT” analysis further aids the process which leads to the conclusions and recommendations below.

OVERVIEW REPORT (CONTINUED)

PROCUREMENT STRATEGY

SCOPE FOR PPPI

99. Given approval to take forward a land storage solution, this could be carried out by either a PPPI scheme or by a conventional route which would include a DEO works project in accordance with JSP 435. The present preference is the former procurement route, if appropriate, with a fallback to the latter if PPPI proves unfruitful.

100. It is evident that several companies regard storage and disposal of nuclear submarines and the radioactive waste therein as a significant and worthwhile business opportunity. Several unsolicited innovative ideas already presented include ...[Information deleted to allow public release of this Report.]

101. Thus this project is a likely contender for PPPI procurement.

PROCUREMENT IMPLEMENTATION

Initiation of PPPI

102. A PPPI scheme could embrace cut out of RC, disposal of the remainder of the submarine and construction of a storage facility for the RC on a site provided by the contractor or possibly on a MOD site. Other proposals might be made. The project would be advertised in the Contracts Bulletin and suitable contractors invited to an "Industry day" to outline the project.

103. As well as evaluating proposals against the assessment criteria used in this investigation (paragraph 28 and Annex C), a full investment appraisal of each PPPI would require the development of a Public Sector Comparitor (PSC). Consideration would need to be given to engaging a Nuclear advisor and financial/legal advisors to ensure that the key issues, particularly public acceptability, are handled in a proper and timely manner.

Development of Public Sector Comparitor (PSC)

104. The PSC should be based on intact land storage of separated RCs, which is assessed as the best of all the options considered in this report. It is envisaged that there would be a direct contract, with a suitable dockyard or shipyard, for cut-out of the RC and disposal of the residual hull and structure, with a separate works project for development of a land store facility and transfer of the RC from the cut-out site to the store. The DEO would develop the works project using the Authority Design as laid down in JSP 435 on a preferred site selected by DEO in conjunction with SSA.

OVERVIEW REPORT (CONTINUED)

105. The PSC project procurement route would involve
- a. Appointment of Project Sponsor
 - b. Project Definition.
 - c. Production of Project Brief.
 - d. Appointment of Project Manager.
 - e. Project Planning and Preliminary Design (including gaining regulatory approval).
 - f. Detailed Design and Tender preparation.
 - g. Tender invitation Evaluation and contract award.
 - h. Works construction.
106. The JSP 435 'Authority Design' strategy has been adopted for the recent comparable nuclear works projects: Jason Decommissioning, and Remote Ammunitioning Facility Tamar (RAFT). It minimises project risk by placing control of the risk with the Project Manager.

OVERVIEW REPORT - CONCLUSIONS

CONCLUSIONS

107. In addition to the key conclusions which follow, two supporting conclusions are highlighted because they are directly relevant to the recommendations below:

a. The future legislative and regulatory position for interim storage and the associated disposal processes is not entirely clear-cut. Care will be needed to ensure that the chosen strategy is able to adapt to potential legislative changes. (Paragraphs 30 - 38.)

b. A storage period of 30 years brings worthwhile gains, but storing for a total of 60 years before packaging would optimise the benefits. (Paragraphs 56 - 58.)

108. Key Conclusion 1 - The interim storage strategy for the laid-up submarines should not be dependent on realisation of a national Deep Waste Repository*. Despite it being assumed for planning purposes, realisation of a national Deep Waste Repository* in 2040 cannot be guaranteed. Therefore the interim storage strategy for the laid-up submarines must have the flexibility to adapt to indefinite store-and-monitor rather than eventual disposal. (Paragraphs 52 and 53.)

109. Key Conclusion 2 - Afloat storage should be regarded only as a stop-gap measure pending development of an alternative strategy for interim storage. Although a valid policy to date, afloat storage pending disposal is increasingly difficult to sustain as a justifiable strategy. The shortcomings are such that very long-term storage afloat cannot be regarded as practicable, and therefore afloat storage should be regarded only as a stop-gap measure pending development of an alternative strategy. (Paragraphs 78 - 80, and 97, and footnote 4 at paragraph 23.)

110. Key Conclusion 3 - If the major shortcomings of future afloat storage are ignored, additional berths probably could be found for laid-up submarines when current berths are filled. The current Long Term Review programme indicates that current non-tidal berths for Afloat Storage will be filled by 2012. Thereafter, continuation of a policy of *afloat* storage would depend on the availability of alternative storage sites. To a greater or lesser extent, all the alternative afloat storage sites considered in this investigation have potential disadvantages (relating to security, maintenance, public perception, potential opportunity cost penalties and possible nuclear site licensing problems in future). The most promising would be in tidal water in Devonport Naval Base, preferably in 4 Basin if conflict with current usage could be resolved, or on a sea-wall berth or a mooring. (Paragraphs 38b and c, 62a, 66, and 70.)

111. Key Conclusion 4 - Land Storage of separated RCs is an attractive option but further work is needed to narrow the site options and develop the strategy. Land Storage of separated RCs is a viable and attractive option with maximum flexibility for future disposal

OVERVIEW REPORT - CONCLUSIONS (CONTINUED)

(or indefinite storage in lieu of disposal - see paragraph 115). Further work is needed to develop this option as a Public Sector Comparator against which to assess PPPI options (mentioned below). (Paragraphs 87, 88 and 97.)

112. Key Conclusion 5 - Land Storage of separated RPV/PSTs is worthy of further consideration. Land Storage of separated RPV/PSTs also is a viable option which deserves further consideration but, compared with the option of storing intact RCs, there are a number of perceived disadvantages to be balanced against the benefits. (Paragraphs 87, 88 and 97.)

113. Key Conclusion 6 - Immediate break-up of the submarine and packaging of the radioactive waste is technically feasible but has potential disadvantages. Immediate, complete break-up and packaging of the primary plant also is technically feasible. However, it could be difficult to demonstrate that it satisfies the “ALARP” principle for dose rate and, in the absence of a disposal route for ILW before 2040, it appears to offer little advantage. Nevertheless, it has been discussed as a possible PPPI option (see paragraph 115) and therefore cannot be dismissed from further consideration. (Paragraphs 86 and 97.)

114. Key Conclusion 7 - There would be distinct advantages in pursuing [the BRDL unsolicited proposal] as a risk-reduction exercise. There would be advantage in pursuing [the BRDL unsolicited proposal] to increase confidence in the assessed costs of the preparatory processes, and develop a greater understanding of the issues requiring to be addressed. (Paragraph 90.)

115. Key Conclusion 8 - There is worthwhile scope for PPPI. There is worthwhile scope for PPPI for storage and disposal of the radioactive waste. Specific proposals on the table to date come from ... [Information deleted to allow public release of this Report.] (Paragraphs 99 - 101.)

116. Key Conclusion 9 - There would be advantage in early processing of the submarines for Land Storage. There are strong arguments for urgent implementation of a land storage strategy to minimise long-term expenditure, to reduce environmental impact and allay public criticism, and to reduce legislative and cost related risks associated with loss of the nuclear refitting capability at Rosyth. Should that prove impracticable, it is highly desirable, given the current Long Term Review programme, for processing of the existing laid-up submarines to begin no later than 2012. (Paragraphs 37 - 38, 59 - 60, 87d, 91 - 92, and 95.d.)

OVERVIEW REPORT - RECOMMENDATIONS

RECOMMENDATIONS

117. To note the foregoing conclusions.
118. To pursue an interim storage strategy of break-up of the submarines and land storage, for at least 60 years, of the RCs or its major component package (RPV/PST). The aim to be implementation at the earliest opportunity, to alleviate public concern, minimise the long term costs, and reduce the risk of cost escalation resulting from increasingly stringent legislation.
119. To form an adequately resourced Project Team to take forward the ISOLUS Project into Phase 2 (the Assessment Phase of the McKinsey Procurement Cycle), with the following objectives:
- a. to narrow the options for a Land Store site and develop reliable costings for Land Storage of Separated RCs as a Public Sector Comparator (PSC) against which to conduct an Investment Appraisal of all proposals from Industry;
 - b. to enter into dialogue with Industry:
 - (1) to seek formal proposals for Commercial solutions (PPPI) for land storage and eventual disposal of the radioactive waste in submarines withdrawn from service (including [Information deleted to allow public release of this Report])
 - (2) to develop an ITT for the work to be undertaken during the Development phase of the McKinsey Cycle;
 - c. to pursue [the BRDL unsolicited proposal]; [Information deleted to allow public release of this Report].
 - d. to clarify the future legislative and regulatory position for interim storage (on land or afloat) and processing for final disposal.

ANNEX A – TERMS OF REFERENCE (CONTINUED)

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ANNEX A

REFERENCES FOR OVERVIEW REPORT

- A. D/US of S/JS 25/1/2 dated 27 February 1998
- B. SSA Sec/42/20 dated 12 December 1997
- C. RWMAC (Radioactive Waste Management Advisory Committee) Report dated December 1997
- D. DG(Nuc) 038/1573/6178 dated 4 September 1998
- E. Notes of meeting held in Bristol 3/3/98 between representatives from MoD and Environment Agency (EA) - Distributed under cover of DDef (H&S) fax, reference D/Def/H&S/ dated 9 Mar 98
- F. House of Lords Select Committee on Science and Technology, Third Report, dated 10 March 1999 – Management of Nuclear Waste.
- G. Note from Master Rigger, Devonport, dated 15 October 1998, unreferenced.
- H. Long Term Berthing Plan, D/NBSA/DBS(INF)38/7/23 dated 3 Dec 98.
- I. FAX Serial 133 from Master Rigger, Devonport, dated 5 January 1998.

Note: References for the Annexes are listed separately in each Annex

ANNEX A – TERMS OF REFERENCE (CONTINUED)

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