



ISM

SUBMARINE DISMANTLING PROJECT (SDP)

Integrated Options Paper

Issue 1.1 – October 2011



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Distribution

SDP Virtual Team
SDP Scrutiny Meeting Members

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1. Introduction

1.1. Context

1.1.1. The aim of the Submarine Dismantling Project (SDP) is to deliver a safe, secure, environmentally responsible, timely and cost-effective solution for the dismantling of 27 of the UK's defueled nuclear powered submarines.

1.1.2. This paper defines the options for delivery of SDP. These options have been subject to a formal Combined Operational Effectiveness and Investment Appraisal (COEIA), which has led to the production of an Operational Analysis Supporting Paper (OASP)¹ which forms the basis for the project's proposals for public consultation. This report explains how these options were developed.

1.2. Specific Features of SDP

1.2.1. SDP is characterised by features unusual to most MOD acquisition programmes:

- No new military capability is being acquired; instead legacy equipment is undergoing disposal.
- The project is subject to an unusually high degree of Public & Stakeholder Engagement (PSE).
- The project has undertaken a Strategic Environmental Assessment (SEA) and is committed to Public Consultation before developing recommendations or making major decisions. Hence, at this stage, the OASP supports the development of proposals for public consultation rather than recommendations for decision makers.

1.2.2. These features reinforce the need for the project to be driven by robust evidence and for the options analysis process to be as open and transparent as possible.

1.3. Document Structure

1.3.1. The document is structured as follows:

- Section 2 provides explains how previous screening and analytical work informed development of the options.
- Section 3 develops the option set.

¹ SDP Operational Analysis Supporting Paper, Issue 1.0, dated October 2011

2. Background to Options

2.1. Overview

2.1.1. This section sets out the conclusions of previously conducted options work and provides the boundaries for the analysis in Section 3.

2.2. The 'Do Nothing' & 'Do Minimum' Options

2.2.1. **'Do Nothing'**: This option is a continuation of afloat storage of redundant submarines. The capacity to store further submarines will be reached by 2020, however, so as this option does not comply with Government and MOD policy², it has been de-selected with the agreement of D Scrutiny³.

2.2.2. **'Do Minimum'**: This option is also a continuation of afloat storage of redundant submarines but identifies and implements the lowest incremental activities⁴ that can meet all mandatory requirements. This option is subject to the same argument as the Do Nothing Option and has also been discounted. This option has, however, been fully developed as a comparator against which the cost effectiveness of the 'Do Something' options can be compared.

2.3. Do Something Options

2.3.1. Do Something Options involve combinations of the following:

- The technical approach for removing radioactive materials from submarines (the 'initial dismantling' activity);
- The site(s) to be used for the initial dismantling activity;
- The type of site to be used for interim storage of Intermediate Level Waste (ILW) that is awaiting disposal in the UK's proposed Geological Disposal Facility.

2.3.2. These combinations are *integrated options* which also include:

- Recycling or disposal of non-radioactive components;
- Transport of submarines and the materials and waste arising from dismantling activities;
- Decommissioning of facilities at the end of life.

² DTI Amendment to Command 2919 (the Decommissioning of the UK Nuclear Industry's Facilities) and the MOD Policy for Decommissioning.

³ Scrutiny Review of SDP Options Analysis Paper, Letter Ref. 20081204 dated 19 January 2009 and Scrutiny Review of SDP Interim Storage Options Analysis Paper, Letter Ref D/DISM/SDP/420/1727/OA dated 21 April 2009.

- The commercial approach underpinning delivery of SDP; and
- Any other integrative factors.

2.4. Derivation of Option Set

2.4.1. Technical Approach

2.4.2. A number of technical and environmental assessments have been carried out to develop a more detailed understanding of the available options, leading to the shortlist of three alternatives for removing the radioactive waste from the submarines.

- Separate and store the whole Reactor Compartment (RC): the whole RC is separated from the front and rear sections of the submarine and stored whole, leaving the hull of the submarine in two halves.
- Remove and store the Reactor Pressure Vessel (RPV): the RPV and other radioactive materials are removed from the submarine, leaving the submarine intact.
- Remove and size reduce the RPV for storage as Packaged Waste: the RPV and other radioactive waste is removed and then cut into smaller pieces and packaged approved containers for storage and eventual disposal. The submarine is left intact.

2.4.3. Initial Dismantling Site(s)

2.4.4. Three generic types of sites were assessed for their suitability for SDP.

- Greenfield sites: sites that are undeveloped (or have reverted to a 'natural' state) and with no existing Authorisation or License for nuclear work.
- Brownfield sites: sites that are already developed but do not have an existing Authorisation or Licence for nuclear work.
- Existing authorised / licensed sites: sites that are already developed and have an existing Authorisation or Licence for nuclear work.

2.4.5. Initial screening work concluded, on value for money grounds, that Greenfield and Brownfield sites will only be considered further if no suitable existing licensed/authorised site is available. The Greenfield and Brownfield site options are, therefore, not entirely discounted from further consideration (and have been assessed within the SEA) but were excluded from the long list of site options, which comprised the list of all existing nuclear authorised and licensed sites in the UK⁵.

⁵ A register of nuclear licensed sites in the UK is available on the Health & Safety Executive web site at <http://www.hse.gov.uk/nuclear/licensees/pubregister.pdf>

- 2.4.6. This long list of sites was screened to assess their suitability for initial dismantling against a pre-defined set of mandatory threshold criteria⁶, based on Measures of Effectiveness (MoE) recorded in the User Requirements Document (URD). The remaining shortlisted options were:
- Devonport Dockyard;
 - Rosyth Dockyard;
 - Both Devonport and Rosyth Dockyards.
- 2.4.7. The dual site option uses both of the identified sites for submarine dismantling but, as duplication of all facilities would be prohibitively expensive⁷, only one size reduction facility is assumed. For purposes of options analysis, it has been assumed that this facility will be located at one of the initial dismantling sites (for the storage as Packaged Waste options) or at the ILW storage site (for the storage as RPV and RC options).
- 2.4.8. Generic ILW Storage Site(s)
- 2.4.9. The same three generic types of sites were assessed for their suitability for interim ILW storage: Greenfield sites; Brownfield sites; and existing authorised / licensed sites. It was concluded that Greenfield and Brownfield sites will only be considered further if no suitable existing licensed/authorised site is available⁸.
- 2.4.10. At this stage, it has not been possible to screen the long-list of existing nuclear licensed/authorised sites because of the different contexts and developing strategies affecting different types of site. For example, the NDA is in the process of exploring opportunities to share its current and planned storage facilities to improve value for money and reduce environmental impact of new store build. Such a development in the NDA's strategy would be an important consideration in any site screening exercise. Commercial sites, meanwhile, would need to be screened through a commercial process inviting expressions of interest from site owners. As an intermediate step therefore, four possible types of candidate sites for storage of ILW have therefore been identified and assessed at a generic level:
- Sites at point of waste generation (Devonport Dockyard / HM Naval Base Devonport and / or Rosyth Dockyard). For the dual site dismantling option, storage at the point of waste generation would mean RCs, RPVs or Packaged Waste being transported to one of the two sites after initial dismantling, for interim storage⁹.

⁶ SDP Site Criteria and Screening Paper, Issue 2.1 dated 31 May 2011

⁷ The cost of a single size reduction facility has been estimated to be around [REDACTED]. The cost of a single facility is thus expected to provide significant savings over the cost of two facilities, even when additional costs are taken into account such as the movement of RPVs between sites.

⁸ SDP Site Criteria & Screening Paper, Issue 2.1, 31 May 2011.

⁹ Cost modelling has indicated that, due to the relatively low number of waste packages, the cost of waste movement is preferable to the cost of building additional storage facilities. The building of two stores results in

- Commercial sites, remote from the point of waste generation. This category could include both Rosyth Dockyard and Devonport Dockyard if dismantling were conducted at the other site, but also any existing licensed sites where the owner wished to bid for provision of a storage service to MOD.
- MOD sites, remote from the point of waste generation. This category includes all the nuclear licensed or authorised sites owned by MOD that are remote from the point of waste generation.
- NDA sites (all are remote from point of waste generation). It may be possible for MOD waste to use NDA storage facilities.

significant upfront capital costs but also creates a legacy in terms of operation and decommissioning making it uneconomic to develop two stores at two locations.

3. Selection of Integrated Options

3.1. Possible Combinations

3.1.1. The tables below show all the possible combinations of sites, with one table for each of the technical approaches to dismantling. The symbols and colour coding are as follows:

- **Red (X)**: Not feasible for technical or economic reasons and therefore, not taken forward as an integrated option.
- **Amber (?)**: Feasibility not proven or not feasible based on current assumptions. These have not been taken forwards as integrated options but will be monitored and / or developed as project opportunities.
- **Green (√)**: Feasible and therefore taken forward as an integrated option.

3.1.2. RC (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Categories of ILW Site			
	Storage at point of waste generation	Storage at commercial site, remote	Storage at MOD site, remote	Storage at NDA site(s)
Devonport Royal Dockyard	√	? (1)	? (1)	X (2)
Rosyth Royal Dockyard	√	? (1)	? (1)	X (2)
Devonport & Rosyth Royal Dockyards (Dual Site)	√	? (1)	? (1)	X (2)

(1) RCs are both large and heavy making transportation difficult and expensive. The costs associated with transport and dockside handling facilities to move all 27 RCs, render their storage at a remote site as uneconomic. Storage at remote commercial or MOD sites have not, therefore, been taken forward for assessment as integrated options. The only exception is dual site dismantling where there would have to be transport of RCs from one site where initial dismantling has been conducted to the other initial dismantling site where they would be stored. This is necessary because the costs, risks and operational legacy associated with two stores are judged to outweigh those of transporting RCs.

(2) NDA sites are all remote from the point of waste generation and so would also be uneconomic for storage of RCs, for the same reasons as other types of remote site. In addition, however, NDA sites have no developed port access that would be required for transportation of RCs by sea.

3.1.3. RPV (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Storage at point of waste generation	Storage at commercial site, remote	Storage at MOD site, remote	Storage at NDA site(s)

Devonport Royal Dockyard	√	√	√	? (3)
Rosyth Royal Dockyard	√	√	√	? (3)
Devonport & Rosyth Royal Dockyards (Dual Site)	√	√	√	? (3)

(3) The feasibility of storing RPVs on an NDA site is not yet proven as it is not yet clear whether the NDA have existing or planned facilities that would be capable of handling ILW in this form. This is the subject of an ongoing feasibility study with NDA.

3.1.4. Packaged Waste (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Storage at point of waste generation	Storage at commercial site, remote	Storage at MOD site, remote	Storage at NDA site(s)
Devonport Royal Dockyard	√	√	√	√
Rosyth Royal Dockyard	√	√	√	√
Devonport & Rosyth Royal Dockyards (Dual Site)	√	√	√	√

3.2. Mapping Integrated Options to Full Tables

3.2.1. Excluding the Do Minimum comparator, which will be named Option 0, there are 25 options listed in the tables above. For ease of management these will be grouped into 8 options, each with three variants for dismantling site:

- D: Devonport
- R: Rosyth
- B: Both – dual site dismantling

3.2.2. The options and variants are noted in the tables below.

3.2.3. RC (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Categories of ILW Site			
	Storage at point of waste generation	Storage at commercial site, remote	Storage at MOD site, remote	Storage at NDA site(s)
Devonport Royal Dockyard	1D			
Rosyth Royal Dockyard	1R			
Devonport & Rosyth Royal Dockyards (Dual Site)	1B			

3.2.4. RPV (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Storage at point of waste generation	Storage at commercial site, remote	Storage at MOD site, remote	Storage at NDA site(s)
Devonport Royal Dockyard	2D	3D	4D	
Rosyth Royal Dockyard	2R	3R	4R	
Devonport & Rosyth Royal Dockyards (Dual Site)	2B	3B	4B	

3.2.5. Packaged Waste (vertical axis dismantling; horizontal axis ILW storage)

Site(s)	Storage at point of generation	Storage at remote commercial site	Storage at remote MOD site	NDA waste consolidation strategy
Devonport Royal Dockyard	5D	6D	7D	8D
Rosyth Royal Dockyard	5R	6R	7R	8R
Devonport & Rosyth Royal Dockyards (Dual Site)	5B	6B	7B	8B

3.3. **Integrated Options**

3.3.1. The table below summarises the options and variants.

Option	Variants
Option 0: Do Minimum	None
Option 1: Reactor Compartment (RC) separation with interim storage at point of waste generation and at a later date size reduction of ILW before transfer to the proposed GDF	Three variants for each: dismantling site at Devonport Dockyard (D), Rosyth Dockyard (R) and Both (B)
Option 2: Reactor Pressure Vessel (RPV) removal with interim storage at point of waste generation and at a later date size reduction of ILW before transfer to the proposed GDF	
Option 3: RPV removal with interim storage at a remote commercial site and at a later date size reduction of ILW before transfer to the proposed GDF	
Option 4: RPV removal with interim storage at a remote MOD site and at a later date size reduction of ILW before transfer to the proposed GDF	
Option 5: RPV removal and size reduction to form Packaged Waste with interim storage at point of waste generation	
Option 6: RPV removal and size reduction to form Packaged Waste with interim storage at a remote commercial site	

Option	Variants
Option 7: RPV removal and size reduction to form Packaged Waste with interim storage at a remote MOD site	
Option 8: RPV removal and size reduction to form Packaged Waste with interim storage at NDA site(s)	

A References

Title	Originator	Issue	Date
SDP Site Criteria and Screening Paper	ISM	Issue 2.1	May 2011
SDP Operational Analysis Supporting Paper	ISM	Issue 1.0	October 2011
SDP Project Management Plan	ISM	Issue 9.0	October 2011

B Abbreviations

Abbreviation	Meaning
COEIA	Combined Operational Effectiveness and Investment Appraisal
HMNB	Her Majesty's Naval Base
IA	Investment Appraisal
ILW	Intermediate Level Waste
MoE	Measure of Effectiveness
NDA	Nuclear Decommissioning Authority
OASP	Operational Analysis Supporting Paper
OE	Operational Effectiveness
PMP	Project Management Plan
PSE	Public Stakeholder Engagement
RC	Reactor Compartment
RPV	Reactor Pressure Vessel
SDC	Submarine Dismantling Consultation
SDP	Submarine Dismantling Project
SEA	Strategic Environmental Assessment
URD	User Requirements Document
VFM	Value for Money