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ISM

SUBMARINE DISMANTLING PROJECT

Operational Effectiveness (OE) Report

- interim version to support the Submarine Dismantling Consultation

Issue 1.0 – October 2011

This document has been released as background information to support the Submarine Dismantling Consultation (28 Oct 2011 – 17 Feb 2012). It has been redacted to protect:

- **Personal information;**
- **Information that is commercially sensitive; and**
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Amendment History

Issue	Date	Details of Amendment	DCCF
0.1	1 Jul 11	Initial draft for internal discussion	
0.2	11 Jul 11	Draft following review by SDP team	
0.3	14 Jul 11	Addition of Annexes describing the development of criteria and assumptions, and additional editorial revision	
1.0	14 Oct 11	Updated to take account of development of the OASP	

Distribution

SDP Virtual Team
MCDA Workshop Attendees (see Annexes B to F)
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. At the end of its Assessment Phase, SDP plans to submit a Main Gate Business Case (MGBC) with recommendations on the key decisions that need to be taken in order to proceed to its Demonstration Phase. Before submission of the MGBC to the Investment Appraisal Committee (IAC), however, SDP will go through a formal process of public consultation. To support this an Operational Analysis Supporting Paper (OASP) has been prepared which summarises the currently available evidence and proposals for the most cost-effective approach towards successfully meeting the aims of the project.

1.1.3. This document underpins the OASP and specifically presents the results of the Operational Effectiveness (OE) analysis which is a key component of the process to select proposed options for Public Consultation.

1.2. SDP Decision Making Process

1.2.1. The decision making process leading up to MGBC is set out in the document *'SDP - Our Approach to Decision Making'* and SDP will prepare its recommendation to the IAC based on the combination of three analyses:

- **Operational Effectiveness (OE)**: how effectively does each SDP option[1] meet the needs of the MOD set out in the User Requirements Document (URD)[2]?
- **Investment Appraisal (IA)**: what is the Whole Life Cost (WLC) of each SDP option?
- **Other Contributory Factors (OCF)**: what is the potential impact and significance of non-quantifiable factors on each SDP option?

1.2.2. The results of the OE and IA have been brought together to form a Combined Operational Effectiveness and Investment Appraisal (COEIA), and then reported, alongside the discussion of the OCF analysis, in the OASP. Once Public Consultation is complete:

- The COEIA, and underpinning OE and IA, will be revised where sound technical concerns have been raised regarding the analysis, assumptions or input data. Such revision will require formal agreement from the SDP team and an audit trail to data underpinning the technical concerns.
- The COEIA will also be revised where further work is required to test underpinning assumptions or the feasibility of key opportunities.

[1] SDP Integrated Options Report, Issue 1.1 dated October 2011.
[2] SDP URD, Issue 5.0 dated October 2011.

- The OCF will be refined, clarified and analysed on the basis of the results of Consultation.

1.2.3. A revised OASP will then be submitted to D Scrutiny for formal endorsement as part of the MGBC submission to the IAC.

1.3. Strategic Environmental Assessment and Public Consultation

1.3.1. There is significant public in SDP and it is important that the public should have confidence in the solution that is chosen. The project is undertaking a Strategic Environmental Assessment (SEA) in accordance with the relevant legislation[3] to assess the likely significant environmental effects of SDP activities and options, with key findings incorporated into the IA, OE and OCF analyses. Public Consultation will seek the public's views on both the options for the project and environmental assessment of all SDP activities (described in the Environmental Report from the SEA). The consultation will be at a local and national level with local events focussed around the candidate dismantling sites.

1.4. Document Structure

1.4.1. The document is structured as follows:

- Section 2 describes the SDP option set.
- Section 3 describes how the OE analysis was conducted.
- Section 4 describes the results of the Multi Criteria Decision Analysis (MCDA) which forms the basis of the OE.
- Section 5 summarises key findings and presents findings.
- Annex A contains a list of abbreviations.
- Annex B provides summary notes of the SDP Criteria Workshop.
- Annex C provides summary notes of the SDP Weighting Workshop.
- Annex D provides summary notes of the Health & Safety (H&S) and Policy (POL) syndicate of the SDP Scoring Workshop.
- Annex E provides summary notes of the Operations (OP) syndicate of the SDP Scoring Workshop.
- Annex F provides summary notes of the Environment (ENV) syndicate of the SDP Scoring Workshop.
- Annex G provides a list of assumptions made at the Scoring Workshop.

[3] Strategic Environmental Assessment Directive, 2001/42/EC

2. Options

2.1. Summary of Options

2.1.1. SDP has a large number of potential solutions, which have been formed into 9 options with a number of variants, developed from combinations of the following:

- **Technical Approaches** to the initial dismantling of submarines.
- **Initial Dismantling Site(s)**.
- **Generic Intermediate Level Waste (ILW) Storage Site(s)** for ILW arising from initial dismantling.

2.1.2. Each option and variant also includes the re-use, recycling or disposal of non-radioactive components and transport of submarines and their waste.

2.2. Derivation of Option Set

2.2.1. Technical Approach

2.2.2. 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 Reactor Pressure Vessel for storage as Packaged Waste: the RPV and other radioactive waste is removed and then cut into smaller pieces and packaged into boxes for storage. The submarine is left intact.

2.2.3. Initial Dismantling Site(s)

2.2.4. 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.

2.2.5. 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 UK[4] .

2.2.6. This long list of sites was screened to assess their suitability for initial dismantling. against a pre-defined set of mandatory threshold criteria[5], based on Measures of Effectiveness (MoE) recorded in the URD. The remaining shortlisted options were:

- Devonport Dockyard;
- Rosyth Dockyard;
- Both Devonport and Rosyth Dockyards.

2.2.7. The dual site option utilises both of the identified sites for submarine dismantling but, as duplication of all facilities would be prohibitively expensive[6], only one size reduction facility is assumed. 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).

2.2.8. Generic ILW Storage Site(s)

2.2.9. 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 available[5].

2.2.10. At this stage, it has not been possible to screen the long-list of existing nuclear Licensed/Authorised sites because of the different governance arrangements and strategies for sites under differing ownership. As an intermediate step, 4 possible categories of candidate sites for storage of ILW have therefore been identified and assessed at a generic level:

- Storage 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 storage[7].
- Storage on commercial site remote from point of waste generation. This category could include Rosyth Dockyard or Devonport Dockyards if

[4] 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.
[5] SDP Site Criteria and Screening Paper v2.0 dated March 2011.
[6] The cost of a single dismantling facility has been estimated to be around [redacted]. The cost of two facilities, even taking account of the costs of RPV movement, has been estimated to be around [redacted] or more than a single facility.
[7] Cost modelling has indicated that the cost of waste movement is preferable to the cost of building additional storage facilities, due to the relatively low number of waste packages. The building of two stores results in 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.

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.

- Storage on MOD site remote from 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.

- Storage on Nuclear Dismantling Authority (NDA) site(s). It may be possible for MOD waste to use NDA storage facilities. These are all remote from the point of waste generation.

2.2.11. The costs associated with transport and dockside handling facilities to move all 27 RCs, render their storage at a remote site, including NDA sites, as uneconomic and this has not, therefore, been assessed as an option[8] although it remains as an opportunity to be reviewed as estimates are refined and assumptions are tested. Storage of RPVs at an NDA site has also not been assessed as an option because its feasibility has yet to be proven through joint studies with NDA.

2.3. Option Set

2.3.1. The options are described fully in the SDP Options Report[9] and summarised in Table 1.

Option	**Variants**
Option 0: Do Minimum	None
Option 1: Reactor Compartment (RC) separation with interim storage at point of waste generation[10] 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[11] 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	

[8] For economic reasons, the project has assumed that no transport of RCs would be undertaken with the exception of Option 1B which includes 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 because the costs and risks of two RC stores are assumed to outweigh those of transporting RCs between initial dismantling sites.
[9] SDP Options Report, v1.0, dated February 2011.
[10] Devonport (D), Rosyth (R) or Both (B).
[11] 'Remote' means a site remote from the location where dismantling occurs; it does not include a ILW storage location at a different place on the same site.

Option	Variants
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 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)	

Table 1 - SDP Options

2.3.2. It should be emphasised that *all* Options (except Do Minimum) conclude with the ILW in the form of Packaged Waste ready for disposal in the proposed Geological Disposal Facility (GDF). The key difference is that Options 5 to 8 assume that size reduction happens shortly after initial dismantling, with ILW being placed in interim storage as Packaged Waste; whereas Options 1 to 4 assume that the RCs or RPVs are put in interim storage with size reduction conducted only when the proposed GDF is ready.

2.3.3. As noted above, Do Minimum (Option 0) represents a continuation of afloat storage of redundant submarines but identifies and implements the lowest incremental activities that can meet all mandatory requirements. This option is a comparator for analytical purposes and does *not* have the same end point as the technical options described above (i.e. final disposal in the proposed GDF).

3. Analysis Approach

3.1. OE and User Requirements

3.1.1. SDP is concerned with developing a solution to deal with dismantling, recycling and disposal of existing assets rather than with developing a new military capability. Operational Effectiveness has therefore been assessed on the basis of 'how well' the different approaches to dismantling, storage and disposal meet the User Requirements (URs) as defined in the URD and, hence, how well the approaches deliver the intended SDP benefits.

3.2. OE Analysis Method

3.2.1. The ability of each option to meet individual URs and, hence, deliver SDP benefits has been analysed using MCDA. The SDP user requirements are designed to deliver many diverse benefits. The relative importance of the benefits can only be assessed by applying the judgement of a diverse group of Subject Matter Experts (SMEs) in a structured manner. Similarly, the relative importance of the user requirements to the achievement of benefits can only be arrived at by structured judgement and, finally, expert judgement is needed to assess how well an option meets a user requirement.

3.2.2. In the general case, MCDA identifies criteria which may potentially differentiate options and then 'links' the criteria to benefits to create a structured hierarchy of criteria/benefits with criteria at one end of the hierarchy and an overall 'aggregated' top level benefit at the other. The 'links' in the hierarchy are 'weighted' to indicate the importance of criteria to benefits and the importance of benefits to overall aggregated benefit. The criteria are 'scored' for each option. For SDP, the criteria are 'how well an option meets a user requirement'. The hierarchy, when populated with scores and weights is the completed MCDA model and can be used to generate an overall aggregated score for each option.

3.2.3. The URs have associated MoE, with threshold (the minimum required level of performance) and objective (the maximum level of performance above which no further benefit is accrued). The relevant MoE's (excluding those that were WLC or thresholds for screening), were used to generate a comprehensive list of MCDA criteria.

3.3. Benefits mapping and MCDA Modelling

3.3.1. A workshop involving a range of MOD stakeholders and an Advisory Group (AG) observer was held on 2 November 2010 to capture SDP benefits and disadvantages. The results of this workshop are described in the SDP Benefits Report[12]. The benefits identified at the workshop were used to generate a benefits map which identified causal links between URs and SDP benefits, so providing the structure for the SDP MCDA model.

3.3.2. Three further two-day workshops attended by SMEs were then conducted:

[12] SDP Benefits Report, v1.1, dated October 2011.

- **Criteria:** A benefits map, containing thirty proposed criteria, was reviewed by an expert panel that reduced the number to 21. A summary of the key findings of the criteria workshop is presented at Annex B. A MCDA model structure was then constructed.

- **Weights:** The links in the MCDA model structure were weighted on a scale of 0 to 10 by a panel of 13 experts, supported by technical informers. Individual weights were recorded by each expert to generate a representative spread of results. A summary of the key findings of the weighting workshop is presented at Annex C. Two of the criteria were merged during the workshop so that 20 criteria were taken forward to the scoring workshop.

- **Scores:** The 25 options and variants were scored against each of the 20 criteria. Due to the number of options and criteria the workshop was divided into three parallel syndicates each comprising between 7 and 9 experts. Individual scores were recorded by each expert to generate a representative spread of results. A summary of the key findings of the scoring workshop syndicates are presented at Annexes D, E and F. In addition a record of the assumptions made during the workshop, including agreed subsequent actions, is included at Annex G.

3.3.3. Workshop participants were provided with a Data Report[13] which included a description of each option and variant, and a description of each criterion, including quantitative data, where possible, or a narrative discussion where quantification was not possible. D Scrutiny attended each of the meetings, as did SDP Advisory Group (AG) observers.

3.3.4. WLC was explicitly excluded from discussion at the workshops, as were non-quantifiable issues such as socio-economic impact or political factors, except where necessary to ensure that these issues were being addressed consistently elsewhere in the COEIA process.

3.3.5. The MCDA model captured the effects of variability in scores and weights captured in the workshops using Monte Carlo simulation which sampled from the across the range of weight and score data to generate a distribution of OE for each option[14]. This allowed 10th, 50th and 90th percentile values to be generated for each option, with the range 10% to 90% providing uncertainty bounds around the median of 50%. The 90th percentile is the value at which only 10% of the results score more highly; the 10th percentile the value at which only 10% of the results score more poorly. The model and input data was subject to Verification and Validation (V&V) by the project's team of industry experts[15].

3.4. MCDA Model

3.4.1. The different coloured boxes in Figure 1 (below) identify the four main groups of benefit and related criteria:

[13] SDP Data Report, Issue 2.0 dated June 2011.
[14] This operated by generating histograms for each set of weights (for the 20 criteria) and for each set of scores (for the 25 options scored against the 20 criteria, amounting to 500 in all), and then sampling randomly from the combinations 10,000 times. This generates a distribution of results for each option.
[15] See "Review of SDP MCDA Monte-Carlo Model and Associated Data Checking", dated 30 June 2011, from Nuvia.

- Blue: Reduction in Impact to Government and MOD – Policy **(POL).**
- Yellow: Reduction of impact to Operations **(OP).**
- Purple: Minimisation of Health and Safety **(H&S)** Risk
- Green: Reduction of Environmental **(ENV)** Impact.

3.4.2. The Environmental group of criteria included 6 specific criteria (listed in Table 2) and scoring against these criteria was informed by results from the SEA being undertaken by SDP. The SEA also informed the development of OCF to ensure that coherence was established between the decision making process outlined in this report and findings from the SEA.

3.5. Derivation of the Criteria, Benefits and MCDA Hierarchy

3.5.1. The criteria used in the MCDA model have been derived from earlier work that considered the attributes that should be applied to the assessment of both technical options and site options. Earlier work on attributes for the assessment of technical options includes the ISOLUS Technical Options Study (TOS)[16] which took place in 2008 and involved a wide range of stakeholders. Whilst lacking much of the underpinning data needed to conduct a meaningful assessment, the TOS was formative in understanding the range of views likely to be encountered from external stakeholders and the perception of benefits and disbenefits associated with the project. The attributes applied in the TOS were reviewed in the development of criteria for the subsequent MOD Proposed Option Study (MPOS)[17],[18] which was a tentative and indicative assessment of the technical options only.

3.5.2. The document *'*SDP - Our Approach to Decision Making',[19] sets out the approach to selecting options which included screening of dismantling sites followed by the applications of a MCDA model to assess OE. The threshold criteria that the project applied to the screening of candidate dismantling sites, its proposed criteria for future screening of storage sites and some of the objective criteria for the assessment of all site options are described in the Site Criteria and Screening Paper[20].

[16] SDP Technical Options Study, FNC 35114/35042R dated June 2010.
[17] FNC Technical Note 36995/63406V, Selection of Criteria for MPOS Study, dated April 2010.
[18] SDP MOD Proposed Options Study (MPOS), FNC 36995/36702R Issue 1 dated August 2010.
[19] Based on the Concept of Analysis (CoA), version 1.1, March 2011.
[20] SDP Site Criteria and Screening Paper, Issue 2.1 dated 31 May 2011.

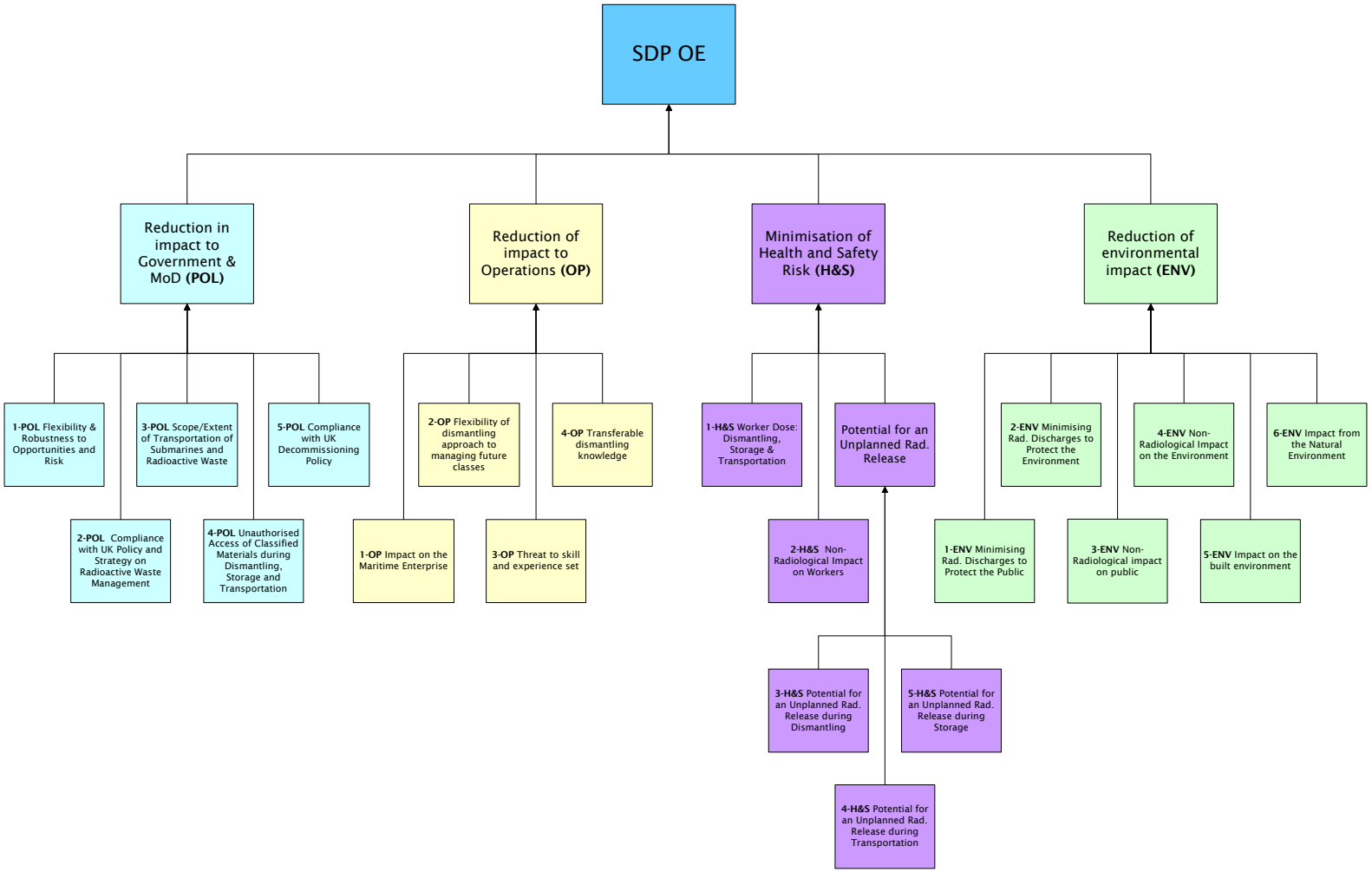

Figure 1 - MCDA Model Structure

3.6. Criteria and MCDA Weights

3.6.1. Table 2 identifies the criteria derived and agreed in the Criteria Workshop and weighted[21] in the Weighting Workshop. The MCDA model structure was built in three levels below the overall OE. The weights assigned to the linkages between the various levels of the model have also been included in Table 2.

Category Weight	Category	Criterion Title		Criterion Weight
25.2%	Reduction in Impact to Government and MOD (POL)	1-POL: Flexibility and Robustness to Opportunities and Risk		**4.8%**
		2-POL: Compliance with UK Policy and Strategy on Radioactive Waste Management		**4.1%**
		3-POL: Scope/Extent of Transportation of Submarines and Radioactive Waste		**4.3%**
		4-POL: Unauthorised Access to Classified Materials during Dismantling, Storage and Transportation.		**6.6%**
		5-POL: Compliance with UK Decommissioning Policy		**5.3%**
32.2%	Reduction of impact to Operations (OP)	1-OP: Impact on the Maritime Enterprise and Wider MOD Operations		**12.2%**
		2-OP[22]: Flexibility of Dismantling Approach to Managing Future Classes		**7.1%**
		3-OP: Threat to Skill and Experience Set		**8.3%**
		4-OP: Transferable Dismantling Knowledge		**4.6%**
17.4%	Minimisation of Health and Safety Risk (H&S)[23]	1-H&S: Worker Dose: Dismantling, Storage and Transportation		**0.0% (see below)**
		2-H&S: Non-Radiological Impact on Workers		**8.3%**
		U-H&S Potential for an Unplanned Radiological Release **(9.1%)**	3-H&S: Potential for an Unplanned Radiological Release during Dismantling	**3.2%**
			4-H&S: Potential for an Unplanned Radiological Release during Storage	**2.5%**
			5-H&S: Potential for an Unplanned Radiological Release during Transportation	**3.4%**
25.2%	Reduction of Environmental Impact (ENV)[24]	1-ENV: Radiological Discharges to the Public		**5.2%**
		2-ENV: Radiological Discharges to the Environment		**4.5%**
		3-ENV: Non-radiological Impact on the Public		**4.5%**
		4-ENV: Non-radiological Impact on the Environment		**4.3%**
		5-ENV: Impact on the Built Environment		**3.3%**
		6-ENV: Impact from the Natural Environment		**3.4%**

Table 2 - Summary of SDP Criteria and Weights

[21] In the table the weightings given are mean values derived from the MCDA model, which sampled from the weights and scores provided.
[22] This criterion recognises that decisions taken now on SDP will set the context for decisions, to be taken at the appropriate point in the future, on dismantling of future classes of submarine. The dismantling of future classes (including Astute and later classes), however, remains outside the scope of SDP.
[23] These criteria are concerned primarily with the H&S of workers and employer responsibilities under the Health & Safety at Work Act.
[24] These criteria have been derived directly from the SEA.

3.6.2. One of the criteria, 1-H&S *Worker Dose: Dismantling, Storage and Transportation*, was weighted and scored but, under advice from DASA/DESA, will instead be addressed as part of the IA following the same practice as the NDA[25]. It has therefore been weighted as zero[26]. The qualitative discussions regarding the dose for each option are included in the OE Report, but the quantitative differences are considered in financial terms in the IA[27].

3.7. Variability in MCDA Weighting

3.7.1. There was a wide range of values ascribed to the MCDA weights at the workshop. The mean standard deviation for the weights ascribed to the links for H&S and OP was 1.6, POL was 2.0 and ENV was 2.1. This reflected different opinions presented at the workshop as described in detail in Annex B to this document.

3.7.2. In contrast the standard deviation of the weights to the links to the overall aggregated benefit (SDP OE) was lower at 1.3, reflecting a broad consensus on the relative importance of each group of SDP OE.

3.8. Non-compliant Scores

3.8.1. Seventeen criteria had threshold values (set at 1) below which options scoring 0 would be deemed as failing to meet the requirements in the URD. For all of these17 criteria, no options were scored zero by all members of the expert panels, but the following received some individual scores of 0:

- Option 0 (Do Minimum) received a single score of 0 for 1-OP *Impact on the Maritime Enterprise and Wider MOD Operations* (although the panel gave this a low mean score of 1.1). The main reason for the low scores was because of the significant impact to dockyard and naval base operations which would result from storing 27 submarines afloat, in terms of the operational impact of constructing new berthing facilities and associated infrastructure.

- Option 0 (Do Minimum) received two scores of 0 for 5-POL *Compliance with UK Decommissioning Policy* (with a mean score of 2.9). The main reason for the low scores was because the 2004 Amendment to Command 2919 paper[28] states that decommissioning operations should be carried out as soon as reasonably practicable, whereas Option 0 does not progress decommissioning.

- Option 1R (RC interim storage at Rosyth) received a single 0 for 1-OP *Impact on the Maritime Enterprise and Wider MOD Operations* (with a low mean score of 1.2). The main reason for the low scores was because the footprint of the RC interim store was comparatively very large (ca.11,600 m^2) and locating such a store at Rosyth would have an adverse effect on the ability to decommission or develop Rosyth, which in turn could have a negative impact on the maritime enterprise.

[25] NDA Guidance for the Production of Business Cases, Doc No EGG 08, Rev 6, November 2009. Available at: http://www.nda.gov.uk/documents/upload/EGG08-NDA-guidance-for-the-production-of-business-cases-Rev7.pdf
[26] A sensitivity analysis was conducted by including the weight provided to 1-H&S during the OE. See section 4.7
[27] A sensitivity analysis was also conducted by setting all the H&S criteria to zero. See section 4.8
[28] The Decommissioning of the UK Nuclear Industry's Facilities – Amendment to Command 2919, DTI Paper, September 2004.

3.8.2. The lack of consensus on these scores means that it is unreasonable to regard the associated options as non-compliant, although they are indicative of potential difficulties that have yet to be quantified. This is particularly true for the scores for 1-OP where the average values are very low for both options discussed above.

3.8.3. It is also important to place Option 0 in context: it represents a comparator with a different end state to all the other options (the submarines are afloat, intact and continue to be a liability, rather than being made ready for disposal in the proposed GDF). During indefinite afloat storage, periodic inspections of the submarine hull would need to be carried out and relevant measures undertaken to prevent or limit hull corrosion. The same regulatory regime would continue to apply and conformance with authorisation / licensing conditions would still be mandatory.

4. MCDA Findings

4.1. Results

4.1.1. The data captured at the Scoring and Weighting Workshops was entered into the MCDA model. Figure 2 (below) shows the results from the MCDA model, following 10,000 iterations using a Monte Carlo simulation, and shows the 10th, 50th and 90th percentile values are shown. Note that the scale extends from 3.5 to 6; the full range of potential scores is from 0 to 10.

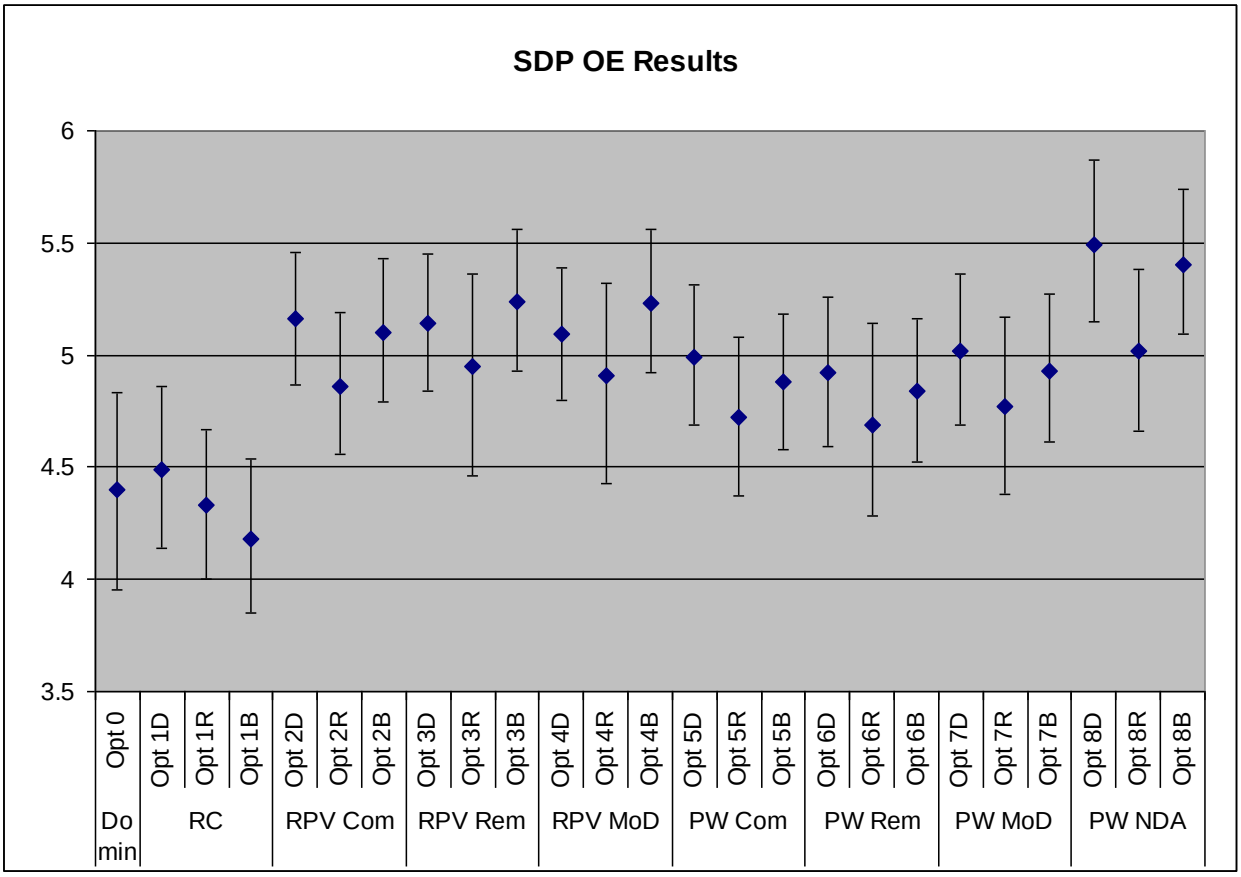

Figure 2 - OE Plot (uncertainty bounds show 10%, 50% and 90% values)

4.1.2. Table 3 provides the SDO OE results in tabular form.

Option	10th%	50th%	90th%
0: Continued Afloat Support	3.95	4.40	4.83
1D: RC separation at Devonport with interim storage at point of waste generation (POWG)	4.14	4.49	4.86
1R: RC separation at Rosyth with interim storage at POWG	4.00	4.33	4.67
1B: RC separation at Devonport & Rosyth with interim storage at POWG	3.85	4.18	4.54
2D: RPV removal at Devonport with interim storage at POWG	4.87	5.16	5.46
2R: RPV removal at Rosyth with interim storage at POWG	4.56	4.86	5.19
2B: RPV removal at Devonport & Rosyth with interim storage at POWG	4.79	5.10	5.43
3D: RPV removal at Devonport with interim storage at remote commercial site	4.84	5.14	5.45
3R: RPV removal at Rosyth with interim storage at remote commercial site	4.46	4.95	5.36
3B: RPV removal at Devonport & Rosyth with interim storage at remote commercial site	4.93	5.24	5.56

4D: RPV removal at Devonport with interim storage at remote MOD site	4.80	5.09	5.39
4R: RPV removal at Rosyth with interim storage at remote MOD site	4.43	4.91	5.32
4B: RPV removal at Devonport & Rosyth with interim storage at remote MOD site	4.92	5.23	5.56
5D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at POWG	4.69	4.99	5.31
5R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at POWG	4.37	4.72	5.08
5B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at POWG	4.58	4.88	5.18
6D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote commercial site	4.59	4.92	5.26
6R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at remote commercial site	4.28	4.69	5.14
6B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at remote commercial site	4.52	4.84	5.16
7D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.69	5.02	5.36
7R: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.38	4.77	5.17
7B: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.61	4.93	5.27
8D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at an approved NDA site	5.15	5.49	5.87
8R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at an approved NDA site	4.66	5.02	5.38
8B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at an approved NDA site	5.09	5.40	5.74

Table 3 - SDP OE Results

4.2. Interpretation of Results from Scoring Workshop

4.2.1. Key points on the scoring scale were given a specific and tangible meaning and these were written down for reference on the scoring sheets provided at the Scoring Workshop. A score of 1 corresponded to meeting a threshold value and 9 to an objective value. The resulting overall OE scores are, therefore, related to the threshold and objective measures of effectiveness specified in the URD but are quantified by variability bounds consistent with the spread of weights and scores captured at the workshop.

4.2.2. The median overall SDP OE scores for the options range from 4.18 for Option 1B to 5.49 for Option 8D. The lowest 10th percentile value is 3.85 for Option 1B and the highest 90th percentile value is 5.87 for Option 8D. Taken together, these scores show that all the options are relatively closely situated in terms of OE.

4.2.3. In the interpretation which follows, these terms have been used:

- **Statistically significant**; where the 10% value for one option exceeds the 90% value of another, their separation is considered statistically significant as there is less than a 1% chance of the lower scored option achieving a OE score greater than the higher scored option.

- **Trend or Clustering**; where there is a noticeable grouping or other arrangement of options, whilst understanding that they are not necessarily statistically significant.

4.2.4. Overall

4.2.5. The mean of the median SDP OE scores across the options is 4.9, with a mean standard deviation of 0.7, demonstrating relatively close agreement between the members of the expert panels providing the scores at the workshops. Although the workshops included extensive and healthy debate as reported in Annexes C to E, the results indicate a reasonable degree of consensus. This was particularly strong correlation of the scores from delegates scoring the Health & Safety and Environment groups.

4.2.6. Policy

4.2.7. The Policy group has a moderately narrow range of median scores across the options, from 1.2 for Options 1B to 1.6 for Options 8D and 8R.

4.2.8. With regard to the adaptability and robustness of options against future opportunities and risks (1-POL), it was concluded that Do Minimum was balanced between the two; and RC scored higher than Do Minimum, although with perceived technical issues associated with the movement of RCs between sites. The RPV option scored highest due to being able to take advantage of several known opportunities such as whole RPV disposal, and the potential emergence of new technologies or policies in the future. In contrast, Packaged Waste scored poorly because size reduction is completed at an earlier stage with little flexibility remaining, although the option of storage at NDA sites was seen to offer more flexibility.

4.2.9. Scores for compliance with UK radioactive waste policy and strategy (2-POL) were highest for those options with ILW storage at the point of waste generation, and with those seen to progress dismantling more quickly. Consequently, the highest score was for Option 5, Packaged Waste stored at the point of waste generation. The Do-Minimum option scored reasonably well as the submarines stored afloat are not treated as waste, although it was noted that was taking the letter of the policy rather than the spirit. A similar pattern was followed for scoring compliance with UK decommissioning policy (5-POL), except that it was independent of the issue of where the waste would be stored.

4.2.10. The scores for transportation (3-POL) were reasonably closely grouped, with lower scores for those options involving more transport. Accordingly, Do Minimum scored highest, followed by those options with ILW storage at point of waste generation.

4.2.11. The highest score for unauthorised access to classified waste (4-POL) came from Do Minimum, as security for afloat storage is considered to be very good, and those options with ILW storage at the point of waste generation scored similarly well. Storage at a remote commercial site was regarded as less effective, as was storage of RPVs as their contents are not shape destroyed.

4.2.12. The scores for the constituent elements of Policy tend to balance one another out, with – for example – Do Minimum scoring well against transport but poorly against UK decommissioning policy. Consequently, although options involving the use of NDA sites scored highest, the differences between them are not significant.

4.2.13. Health & Safety

4.2.14. The Health & Safety group has a narrow range of median scores across the options, from 0.8 for Options 1B to 1.2 for Option 0.

4.2.15. Worker Dose (1-H&S), although scored to bring out discussion and debate, has not been assessed as OE but within the IA For information, however, the scores for dose were all extremely close, with 8.1 for Do Minimum, 7.9 for RC separation and 6.9 for RPV removal and Packaged Waste. All of the options scored considerably in excess of the score for the legal limit (which was set at 1).

4.2.16. The highest score for the non-radiological impact on workers (2-H&S) was for Do-Minimum, as no new activity is being conducted. The other options scored closely with lower scores because of the impact of transport.

4.2.17. The scores for the potential for unplanned release during dismantling (3-H&S) decreased with options that progress dismantling quicker. So Packaged Waste was the worst and Do-Minimum the best, again reflecting the level and rate of the activities involved. The scores for the potential for unplanned release during transportation (4-H&S) exhibit a similar pattern. This is not true for unplanned release during storage (5-H&S), where Packaged Waste was considered the safest and therefore highest scoring option, with the others presenting broadly similar scores.

4.2.18. Uniquely amongst the criteria groups, scores for the Do-Minimum option were the highest by a moderate margin (bearing in mind the closeness of all the options in this group) due to the fact that all the other options involve a higher degree of activity and therefore risk. It is important to stress, however, that all these scores apply to health and safety impact *after* legal minimum requirements have already been met.

4.2.19. Operations

4.2.20. The Operations group has a relatively wide range of median scores across the options, from 0.7 for Option 1 to 1.9 for Options 3B and 4B. The largest contribution to this separation comes from the impact on the maritime enterprise (1-OP), where Do Minimum and RC separation scored very low due to their negative impacts on the Dockyard and Naval Base operations. Dismantling at Rosyth scored particularly poorly due to the potential impact on the Maritime Change Programme and plans for re-development of the Rosyth site.

4.2.21. Flexibility to dismantle future classes (2-OP) was scored highest for RC and lowest for Packaged Waste, as there is less flexibility if the overall dismantling process is progressed more quickly. Nonetheless, afloat storage scored zero[29] as it offers nothing of value for dismantling future classes.

4.2.22. The scores against with threat to skills from SDP (3-OP) were not straightforward as they took account of the potential use of scarce MOD resources, the availability of skilled personnel from the civil sector, and the loss of knowledge if dismantling is delayed. As a consequence there was a degree of balancing between the options

[29] This criterion was not one of those with a threshold value; 2-OP provides benefit to SDP but is a tradable requirement without a firm minimum.

and little overall difference, although Rosyth scored lower than Devonport due to having less suitably skilled personnel available locally.

4.2.23. The benefits of knowledge transfer with other MOD projects, the civil sector and other countries (4-OP) were greatest for size reduction, as there would be more learning involved and therefore lessons to share, followed by RPV removal, which would also involve some learning, although there was also seen to be some benefit with continued afloat storage arising from the need to develop new techniques for safe long-term hull maintenance.

4.2.24. In summary, Do Minimum scores badly for operational impact, with RC separation lower than Packaged Waste and RPV achieving the highest scores.

4.2.25. Environment

4.2.26. The Environment group has a narrow range of median scores across the options, from 0.9 for Options 1D and 1B, to 1.2 for Option 0.

4.2.27. For radiological discharges to the public (1-ENV) and the environment (2-ENV), Option 0, which involves little new activity, had a score close to the current level of impact (5). None of the other options, however, were considered to have a significant impact on the environment, and there is little difference in terms of potential dose to the public or the environment as all work is carried out within the dockyards.

4.2.28. The non-radiological impact on the public (3-ENV), including nuisance, vibration, noise and congestion, was considered to be lower for dismantling at Rosyth because of its relative remoteness from centres of population. Packaged Waste has the lowest score of the technical approaches as size reduction is the most extensive process for dismantling, with the exception of the use of a NDA site as it does not require new facilities to be built. A similar pattern of scores emerged s observed with the non-radiological impact on the environment (4-ENV) and the impact on the built environment (5-ENV).

4.2.29. In terms of impact from the natural environment (6-ENV), none of the differences in scores were statistically significant. Risk from flooding was highlighted as the most significant environmental threat, with Rosyth being more vulnerable than Devonport. Nonetheless, the existence of flood defences and procedures for planning permission resulted in all of the options being given closely grouped scores.

4.2.30. Do Minimum scores most highly due to the lack of activity which can impact the environment. However, the other options score close to the value for Do Minimum, with the NDA sites delivering the highest scores other than Option 0. It is important to stress that all these scores apply to environmental impact *after* legal minimum requirements have already been met.

4.3. Analysis

4.3.1. Table 4 ranks the options from highest to lowest median scores.

Rank	Option	10th%	50th%	90th%
1	8D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at an approved NDA site	5.15	5.49	5.87

Rank	Option	10th%	50th%	90th%
2	8B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at an approved NDA site	5.09	5.40	5.74
3	3B: RPV removal at Devonport & Rosyth with interim storage at remote commercial site	4.93	5.24	5.56
4	4B: RPV removal at Devonport & Rosyth with interim storage at remote MOD site	4.92	5.23	5.56
5	2D: RPV removal at Devonport with interim storage at POWG	4.87	5.16	5.46
6	3D: RPV removal at Devonport with interim storage at remote commercial site	4.84	5.14	5.45
7	2B: RPV removal at Devonport & Rosyth with interim storage at POWG	4.79	5.10	5.43
8	4D: RPV removal at Devonport with interim storage at remote MOD site	4.80	5.09	5.39
9	7D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.69	5.02	5.36
10	8R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at an approved NDA site	4.66	5.02	5.38
11	5D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at POWG	4.69	4.99	5.31
12	3R: RPV removal at Rosyth with interim storage at remote commercial site	4.46	4.95	5.36
13	7B: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.61	4.93	5.27
14	6D: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote commercial site	4.59	4.92	5.26
15	4R: RPV removal at Rosyth with interim storage at remote MOD site	4.43	4.91	5.32
16	5B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at POWG	4.58	4.88	5.18
17	2R: RPV removal at Rosyth with interim storage at POWG	4.56	4.86	5.19
18	6B: RPV removal & size reduction at Devonport & Rosyth to form Packaged Waste with interim storage at remote commercial site	4.52	4.84	5.16
19	7R: RPV removal & size reduction at Devonport to form Packaged Waste with interim storage at remote MOD site	4.38	4.77	5.17
20	5R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at POWG	4.37	4.72	5.08
21	6R: RPV removal & size reduction at Rosyth to form Packaged Waste with interim storage at remote commercial site	4.28	4.69	5.14
22	1D: RC separation at Devonport with interim storage at point of waste generation (POWG)	4.14	4.49	4.86
23	0: Continued Afloat Support	3.95	4.40	4.83
24	1R: RC separation at Rosyth with interim storage at POWG	4.00	4.33	4.67
25	1B: RC separation at Devonport & Rosyth with interim storage at POWG	3.85	4.18	4.54

Table 4 - Ranked SDP OE Results

4.3.2. From these results, and taking account of the relatively close spacing of the options, it is possible to identify three overlapping clusters:

- Options 0 and 1: the lowest scoring group with median values of between 4.18 and 4.49.
- Options 2 to 7 and 8R: the bulk of the options with median values of between 4.69 and 5.24.

- Option 8D and 8B: the highest scoring group (which is not very clearly differentiated from 2 to 7 and 8R) with median values of between 5.40 and 5.49

4.3.3. Caution is required in assessing these results, as there is only clear differentiation (here defined as the 90% value of one option less than the 10% level of another) between a few of the options:

- Options 2D, 3B, 4B, 8D and 8B are separated from Options 0 and 1 by a statistically significant degree.

- Although not separated by a statistically significant margin, it is notable that all of the Rosyth variants (with the exception of Option 1) score less well than the Devonport and Dual Site variants. Individually this is not significant, but forms a consistent pattern across Options 2 to 8.

4.4. Issues Arising from the Scoring Workshop

4.4.1. Options 1B, 2B and 5B assume initial dismantling at both sites and then transportation of RCs, RPVs or Packaged Waste to one of the two sites for interim storage. In these cases there are differences between interim storage at Devonport or Rosyth. As a working assumption in the Operations syndicate, transport from Rosyth to storage at Devonport was assumed for dual site options as this involved the fewest transportations and was therefore seen as the most favourable configuration in which to assess this option. Discussion of these options in the Operations syndicate led to the tentative conclusion that storage at Rosyth would score slightly less favourably. In contrast discussion of dual site dismantling in the Environment syndicate led to the tentative conclusion that transport to, and storage at, Rosyth would score more favourably. This uncertainty between these two possibilities must be born in mind when considering the scores for 1B, 2B and 5B.

4.5. Importance of Key Option Factors

4.5.1. It is not straightforward to disentangle the importance of the three Key Option Factors (KOFs) which discriminate between options: i.e. technical approach, dismantling site and storage sites. In other words, it is difficult to answer the question ‘which KOF contributes most strongly to differentiating option scores’.

4.5.2. To try and capture this, each option or variant relevant to a particular decision has been grouped by KOF – for example, all the options and variants can be divided into those relevant to the different forms of technical approach; afloat storage, RC, RPV or Packaged Waste. The mean of the medians of these groups can then be measured across the relevant options, as shown in Table 5.

Technical Approach		**Mean of Median SDP OE Score**
Continued Afloat Storage	One option	4.40
RC separation	Three variants	4.33
RPV removal and storage	Nine variants	5.08
Packaged Waste	Twelve variants	4.97
Initial Dismantling Site(s)		
Continued Afloat Storage	One option	4.40
Devonport	Eight variants	5.04

Rosyth	Eight variants	4.78
Both	Eight variants	4.98
Storage of ILW		
Continued Afloat Storage	One option	4.40
Point of waste generation	Nine variants	4.75
Commercial site (remote)	Six variants	4.96
MOD site (remote)	Six variants	4.99
NDA (remote)	Three variants	5.30

Table 5 - SDP OE Scores by Key Option Factors

4.5.3. Broadly, this data can be interpreted to suggest that there is little overall difference between the technical approaches of RPV removal and storage and Packaged Waste, because the mean values are very close.

4.5.4. Looking at the scores for each option in the chart above it is noticeable that of the Packaged Waste options, the NDA sites perform better than the others. Table 6 (below) shows the mean scores if the Packaged Waste options are broken into two (NDA and non-NDA).

Technical Approach		**Mean**
Continued Afloat Storage	One option	4.40
RC separation	Three variants	4.33
RPV removal and storage	Nine variants	5.08
Packaged Waste (not NDA)	Nine variants	4.86
Packaged Waste (NDA)	Three variants	5.30

Table 6 - Revised Technical Approach Results

4.5.5. The following tentative conclusions can be drawn from this analysis:

- Continued afloat support and RC (which have close means) are separated by a statistically significant margin from RPV and Packaged Waste (which also have close means).
- The significance of the dismantling site is not large but Devonport and dual site dismantling (mean of medians of 5.04 and 4.98) are positively differentiated from continued afloat support (4.40) and notably higher than Rosyth (4.78).
- Storage at a NDA site is separated by a statistically significant margin from the other options, which are all close except that afloat storage is more strongly differentiated as well.

4.5.6. Caution must be applied to this analysis but it shows, broadly, what factors are more significant in differentiating between options.

4.6. Breakdown by Criteria Group

4.6.1. The MCDA criteria were scored in 4 topic groups corresponding to the high level benefits and impacts arising from the project. Table 7 (below) shows the mean and standard deviation of the median scores for each group across the options.

Category	**Do Minimum**	**Minimum**	**Maximum**	**Standard**

		Value of Options 1 to 8	Value of Options 1 to 8	Deviation
POL	1.6	1.5	1.9	0.12
H&S	1.2	0.8	1.0	0.08
OP	0.7	1.0	1.9	0.30
ENV	1.2	0.9	1.1	0.06

Table 7 - SDP Results Divided into Categories

4.6.2. This analysis shows that the scores for the options for H&S and ENV are all tightly grouped, indicating little differentiation. There is more differentiation with scores for POL, but the most significant differentiator is OP. In addition, all the options other than the Do Minimum are higher for OP but lower for H&S and ENV, tending to balance each other out.

4.7. Sensitivity Analysis: Inclusion of Dose (1-H&S)

4.7.1. If the scores and weights recorded at the workshops are included in the model, the changes to the OE results are negligible:

- The only changes to the ranking of options based on mean scores relate to Options 2D and 3D reversing position (ranked 5th and 6th normally with a difference of 0.02); Options 5D and 3R reversing position (ranked 11th and 12th normally with a difference of 0.04); and Option 6D advancing two ranks (normally it is 14th).

- The maximum mean score is 5.54 as opposed to 5.49 normally (both for 8D) and the lowest mean score is 4.33 as opposed to 4.18 normally (both for Option 1B).

4.7.2. As noted in Section 3.4, these limited changes reflect the way in which the scores for dose are very close.

4.8. Sensitivity Analysis: Exclusion of Criteria Groups

4.8.1. As cost estimates for SDP are further refined, it may be possible to represent all the Health and Safety (H&S) criteria, and not just Dose (1-H&S) in WLC terms. If the H&S criteria are excluded from consideration, the OE results are altered as follows:

- The highest four ranked options remain unchanged, and the rank of eighteen of the twenty-five options is either unchanged or changes by only one rank. The maximum change in ranking is five, for a single option.

- The maximum mean score is 5.44 as opposed to 5.49 normally (both for 8D) and the lowest mean score is 4.06 as opposed to 4.18 normally (both for Option 1B).

4.8.2. In contrast, if the Environment (ENV) criteria are excluded:

- The highest three ranked options remain unchanged, and the rank of nineteen of the twenty-five options is either unchanged or changes by only one rank. The maximum change in ranking is five, for two options.

- The maximum mean score is 5.84 as opposed to 5.49 normally (both for 8D) and the lowest mean score is 4.3 (for Option 0) as opposed to 4.18 (for Option 1B).

4.8.3. If the Policy (POL) criteria are excluded:

- The highest four ranked options remain unchanged, and the rank of fourteen of the twenty-five options is either unchanged or changes by only one rank. The maximum change in ranking is seven, for one option.

- The maximum mean score is 5.23 as opposed to 5.49 normally (both for 8D) and the lowest mean score is 3.98 as opposed to 4.18 normally (both for Option 1B).

4.8.4. If the Operational (OP) criteria are excluded:

- Only a single option remains at the same rank. Seventeen of the options change by four or more ranks, with a maximum change of twenty-two ranks.

- The maximum mean score is 5.53 (for Option 0) as opposed to 5.49 normally (for Option 8D) and the lowest mean score is 4.41 as opposed to 4.18 normally (both for Option 1B).

4.8.5. These sensitivity analyses support the findings in Section 4.9, with the exclusion of H&S and ENV having relatively little impact on the ranking of the options. The exclusion of POL has more impact, but it is the removal of OP which has a significant impact on ranking, completely changing the pattern of results.

5. Findings

5.1. Key Findings

5.1.1. The OE analysis has not identified clearly a single option or variant as delivering the highest effectiveness. Key findings follow :

- The options all lie within a relatively close range of effectiveness values, although it must be remembered that Option 0 (Do-Minimum) has a different end state to all the others options, in that the indefinite liability associated with afloat storage of submarines remains.

- The environmental impact and health & safety impact of each of the options are close and they do not act as significant differentiators. It should be noted that the weights for these criteria were assigned on the consideration of how important they are *after* statutory minima have been achieved (ie. how important is it to do better than the legal minimum?).

- The comparator Option 0 (Do Minimum) has an effectiveness which is lower, by a statistically significant margin, than the highest performing options with a RPV or Packaged Waste approach; specifically 8D, 8B, 3B, 4B, 2D and 3D.

- Option 1 (RC) has an effectiveness which is lower, by a statistically significant margin, than the highest performing options with a RPV or Packaged Waste approach; specifically 8D, 8B, 3B, 4B and 2D.

- Those variants with dismantling at Rosyth demonstrate consistently less effectiveness than their equivalent variants at Devonport and for dual site dismantling, with the single exception of Option 1 (RC). In all other cases the Rosyth variant is the lowest of the three variants for each option.

- The different types of ILW storage are not separated by a statistically significant margin, including those with storage at point of waste generation. The options with storage of Packaged Waste at a NDA site have the highest effectiveness, albeit not by a statistically significant margin.

- Point of waste generation storage does not offer net advantage when compared to storage at a remote site, because whilst there are advantages of reduced transport and closer adherence to policy, they are offset by operational disruption caused by storage at the dockyards or Naval Base.

- There is some difference between the effectiveness of the dismantling sites, with Rosyth scoring more poorly due to the potential impact on the maritime enterprise and re-development of Rosyth of maintaining the dockyard open for SDP. The dual site dismantling options scored similarly to Devonport because although they scored higher on the policy criteria, they have a greater environmental impact and necessitate more waste transportation.

A Annex A: Abbreviations

Abbreviation	Meaning
AG	Advisory Group
BC	Business Case
CoA	Concept of Analysis
COEIA	Combined Operational Effectiveness and Investment Appraisal
DASA/DESA	Defence Analytical Services & Advice/Directorate of Economic and Statistical Advice
DE&S	Defence Equipment and Support
EA	Environment Agency
ENV	Environmental [Criteria]
GDF	Geological Disposal Facility
HMNB	Her Majesty's Naval Base
H&S	Health and Safety [Criteria]
IA	Investment Appraisal
IAC	Investment Approvals Committee
ILW	Intermediate Level Waste
ISM	In Service Submarines
KOF	Key Options Factor
LLW	Low Level Waste
LLWR	Low Level Waste Repository
MCDA	Multi Criteria Decision Analysis
MCP	Maritime Change Programme
MDAL	Master Data Assumptions List
MG	Main Gate
MGBC	Main Gate Business Case
MOD	Ministry of Defence
MoE	Measure of Effectiveness
MPOS	MOD Proposed Option Study
NDA	Nuclear Decommissioning Authority
OASP	Operational Analysis Supporting Paper
OCF	Other Contributory Factors
OE	Operational Effectiveness
ONR	Office for Nuclear Regulation – formerly the Nuclear Installations Inspectorate (NII)
OP	Operational [Criteria]
POL	Policy [Criteria]
POWG	Point of Waste Generation

Abbreviation	Meaning
RC	Reactor Compartment
RPA	Radiation Protection Advisor
RPV	Reactor Pressure Vessel
SDP	Submarine Dismantling Project
SEA	Strategic Environmental Assessment
SME	Subject matter Expert
TOS	Technical Options Study
UR	User Requirement
URD	User Requirement Document
V&V	Validation & Verification
VLLW	Very Low Level Waste
WLC	Whole Life Cost

B Annex B: Criteria Workshop Summary Notes

Context

This Annex forms a record of the SDP MCDA Criteria Workshop held on 5 – 6 April 2011 at DE&S Ensleigh. The notes take the form of a summary of the discussions at the workshop and do not represent a complete record, serving instead to summarise key assumptions, debates and conclusions.

Thirty potential criteria were presented and discussed at the workshop. The notes below record the decisions made regarding each of these criteria and whether to retain, merge or delete them for the subsequent workshops. Please note that the identifiers for each criterion (such as 1-POL or 4-ENV)[30] were finalised after the workshop, but are included here for completeness.

Attendees

Delegates:

[redacted]	MOD, NP-RPA
	MOD, ISM-PDSA-ST
	MOD, NBC(C)
	MOD, SM Safety
	NDA
	AMEC
	MOD, DIO
	MOD, ISM-SDP App1
	AMEC
	MOD, DIO
	Deloitte
	Deloitte
	MOD, ISM-SUSM
	MOD, DIO
	MOD, ISM-SDP App
	MOD, DIO
	MOD, NP-NRPA

Informers

[redacted]	Babcock
	Babcock
	Babcock
	ONR
	EA
	Nuvia
	Nuvia

[30] At the time of the workshop the criteria were divided into three categories: Reduction of Impact to Government and MOD; Reduction of Impact to Operations; and Reduction of Environmental and Safety Impact. When the criteria were agreed and renumbered after the workshop they were grouped into four categories and explicitly named POL (Policy), OP (Operations), H&S (Health & Safety) and ENV (Environment).

Observers

David Collier	Independent, SDP Advisory Group
Paul Dorfman	Warwick University, SDP Advisory Group
Les Netherton	Chairman, SDP Advisory Group

Facilitators:

[redacted]	BMT
	Nuvia

Recorders:

[redacted]	Nuvia
	BMT

REDUCTION OF IMPACT TO GOVERNMENT AND MOD

1. Ability to take Advantage of Future Opportunities

One delegate asked if this criterion included problems such as future disposal requirements. The project team responded that problems were contained in the project Risk Register, although this criterion included the mitigation of risk. It was agreed to reflect the fact that this criterion included risks and opportunities in a new title.

A number of delegates suggested that the definition of opportunities and risk required measures of probability and impact, but it was concluded after some debate that this criterion was a more general measure of robustness which was not restricted to the six currently identified opportunities.

It was agreed to retain but rename the criterion to *1-POL: Flexibility and Robustness to Opportunities and Risk*.

2. LLW Generation and Management: Compliance with National Policy and Strategy

It was emphasised that this criteria was designed to capture the level of policy compliance of the options, and not the actual volume of LLW, which was treated in cost terms in the WLC model. After some discussion it was agreed that as UK strategy is to minimise LLW, it formed a valid requirement for SDP. An extensive debate followed on whether or not to merge this requirement with that of Criterion 3 (ILW Generation and Management: Compliance with National Policy and Strategy), as both reflect radioactive waste management policy and strategy.

This was eventually agreed and this criterion was merged into a single new criterion entitled *2-POL: Compliance with UK Policy and Strategy on Radioactive Waste Management.*

3. ILW Generation and Management: Compliance with National Policy and Strategy

A similar discussion to that with Criterion 3 followed, where it was emphasised that the IA included the cost of compliance along with the risks associated with the complexity of waste management.

This criterion was merged into a single new criterion entitled *2-POL: Compliance with UK Policy and Strategy on Radioactive Waste Management.*

4. Likely acceptability of interim storage

The workshop concluded that the issues this criterion was attempting to cover were better handled as risks associated with town and country planning (which would become cost issues to be handled within the IA).

This criterion was therefore deleted.

5. Likely acceptability of transportation (regulatory)

The criterion was explained to the delegates. The cost of transport is included within the IA, and this criterion instead covers the regulatory acceptability of a transport option. The project team stated that the transport of RPVs and Packaged Waste was not now seen as problematic, making all the technical approaches similar from a regulatory point of view now none of the options include the movement of RCs[31].

After some discussion it was concluded that the criteria was valid and that it should be measured in terms of the mileage associated with transportation, as a reflection of regulatory difficulty.

It was agreed to retain but rename the criterion to *3-POL: Scope/Extent of Transportation of Submarines and Radioactive Waste*.

6. Vulnerability of Classified materials during the dismantling process

The workshop agreed that it was more rational to amalgamate this criterion with those associated with the vulnerability of classified material during storage and transportation (7 and 8).

Subsequent debate included a discussion of the meaning of this criterion, and it was considered to encompass the management of terrorist risk and preventing intrusion 'within the wire'.

The criterion was merged into *4-POL: Unauthorised Access to Classified Materials during Dismantling, Storage and Transportation*

7. Vulnerability of Classified materials during storage

[31] Option 1 is the only one including RC storage, and it is assumed to be at the point of waste generation. However, during analysis subsequent to this workshop it was determined that variant 1B (RC storage with dual site dismantling) would require RCs to be transported from one site to another, and this was included in consideration of the scoring.

The criterion was merged into *4-POL: Unauthorised Access to Classified Materials during Dismantling, Storage and Transportation*

8. Vulnerability of Classified materials during transportation

The criterion was merged into *4-POL: Unauthorised Access to Classified Materials during Dismantling, Storage and Transportation*

9. Regulatory compliance - MOD policy

It was stated that this criterion exists to answer the question "how well do options meet policy?".

One delegate questioned why MOD policy was being considered separately to Government policy (which was placed under criterion 10). A debate followed on whether there should instead be two criteria based around policy and regulatory compliance. After further discussion, however, it was agreed that SDP had to achieve regulatory compliance and that the cost of this was in the IA. Therefore this criterion was concerned with complying with policy.

It was noted that the NDA strategy was under development and that MOD strategy would be coordinated with it as it is developed. It was also noted that there was a need to consider not only radioactive waste but all of the waste streams associated with SDP.

Later discussion focused on developing a draft scoring system for this criterion. The decision was then taken to merge MOD and National policy (which is not restricted to UK policy but also to policy associated with the devolved administrations) into a single criterion and should be focused on compliance with decommissioning policy, including Command 2919 National Decommissioning Policy.

The criterion was merged into *5-POL: Compliance with UK Decommissioning Policy.*

10. Regulatory compliance - National policy and strategy

The criterion was merged into *5-POL: Compliance with UK Decommissioning Policy.*

REDUCTION OF IMPACT TO OPERATIONS

11. Positive effect on the submarine enterprise

It was agreed that this criterion was valid as the options will have a potentially significant impact on dockyard operations. It was, however, noted that it should be extended to the maritime enterprise as it also covers, but is not restricted to, impact on the Maritime Change Programme (MCP). One delegate commented that there were aspects of the planned exit from Rosyth that might extend beyond the OE and IA and have to be accounted for as an OCF. There was also some concern that this criterion and 16 overlapped to the point they were duplicate[32].

[32] Criteria 11 and 16 were both renamed but retained; however, during the weighting workshop it was agreed to merge them (see the notes in Annex C).

The discussion concluded with agreement that the impact on the maritime enterprise would be determined by judgement from experts rather than data analysis, which could not easily be determined at this stage in the development of the project.

It was agreed to retain, but rename and broaden, the criterion to *1-OP: Impact on the Maritime Enterprise.*

12. Flexibility of dismantling approach to managing future classes

There was a brief debate about this criterion which concluded that it should be retained as the MOD has a requirement within the URD that SDP considers its ability to manage future classes (Astute onwards).

It was agreed to retain the criterion as *2-OP: Flexibility of Dismantling Approach to Managing Future Classes*.

13. Threat to skill and experience set

One delegate stated that this criterion covered the fact that by waiting to conduct dismantling there will be less skilled personnel available with knowledge of the submarines available. Another added that, whilst this was true, it also covered the retention of information and know-how, as well as skills. Although one delegate suggested that this might instead be considered purely as a risk for Babcock as the contractor responsible for dismantling, it was concluded that this remained an issue for MOD.

It was agreed to retain the criterion as *3-OP: Threat to Skill and Experience Set*

14. Development of specialist skills

One delegate queried whether this criterion was employment but the workshop agreed that it was broader and covered the development of specialist skills arising from the conduct of SDP. Further discussion concluded, however, that wider employment issues should be managed as part of socio-economic impact within the OCF and specialist skills incorporated into 15. Transferrable Dismantling Knowledge.

The criterion was merged into *4-OP:Transferable Dismantling Knowledge.*

15. Transferable dismantling knowledge

The project team explained that this criterion was designed to capture the potential benefit of knowledge exchange arising from SDP with other countries (France and the USA in particular). After some discussion the workshop decided that it should be broadened to include knowledge transfer to other MOD projects and to the civil nuclear sector, and indeed that these benefits were likely to be much greater than international knowledge exchange.

The criterion was renamed *4-OP:Transferable Dismantling Knowledge.*

16. Impact on wider operations

The project team explained that this criterion included both the direct impact to MOD operations from SDP, such as the provision of an escort vessel for transporting defuelled submarines between sites, and the indirect impact on non-maritime sites and operations. After some debate, the workshop agreed to keep this criterion separate to Criterion 11 but to focus it on direct impact on operations rather than the maritime enterprise, which would be retained under Criteria 11.

The criterion was redefined and renamed *5-OP: Impact on Wider MOD Operations.*

REDUCTION OF ENVIRONMENTAL AND SAFETY IMPACT

17. Worker dose - dismantling

Discussion opened with an explanation of the dose data from Babcock on [redacted]. It was stated that removal of the primary circuit steam generators generates most dose and that the following could be concluded about the technical approaches:

Option 1 (RC) – no need to remove the circuits, so no dose.

Option 2-4 (RPV) – higher dose.

Option 5-8 (Packaged Waste) – higher dose (similar to RPV).

As a result of the ALARP process, dose still worked out as only 1mSv/anum/worker compared to 2.2mSv/annum/worker which is received from natural occurring radiation.

The workshop noted that Treasury guidelines state that dose should be included as a cost and that NDA had advised SDP that this was their approach to dose. It was therefore agreed to treat worker dose in the IA, with the agreement of DASA/DESA and D Scrutiny. The workshop questioned this direction and noted that the public were likely to be very interested in worker dose, and there was a discussion of the relative dose implications of each technical option and concluded that it would form a valid criterion if it had not been taken out of contention by the NDA recommendation. It was agreed that dose would still, however, be included as a criterion to capture discussion, although it would be weighted to zero and only scored for information purposes. The workshop also agreed to merge this criterion with 18 and 19.

The criterion was merged into *1-H&S: Worker Dose – Dismantling, Storage and Transportation.*

18. Worker dose - storage

The criterion was merged into *1-H&S: Worker Dose – Dismantling, Storage and Transportation.*

19. Worker dose - transportation

The criterion was merged into *1-H&S: Worker Dose – Dismantling, Storage and Transportation.*

20. Accidental radiological exposure during dismantling

The decision was made by the workshop to discuss this criterion at the same time as 21 and 22. One delegate asked if these criteria represented the 'maximum credible event' and clarification was provided that they relate to the *potential* for an unplanned release *after* risk mitigation to ALARP, which is managed within the IA as the cost to achieve this mitigation. Therefore these criteria represent the 'residual' risk. It was also confirmed that the public perception of radiological exposure would be handled as an OCF.

It was decided to keep the three criteria separate rather than to combine them and to re-title them as the potential for an unplanned release.

The criterion was renamed *3-H&S: Potential for an Unplanned Radiological Release during Dismantling.*

21. Accidental radiological exposure during storage

See Criterion 20 for discussion.

The criterion was renamed *4-H&S: Potential for an Unplanned Radiological Release during Storage.*

22. Accidental radiological exposure during transportation

See Criterion 20 for discussion.

The criterion was renamed *5-H&S: Potential for an Unplanned Radiological Release during Transportation.*

23. Radioactive discharges - impact on public

Debate initially centred around whether this criterion was the same as the impact on the natural environment (Criterion 26). Although it was noted that the management of radioactive discharges is 'normal business' it was concluded that there was a need to present data to the public. The workshop discussed the issues of whether this criterion should measure effectors or impacts, with final agreement that it was the latter. It was also agreed that information within the SEA would inform the scoring of the criterion for different options.

The workshop decided to merge it with Criterion 26, but subsequent assessment of the SEA outputs by the project team led to it being kept separate.

After analysis subsequent to the workshop it was agreed to retain and rename this criterion as 1-*ENV: Minimising Radiological Discharges to Protect the Public.*

24. Non-radiological impact on workers

It was noted that this criterion relates to the impact of non-radioactive material and includes asbestos etc. One delegate commented that its management represented 'business as usual' and whilst this was accepted it was noted that this, in common with the other environmental criteria, existed to measure impact beyond legal requirements (the cost of which was being captured in the IA). One delegate

commented that the greater the activity, the higher the likely impact on workers. It was agreed that this criterion covered post-DDLP operations.

This criterion was retained as *2-H&S: Non Radiological Impact on Workers.*

25. Non-radiological impact on the public

There was some discussion on whether this criterion was the same as 24 (above), and also whether it should be merged with 27 (Non-radiological impact on the environment). After discussion, however, it was agreed to retain it as several factors in the SEA contributed to it and that it was therefore best treated as a separate criterion. Later in the workshop a draft scoring system was developed for the criterion which set zero as non-compliance, and that a score of 7 (subsequently changed to 5) should represent the current impact, and that SME Judgement should be used for scoring.

This criterion was retained as *3-ENV: Non-Radiological Impact on the Public*

26. Radioactive discharges - impact on the natural environment

It was stated that this criteria summarised a number of factors assessed in the SEA. There was some discussion of whether these were such that the criterion should be separated but it was eventually decided that the OE served a different purpose and that so long as the assessment from the SEA fed into it in a transparent and accurate fashion, this could be retained as a single criterion.

At the meeting it was actually decided to merge this criterion into 23, but subsequent assessment of the SEA outputs by the project team led to it being kept separate.

After analysis subsequent to the workshop it was agreed to retain and rename this criterion as *2-ENV: Minimising Radiological Discharges to Protect the Environment*

27. Non-radiological impact on the environment

The workshop questioned the scope of this criterion and suggested, subject to the availability of data, the inclusion of a new criterion, Carbon Footprint. After the workshop it was concluded that insufficient accurate data was available to inform this new criterion and that instead the SEA would feed whatever information was available into the criterion as it stood. Subsequent work determined that the criterion should draw on the outputs from 7 SEA topic assessments (Biodiversity and Nature Conservation, Soil and Geology, Water, Air, Waste Management, Materials and Land Use and Coastal Change and Flood Risk).

This criterion was retained as *4-ENV: Non-Radiological Impact on the Environment*

28. Impact on the built environment

The workshop discussed the meaning of this criterion and it was stated that it covered not only visual impact but also impact on cultural heritage, social impact and quality of construction. One delegate suggested that it could be treated as cost in the IA as it is all about meeting the requirements of town and country planning, but after discussion it was concluded that it should be retained as it includes more than financial impact and can build on the output from the SEA. There was some

discussion of merging the criterion with others but eventually it was decided that it deserved to be retained separately.

Subsequent work confirmed that the criterion should draw on the outputs from 3 SEA topic assessments (Materials and Land Use, Cultural Heritage, Landscape and Townscape).

This criterion was retained as *5-ENV: Impact on the Built Environment.*

29. Nuisance

The workshop confirmed that this criterion covered the statutory requirement for nuisance (construction, transport, etc) to be minimised. It was agreed that the SEA would feed into this criterion, but there was also debate about whether it should be merged into criterion 25. A draft decision was taken to keep them separate but subsequent analysis by the project team led to their merger.

The criterion was merged into *3-ENV: Non-Radiological Impact on the Public.*

30. Impact from the natural environment

The project team confirmed that this criterion covered the future impact of weather and other natural hazards such as floods, sea level rise, earthquakes, subsidence, etc. One delegate noted that it was covered by planning risk but again it was re-iterated that it measured impact beyond the minimum legal requirements.

This criterion was retained as *6-ENV: Impact from the Natural Environment.*

C Annex C: Weighting Workshop Summary Notes

Context

This Annex forms a record of the SDP MCDA Weighting Workshop held on 4 – 5 May 2011 at DE&S Foxhill. The notes take the form of a summary of the discussions which accompanied weighting and do not represent a complete record, serving instead to summarise key assumptions, debates and conclusions.

Attendees

Delegates:

[redacted]	MOD, ISM-SDP App
	MOD, DIO
	MOD, NBC(C)
	MOD, Cap-DUW
	MOD, ISM-SUSM
	MOD, ISM-SDP App1
	MOD, DIO
	Deloitte
	Deloitte
	MOD, DIO
	AMEC
	MOD, ISM-DSA ST

Informers:

[redacted]	Babcock
	Babcock
	Nuvia

Observers

David Collier	Independent, SDP Advisory Group
Paul Dorfman	Warwick University, SDP Advisory Group
Les Netherton	Chairman, SDP Advisory Group
[redacted]	MOD, D Scrutiny

Facilitators:

[redacted]	Nuvia
	Nuvia
	BMT

Recorders:

[redacted]	BMT
	Nuvia
	Nuvia

Introduction

The facilitators explained the details of the weighting process. The process throughout was for delegates to provide an initial weight (by holding up printed cards with a score from 0 to 10, with meanings described on the scoring sheets used at the workshops) and to mark it on the sheets provided, followed by a discussion, after which they were asked to mark their weighting sheets for a second and final time.

The MCDA model was made up of 21 criteria arranged in 4 groups: Policy (POL), Operations (OP), Health & Safety (H&S) and Environment (ENV). The criteria within H&S were arranged such that three of them gathered under one criterion, U-H&S, which was, along with 1-H&S and 2-H&S, part of the H&S group. The purpose of the workshop was to weight every linkage between the criteria, amounting to 28 links in all.

GROUP 1– REDUCTION IN IMPACT TO GOVERNMENT & MOD (POLICY)

The facilitator asked if there were any queries about the weighting questions on the weighting sheets. With regard to Criteria 2-POL (Compliance with UK Policy and Strategy on Radioactive Waste), a query arose as to whether the differences between Scottish and UK (other) policy was a significant issue. It was indicated that it was not.

A discussion followed, based around 2-POL but actually more general in context, on whether a criteria should be weighted low if it did not act as a discriminator. The clarification provided was that criteria should be weighted according to their importance, and that scores provided for different options would indicate if there was or was not discrimination.

In relation to Criteria 4-POL (Unauthorised Access of Classified Material) it was advised that the 1958 Agreement for Co-operation on the use of Atomic Energy for Mutual Defence Purposes (Cmnd 537, as amended) applies to all 27 submarines and it would seriously prejudice Government to Government relations if breached.

Criterion 1-POL – Flexibility & Robustness to Opportunities and Risk

Initial Weights Range: 2 – 9

The facilitator asked a delegate with a low score to explain the reasons; it was felt that the opportunities and risks would balance each other out and therefore reduce the significance of the criteria. A delegate with a high score felt the same, and thought that instead the key was to remain aware and open to project opportunities and risks. It was suggested that with active management of ‘Risk & Opportunities’ the project should benefit and the weight should be higher.

One delegate considered marking at 0 because risks are considered in the Whole Life Cost (WLC) model, but it was confirmed that the model only contains known risks, and that this criteria reflects the ability to respond to as yet unknown risks/opportunities.

Final Weights Range: 2 - 9.

Criterion 2-POL – Compliance with UK Policy and Strategy on Radioactive Waste

Initial Weights Range: 2 – 10

A delegate who scored high (10) suggested that compliance was mandatory. In response it was noted that legislation is different to policy; you must comply with legislation, but policy requires a level of interpretation. It was also felt that the SDP should challenge policies and strategies for the good of the project. It was noted that the volume of ILW produced by SDP was very small in comparative terms to the wider UK nuclear industry.

Some discussion ensued about the policies covering ILW. A SME confirmed that ILW is included in the waste hierarchy so that it should be minimised. Some felt that the policy lagged behind the SDP and that it was produced with no consideration for submarine dismantling and could lead SDP wrongly. It was stated that the MOD do have experience of disposing of ILW and thermocouple probes were quoted as an example. A delegate suggested that to follow policy was easy and less work, whilst challenging it would be more work. The thoughts on this were that the SDP should help develop policy although one delegate suggested that care was needed not to give the perception that the SDP will go against National policy.

The facilitator summarised by suggesting that there was some merit in providing a low weight if a delegate felt that there should be less emphasis on following policy and a high weight if a delegate felt that there should be more emphasis on following policy.

Final Weights Range: 1 - 9.

Criterion 3–POL - Scope/Extent of Transportation of Submarines and Radioactive Waste

Initial Weights Range: 2 – 10

A number of delegates commented on the importance of transport as it represented the most public part of SDP and will be closely scrutinised. In contrast another delegate suggested that this was ‘normal business’. An SME confirmed that all of the transportation involved in the options were feasible, but the level and types of approvals required would be differentiators and potentially onerous. Another commented that the level of perceived difficulty in obtaining approvals is not relevant here, although public perception of hazard is important and MOD must be seen as a responsible organisation.

It was suggested by an SME that this was covered in the environmental criteria and that consequences of transport was more important than scope/extent. It was noted that the environmental implications are covered in those criteria, but there is still inherent value in the minimisation of transportation, which is why current ILW policy is to store at the point of generation.

Final Weights Range: 2 - 10.

Criterion 4–POL - Unauthorised Access of Classified Materials during Dismantling, Storage and Transportation

Initial Weights Range: 2 – 10

One delegate who provided a high weight (10) suggested that this was fundamental and will affect our relationship with other nations and our own reputation. Another delegate said that some options lend themselves for early de-classification. A further high scoring delegate (10) confirmed that the 1958 agreement applies and it is unlikely to be revisited soon. The US are very sensitive as they donated information and plant.

A delegate with a low weight (2) suggested that the dismantling work would be carried out at a licensed site with the security infrastructure already in place following the application of lessons learned from security incidents over the years and that storage was also 'normal business'.

Further discussions followed and it was agreed that the security issue was very significant for MOD and Government.

Final Weights Range: 7 - 10

Criterion 5–POL - Compliance with UK Decommissioning Policy

Initial Weights Range: 4 – 9

A brief discussion ensued about relevant policies. A delegate stated that the MOD policy just states that we should comply with the law and conduct dismantling as soon as reasonably practical.

A high scorer (9) said that this was a fundamental user requirement and the raison d'être for the project. Another delegate agreed, but added that it's the heart of the policy to look at the balance of dismantling now or later. All options will be compliant but 'as soon as possible' has to be traded against 'decay benefits'. A countervailing point was put by a SME that the policy is a guideline which allows decisions to be made whereas a low scorer (2) stated that the policy is sufficiently loosely worded for all options to be covered. Another delegate voiced the view that it is important to be seen to comply and hence the weight should be high.

One delegate explained that the policy informs legislation, which must be complied with, so he weighted low because it is of relatively low importance. A delegate with similar views (2) added that the contribution to the UK decommissioning policy by MOD is low in comparison with the civil nuclear industry.

A high scoring (9) delegate stated that the MOD policy is in line with the UK policy and that it should be weighted high. A delegate added that, at public consultation, there will be comparisons made between the civil nuclear industry and MOD.

One delegate considered that this was the only criteria to capture the 'intergenerational' argument (i.e. not leave problems for future generations) and that was why they had weighted this issue high.

A delegate asked why, if the MOD policy was invoked in 2004, have submarines been left in afloat storage for 10 years? Another delegate answered that MOD have complied by choosing the right time to do de-fuelling and C&M, but that now is the time to decide whether it is appropriate to do dismantling. It was pointed out by an SME that in 2004, when the MOD policy was updated, it had introduced submarine dismantling as an issue, but it also stated that the proposed GDF would be ready by 2010 (it will not be available until 2040 or later).

Final Weights Range: 3 - 9

GROUP 2 – REDUCTION OF IMPACT TO OPERATIONS (OPS)

There was considerable discussion on whether criteria 1-OP (Impact on the Maritime Enterprise) and 5-OP (Impact on Wider MOD Operations) were too close to be realistically separable. After some discussion it was agreed to score both criteria but also a combined 1-OP and 5-OP[33].

A SME also explained that Criteria 2–OP (Flexibility of Dismantling Approach to Manage Future Classes) meant that the dismantling strategy should be open to

[33] Subsequent to the workshop it was agreed to merge 5-OP into 1-OP and the combined criteria (and its associated weight) was used for scoring. This was the only case of a change to the criteria during the weighting workshop.

future submarine classes, although the requirement upon which it was based was not mandatory.

Criterion 1–OP - Impact on the Maritime Enterprise

Initial Weights Range: 6 – 10

One of the lowest scorers (6) felt that this is an important criteria, but others were more significant and suggested that the impact on wider operations (5-OP) was most significant (as noted above, this debate was a major topic of discussion). A high scorer (10) said that, to maintain a sustainable submarine enterprise, whilst providing value for money, is a key user requirement. A delegate, who weighted at 7, suggested that this is significant although was not sure how much impact SDP would have, but a high weighting is nevertheless important.

It was added by another delegate that the primary concerns have to be the long term enterprise bearing in mind that there is congestion in the naval bases and that there will be no more room for submarines in 2020. It was noted that additional berthing is captured in the cost model.

Final Weights Range: 7 – 10 (for both 1-OP and 1-OP plus 5-OP)

Criterion 2-OP – Flexibility of Dismantling Approach to Managing Future Classes

Initial Weights Range: 3 – 9

A low scorer (3) thought that this criterion was of negligible importance to the project. Another added that this was not a key user requirement but was instead tradable.

It was pointed out by an informer that there is currently no de-fuel facility for Astute and also that technology will move on considerably during the SDP programme, which is planned to run for approximately 30 years. He also pointed out that the future design is unknown and that it is very likely that any nuclear facility will require upgrade over that length of time.

Another delegate stated that they felt it was a major requirement and not just desirable, and that with regard to future design it is very likely that the same reactor (PWR2) will be used in future classes and the reactor is salient for SDP. Therefore it remains important even though there are data gaps in ASTUTE and PWR2/PWR3.

The representative from the MCP said that he has scored high because D Scrutiny and DASA/DESA will expect SDP to credibly consider future classes.

It was thought by one high scoring delegate (10) that there was an opportunity to design (e.g. lifting equipment) to cover future classes.

Final Weights Range: 2 - 9.

Criterion 3-OP – Threat to Skill and experience Set

Initial Weights Range: 3 – 10

A high scorer (10) said that this is the second biggest issue for the SDP and that time was lost on the Astute project due to the loss of skills. A second high scorer (10) agreed and said that MOD were already suffering this problem in some areas for the older submarines. One delegate considered this a good discriminator and marked high.

One delegate asked if the criterion was about availability; what skill can't you buy? It was suggested that there are valuable memories and knowledge of design and operations on each submarine. In contrast some of the skills required in the future, e.g. size reduction, packaging, are not currently available.

It was confirmed that the WLC model included the risk of buying different skills is, but not of acquiring lost knowledge. A SME stated that in the civil nuclear industry decommissioning is generally carried out by the most relevant people; that being the operations staff from that facility. It was also suggested that ongoing maintenance at Winfrith illustrated how issues of skills can be mitigated by 'money'. Another suggested that we should utilise the skills we have on the dockyards currently carrying out work on submarines.

One delegate was less concerned over the loss of skill as, over the long SDP programme and 27 submarines, there would be plenty of time for training. Another contributor suggested that this will be a load levelling project and as such can level the load on specific skill sets under normal business whilst recognising that dismantling is different to operations.

Final Weights Range: 3 - 8.

Criterion 4-OP – Transferable Dismantling Knowledge

Initial Weights Range: 2 – 9

A high scorer (9) started the discussions by stating that it is of high importance to learn what other organisations and countries are doing and share knowledge to get 'Value for Money', and it was stated that there was value in sharing knowledge with other MOD projects. A low scorer felt that this is a factor, but asked whether this should drive the best option for SDP. Another delegate pointed out that it is a regulatory expectation to learn from current experience and apply it to future experience.

Final Weights Range: 2 - 7.

Criterion 5-OP – Impact on Wider MOD Operations

Initial Weights range 0 – 8

A delegate asked if this was the 'Berthing Issue'. The facilitator said that was addressed in Criteria 1-OP.

A delegate who weighted at 0 started by stating that he thought the key issues were covered in 1-OP and that the provision of an escort for submarine transport for instance was 'normal business' and was of insignificant importance. A differing view was put forward by another delegate stating that it is top priority to support operations although the real impact of SDP maybe minuscule.

The discussion then moved on, as noted above, to merging 5-OP into 1-OP as it was difficult to determine what 5-OP covered that was separate or significant from 1-OP. An informal and non-binding vote had all delegates except one agreeing to merge the two criteria.

Discussion with the D Scrutiny observer indicated that a merger was feasible so long as it was transparent, explained fully and documented. In the mean time it was agreed to weight 1-OP, 5-OP *and* a merged 1-OP and 5-OP.

Final Weights Range: 0 - 9 (see also 1-OP results)

GROUP 3 – MINIMISATION OF HEALTH & SAFETY RISK (H&S)

A SME added that unplanned release is difficult to quantify and safety cases would need to identify planned releases before identifying credible unplanned releases. However the MCDA Data Report gave some guidelines and suggested some potential events;

- RC separation – radiation dose and contamination (Co60) from separation works

- RPV removal – radiation dose and contamination (Co60) from removal works

- Packaged waste – radiation dose and contamination (Co60) from failure of manipulator or a window in a hot cell.

One delegate asked for clarification that weighting was being done on the basis of having already achieved ALARP. This was confirmed, as was the fact that these criteria look at the release to workers.

A delegate asked if there were any examples on storage or transportation. A SME stated that transportation is well documented and that for approximately ½ million movements per year there have only been 32 events, all of which had no effect on the public. Storage follows passive safety guidelines and the possibility of unplanned release is also low.

Another delegate, however, noted that the majority of the ½ million movements per year are small medical sources in type A packages and it is very difficult to correlate this with the possible movement of large lumps of metal etc. from the SDP. Another delegate also confirmed that dismantling could include the processing of waste off-site at various different sites.

Criterion 1-H&S – Worker Dose: Dismantling, Storage & Transportation

A SME provided a summary of this criterion and explained that the dose data had been taken from the Babcock report from submarine refitting and maintenance

experience. Most doses will be from the removal of components from the RC prior to the removal of the RPV. The best estimates of dose across the options are;

RC separation - < 1mSv/year and 9 man mSv in total

RPV removal - < 1mSv/year and ~50 man mSv in total

Packaged Waste - < 1mSv/year and ~50 man mSv in total

It should be noted that whilst there is a differential this is still very low in comparison to the Basic safety Limit (BSL) at 20mSv/year. It was confirmed that the dose uptake for annual inspections etc. were included in the RC separation option.

Initial Weights range 2 – 10

A low scorer (3) started by saying that all work will be undertaken using ALARP principles, whereas a high scorer (10) stated, correctly, that if important, dose should be weighted highly, with discrimination between options decided by scoring. A mid scorer (5) said that it's not of high significance to the project because the work has to be done and the dose uptake will be controlled/managed. Another delegate suggested that the law protects workers so don't add further importance by scoring high.

Delegates were informed that although 1-H&S was being weighted, the weights would not be used in the MCDA model as DASA/DESA had stipulated that dose had to be managed through WLC, following NDA guidelines.

Final Weights Range: 3 – 9

Criterion 2-H&S – Non Radiological Impact on Workers

Initial Weights Range: 5 – 8

A delegate asked if there was available data; the reply was that there is data on LTA's etc, at dockyards which are equated to the number of hours worked. The MCDA Data Report suggests this is of low importance after mitigation. The facilitator suggested that this should be weighted with a view that it is not in the IA.

Final Weights Range: 3 - 8

Criterion U-H&S – Potential for Unplanned Radiological Release

The facilitator asked for an initial weight for this criterion as a whole relative to the other two health and safety criteria, 1-H&S and 2-H&S.

A debate ensued with regard to whether exposure was included in this criterion and whilst it was noted that the titles of the criteria don't mention exposure it is commensurate that an unplanned release will, or could lead to exposure. It was agreed that the 'potential for an unplanned release' is being weighted

Initial Weights Range: 5 – 9

A mid scorer (5) said that in overall significance the actual hazard associated with an unplanned release is more significant than worker dose. It was generally felt that this is a major issue.

Final Weights Range: 5 - 9

Criterion 3-H&S Potential for Unplanned Radiation Release – Dismantling

Initial Weight Range: 3 – 10

A high scorer (7) felt that dismantling had the highest potential for unplanned release relative to transportation and storage. This view was shared by the other high scorer. One lower scorer (5) said that all three of these criteria should be weighted the same at all phases. Another delegate disagreed, stating that dismantling just affects workers whereas transportation affects public and workers; and storage affects public and workers.

A delegate added that the title of the criteria does not include receptors and just states an unplanned release; a release at any stage is important. A SME suggested that control is more difficult in the public domain. A delegate reminded the workshop that a radiation worker has signed up to work with radiation whereas the public have not.

There followed considerable debate on whether these three criteria should be merged, but in the end it was decided to keep them, as agreed at the previous criteria workshop.

Final Weights Range: 3 - 8

Criterion 4-H&S – Potential for Unplanned Radiation Release - Storage

Initial Weight Range: 3 – 9

The majority of delegates weighted this between 3 and 5, but the high scorer (9) thought that this was significant and equal to the other unplanned release criteria . Another delegate suggested weighting dismantling and storage equally as they are on controlled sites whereas transportation is not.

Final Weights Range: 3 - 8

Criterion 5-H&S – Potential for Unplanned Radiation Release - Transportation

Initial Weight Range: 4 – 10

A low scorer (4) thought that this was less significant than dismantling, as the packaging will be approved. A delegate (10) scored high as transportation was most significant of the three following discussion, which was confirmed to be the view of all the high scorers.

Final Weights Range: 3 - 10

GROUP 4 – REDUCTION OF ENVIRONMENTAL IMPACT

Criterion 1-ENV – Minimising Radiological Discharges to Protect the Public

Initial Weights Range: 2 – 10

Two of the low scorers gave their reasons for their weights as finding it hard to see the link between dismantling work and the public; and that discharges are negligible in comparison to that received from natural and other sources. A high scorer countered by stating that that this would have a high impact even though there is a high probability of it not happening. This was the general consensus from the high scorers with the added iteration that it is of high importance, but that the scores would not be a differentiator.

Another delegate said that compliance with legislation leads to a need to demonstrate provision of a solution, thereby leading to a weighting in the middle.

An informer reminded us that there is no current design for the size reduction or cutting out of ILW for the RPV, which has a high potential for an unplanned discharge to the public. The facilitator stated that this was covered elsewhere in the H & S criteria.

Siting factors i. e. population, SSSI etc. should be taken into account. An environmental representative said that the community perception should be considered in terms of the range of operational activities undertaken near to them and that siting factors such as population and the location of SSSI needed to be taken into account.

One delegate appealed not to weight this low as what was significant was the impact of an unplanned discharge, which would be very important. The facilitator reiterated that all the delegates should be putting aside prior knowledge of options and whether they will score similarly, and instead apply weights according to the relative importance of the criteria.

One delegate said that if the public feel any threat from planned or unplanned discharge then planning permission will not be given, which is hugely important. The response from one delegate was that complying with the law is essential, but to find the option with the lowest discharge is not absolutely essential.

The final comment from a delegate was a reminder that at the criteria workshop the EA were keen to see criteria which added value to minimising discharges in their own right to different receptor groups.

Final Weights Range: 2 - 10

Criterion 2-ENV – Minimising Radiological Discharges to Protect the Environment

Clarification was sought on the difference between this criterion and 1-ENV. The response was that all environmental receptors should be considered for 2-ENV; an example is shell fish, and that the regulators are keen to see them separated. The basic safety standard now looks at non-human species and care should be taken

that a perception that MOD do not care about discharges to the environment is avoided.

Initial Weights Range: 2 – 10

A low scorer suggested that discharges are already minimised and further minimisation should therefore carry a low weight. A mid scorer thought that this should be considered, but the differential will be decided during scoring. It was felt by another mid scorer that anything with radiological in the title will be an emotive subject for the public.

A chartered environmentalist suggested that this is of top priority and a major risk to the project if MOD has not demonstrated the need to avoid any radiological discharge to the environment.

It was thought by one delegate that there was more importance on the minimisation of discharges to the public than the environment although this was countered by one delegate stating that the public and the environment are equal in law. He added that the MOD should aim for, or demonstrate that the aim is, zero discharges

Final Weights Range: 2 - 10

Criterion 3-ENV – Non Radiological Impact on the Public

Initial Weight Range: 3 – 8.

A high scorer suggested that MOD needs to minimise all discharges in the same way and an environmental representative (weighting 4) added that whilst the impact on local people can be high the managed level should be low. The previous high scorer gave asbestos as an example and said that the public are equally concerned about this as radiological impact.

A low scorer considered that this was already minimised through legislation and a following discussion confirmed that weighting is post mitigation.

It was pointed out by one delegate that this is an important subject to the wider community and a discussion followed about the designed facility(s) doing what they need to do and a contributor reminded that on an NII licensed site, noise, dust etc will be assessed initially and continued during works, as part of the safety case and implementation (site licence) process.

One delegate suggested that care must be taken for SDP not to work inside a MOD cocoon. It was confirmed that this phase is about strategic site selection; planning is the next stage.

Final Weights Range: 3 - 8

Criterion 4-ENV – Non Radiological Impact on the Environment

Initial Weights Range: 2 - 9

An environmental representative scored high (9) and suggested that this is very much about bio diversity, siting, SSSI etc and the test is to have no adverse affect or to override public interest.

A low scorer (2) said that the planning process and legislation already delivers to the required minimised point across all solutions and thought that this would not form a significant discriminator. It was reiterated that the delegates should be looking at the strategic level and not on a cost basis.

Final Weights Range: 2 - 9

Criterion 5-ENV – Impact on the Built Environment

Initial weight range 1 – 7

A low scorer (1) said that whatever facilities built by MOD must be functional and will be on a 'Brown Field' or industrial site, and so have minimal impact. This viewpoint was countered by a high scorer (8) who stated that buildings and facilities must achieve planning permission. A delegate stated that we should recognise that there are lots of 'red cards' at the planning stage, but not at this strategic stage. However, if we say this criteria is not important it may result in selecting a site where planning will not happen.

An environmental representative stated that there are a number of listed buildings on sites that need to be considered and that carbon footprint is a component of this criterion. A delegate felt that this group of criteria (ENV) were important, but this one is probably least important in comparative terms.

A SME made a final comment to give the example that a dual site option may have double environmental impact.

Final Weights Range: 1 - 7

Criterion 6-ENV – Impact on the Natural Environment

Initial weight range 2 – 10

A high scorer (10) started by saying that rising sea levels could be a significant concern, and another high scorer agreed adding that climate issues are a worry, plus erosion, but seismic issues are less so. A third high scorer (10) said that this was very important and must be included in planning.

A low scorer (0) put the opposing view that this had no impact. A discussion included thoughts that this is covered by legislation and that the regulator would not give a site licence unless all factors are considered. It was also confirmed that this criteria exists because the SEA does not just cover nuclear facilities. It was agreed that the safety case would cover all of the nuclear facilities. A delegate thought that this should be a criterion, but agreed that it will be covered by legislation.

It was stated by another delegate that they had weighted low because it was recognised that infrastructure impacts up to 2070 would be relatively low. There may be a need to improve sea defences at some sites and storage facilities will not be

sited on known potential flood planes. A SME informed that an ILW store had to be moved at Dounreay because of potential erosion.

Final Weights Range: 1 - 8

SDP OPERATIONAL EFFECTIVENESS WEIGHTING DISCUSSIONS

Impact on Government & MOD (POL)

Initial Weights Range: 5 – 8

A high scorer (8) reiterated the importance of decommissioning policy and this is the raison d'être for the SDP. It was generally agreed that but a mid scorer (6) also pointed out that there is a lot of latitude in policy and whilst all options will comply, it is actually a matter of how well they comply.

Final Weights Range: 5 - 8

Impact to Operations (OP)

Initial Weight Range: 3 – 9

A low scorer (3) saw this as a low impact on operations saying that future classes won't be that different so the challenge to extend is small. The facilitator reminded the workshop that Do Minimum also had to be scored as a comparator. The reply came that policy criteria is wide, but the sustainability of the submarine enterprise is important. Another delegate added that this is a very important issue with regard to the future of Rosyth and the MCP, and must therefore have a high weighting.

The discussion was summarised by saying that the future of the submarine enterprise is dependent upon the success of the SDP demonstrating whole life capability.

Final Weights Range: 6 - 10

Health & Safety Risk (H&S)

The facilitator reminded the workshop that this is the post-mitigation impact on the SDP.

Initial Weight Range: 2 – 7

A low scorer (2) said that this should be low as MOD are already delivering a good H&S level; and that SDP should not be driven by public perception. A high scorer (7) countered with the need to consider and manage public perception and be as safe as possible.

Discharges, accidents and particles on the beach all affect public perception. A mid range scorer (5) said he would have weighted at 2, except for the need to handle public perception. There was some debate around the concern that public perception should not be part of the OE. The facilitator, however, reminded the workshop that there is a Key User Requirement for the MOD to be seen as a responsible operator.

It was confirmed that this criteria pertained mainly to workers.

Final Weights Range: 2 - 7

Environmental Impact (ENV)

Initial Weight Range: 4 – 10

A high scorer (10) quoted public perception whereas a low scorer (4) thought that all work will be undertaken in accordance with legislation, so it should be weighted low. An environmental representative scored high and gave the reason that there is a user requirement requiring MOD to be environmentally responsible.

A mid-range scorer (7) suggested he used that same logic as for the policy group in that we will comply with policy, but there is no functional driver.

There was a warning from a delegate about a Shipping Container Terminal project that was refused on the grounds of environmental impact when public confidence was lost. MOD must pay attention to the environment or risk of the SDP not happening. This view was supported by another delegate and said that environmental compliance is essential.

Final Weights Range: 4 - 10

OTHER DISCUSSION

It was requested and agreed that references to the GDF should be changed to ‘the planned GDF’ (later designated as ‘proposed’).

It was commented by the AG observers that the process had encompassed a healthy degree of challenge and engendered honest and open discussion. It was added that there is a perception that MOD have made their decision, but the weighting workshop had demonstrated a genuine desire to make the decision on the basis of the available evidence and SME opinion.

D Annex D: Scoring Workshop Summary Notes (Policy and Health & Safety Syndicate)

Context

This Annex forms a record of the Policy and Health & Safety Syndicate of the SDP MCDA Scoring Workshop held on 23-24 May 2011 at DE&S Foxhill. The notes take the form of a summary of the discussions which accompanied scoring and do not represent a complete record, serving instead to summarise key assumptions, debates and conclusions.

Due to the number of criteria (20) and options (25 including variants), scoring for MCDA was divided into three parallel syndicates:

- Policy and Health & Safety
- Operations
- Environment

Summary notes for the other two syndicates are presented as separate Annexes.

Attendees

Delegates:

[redacted]	MOD, NP-RPA NDA MOD, DIO MOD, SM Safety MOD, ISM-SUSM MOD, ISM-SDP App MOD, DIO

Informers:

[redacted]	Nuvia (periodic attendance) Deloitte BMT

Observers

David Collier	Independent, SDP Advisory Group
[redacted]	MOD, D Scrutiny

Facilitator:

[redacted]	Nuvia

Recorder:

[redacted]	BMT Nuvia (H&S only)

Introduction

The facilitator explained the details of the scoring process. The process throughout was for delegates to provide an initial score (by holding up printed cards with a score from 0 to 9), followed by a discussion, after which they were asked to mark their scoring sheets. These notes make reference to the final scores recorded on the sheets, although these were not discussed at the workshop.

In the notes which follow some Options are not explicitly discussed, as variants and options were grouped, where appropriate, and scored together.

In some cases the initial scores were recorded, although this was by observation only as the delegates did not write down these scores, only the final set.

Criterion 1-POL – Flexibility and Robustness to Opportunity and Risk

Option 0 – Do Minimum

Do Minimum represents a balancing act between opportunities and risk. Maintaining the submarines afloat continuously does, however, jeopardise the sustainability of submarine enterprise, make transport increasingly risky, places an increased burden on the maintenance of structural integrity, and generates additional costs. This option does not, however, foreclose options and thereby maintains flexibility to take advantage of future opportunities. The proposed GDF may not be available for many years during which time technologies could become available which may be of benefit to the project. It was noted, however, that a number of the other options under consideration also do not foreclose opportunities.

It was noted that from a regulatory and policy standpoint submarines are not waste, but when cutting into a submarine waste is created. Maintaining submarines afloat could therefore be considered to be building up a 'bow wave' of increased risk.

The mean of the final scores provided was 4.3.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)
Option 1R – RC Separation – Storage at point of waste generation (Rosyth)

It was agreed to group these variants. This option represents minimum action in terms of foreclosing options, but successfully removes the risk of having insufficient space available to deliver afloat storage. RC could maximise the opportunity for exploitation of future technologies. One delegate stated that the only way to understand the problem of dismantling submarines was to take action, making delay a poor alternative, but another viewpoint was that the civil sector are involved in a considerable amount of decommissioning and that knowledge and opportunities will accrue as a consequence.

It was noted that the majority of current opportunities apply equally to RC separation and RPV removal. As a more general point it was noted that SDP will generate waste which forms a tiny fraction of the UK's ILW.

The mean of the final scores provided was 5.0.

Option 1B – RC Separation – Storage at point of waste generation (Dual Site)

It was felt that this option, because it required the movement of RCs, would pose technical and political challenges (specifically movement from Scotland to England or vice versa) than 1D and 1R, particularly as the RCs constitute waste whilst the submarines do not.

The mean of the final scores provided was 3.4.

Option 2 – RPV Removal - Storage at point of waste generation

It was noted that the AWAF at Rosyth might be able to store all project waste, but it was made clear that this represented an opportunity and should not affect scoring.

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)

Initial scores were in the range 5 – 8. It was suggested that storage at Devonport was riskier than a remote site but the countervailing point was that people do not want waste ,wherever it was located, making it no more risky than the remote options.

The mean of the final scores provided was 7.0.

Option 2R – RPV Removal - Storage at point of waste generation (Rosyth)

It was agreed to group 1D & 1R. There was no further discussion and the mean of the final scores provided was therefore also 7.0.

Option 2B – RPV Removal - Storage at point of waste generation (Dual site)

As with Option 1B, it was perceived that there would be additional risk involved in moving RPVs across the Scottish border. There would be an increased regulatory interface between SEPA & EA.

The mean of the final scores provided was 5.9.

Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

It was agreed to group the Options, although as scores were recorded by individual delegates, there were potential differences in individual results. It was noted that ILW storage at a MOD site means a bespoke storage solution, whereas a commercial site could mean sharing existing or planned facilities.

The mean of the final scores provided for 3D and 3R were 6.3.
The mean of the final scores provided for 3B was 6.1.
The mean of the final scores provided for 4D, 4R were 6.0.
The mean of the final scores provided for 4B was 5.9.

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)
Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

It was agreed to group these variants. It was noted that by conducting size reduction the project is foreclosing on opportunities, although risk is reduced rapidly.

One delegate added that there was a risk of changes to transport regulations or packaging requirements, which could result in having to re-package ILW in the future. However, it was commented that NDA would be facing the same issues and therefore having to come up with a solution, leading to one delegate commenting that this was another reason for alignment with the civil sector.

The mean of the final scores provided for 5D, 5R were 3.9.

Option 5B – Packaged Waste - Storage at point of waste generation (Dual site)

The score was considered slightly lower due to RPV transportation between the sites and the mean of the final scores provided was 3.0.

Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site

It was agreed to group Options 6 and 7. One delegate stated that what is potentially lost (in terms of a lower score) on transportation and political risks is balanced by potential innovations from industry. Another delegate stated that there should not be any additional risk from transport.

The mean of the final scores provided for 6D, 6R, 7D, 7R were 4.0.
The mean of the final scores provided for 6B, 7B were 3.4.

Option 8 – Packaged Waste – Storage at an NDA site

One delegate commented that this option has risks similar to that of a commercial site, but with opportunities of economies of scales and expertise. NDA storage could involve more than one store, maybe even one either side of border, which would mean that dismantling at two locations becomes less of an issue, with a wider range of geographical locations available. It was noted that there was a foreclosure of opportunities by grouting waste in boxes, but benefits from transferring ownership of the ILW to NDA.

The mean of the final scores provided for 8D, 8R were 6.0.
The mean of the final scores provided for 8B were 5.3.

Criterion 2-POL – Compliance with UK policy on Radioactive Waste Management

Option 0 – Do Minimum

One of the delegates noted that afloat storage conveyed the perception is that nuclear waste is not being dealt with. Another stated that in planning decommissioning, the management of waste should be considered, and that what mattered with afloat storage was the spirit of the policy (although submarines are not considered to be waste) and not the letter. A number of delegates felt that Do Minimum simply defers waste generation. It was concluded that the LUSMs will become more unacceptable or increase potential for non compliance if they are not dismantled, with the risk increasing with time.

The mean of the final scores provided was 5.3.

Option 1 – RC Separation – Storage at point of waste generation

It was agreed to group the variants together. One delegate stated that RC separation could be seen as starting dismantling and then stopping, which could be seen as being worse than doing nothing, although there was disagreement in the workshop on this point. One delegate noted that the RC itself is a good ILW container.

The mean of the final scores provided was 4.3.

Option 2 – RPV Removal - Storage at point of waste generation

It was agreed to group the variants together. This option was seen as being relatively more compliant than option 1, although still partly dismantled and then stopped. It was noted that the ILW store required for RPVs would actually be larger than for packaged waste.

The mean of the final scores provided were 6.3.

Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

It was agreed to group the Options together. One delegate thought that storing waste on a commercial site is 'worse' than MOD site, but another questioned if there was a difference in policy terms. In conclusion it was viewed that these options would be a little worse than the option of staying at the point of waste generation.

The mean of the final scores provided were 5.6.

Option 5 – Packaged Waste - Storage at point of waste generation

It was agreed to group the Options together. It was concluded that the option was more favourable in policy terms than RPV because the waste is being brought to an end state, although its volume will be greater than RPV storage. It was also seen as favourable as the packaged waste will be ready for transfer to the proposed GDF.

The mean of the final scores provided were 7.6.

Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site

These options were grouped and considered slightly less compliant than Option 5 due to movement of waste.

The mean of the final scores provided were 6.6.

Option 8 – Packaged Waste – Storage at an NDA site

One delegate asked if there a policy about concentrating waste geographically, and it was considered that NDA looking to concentrate its waste for better management. This option was therefore scored more highly because of compliance with the emerging NDA strategy.

The mean of the final scores provided were 7.1.

Criterion 3-POL – Scope/Extent of Transportation of Submarines and Radioactive Waste

All Options

There was considerable debate over this criterion, and the initial scoring system was reviewed and changed during the workshop. After review it was decided that while Option 0 involved no transportations, all of the others involved either 2 or 3 different types/sets of transport. For example, Option 8R would involve transportations of submarines from Devonport to Rosyth, transport of packaged waste from Rosyth to the NDA site and transport of packaged waste from the NDA site to the proposed GDF (i.e. 3 sets of transportations). In general all of the remote storage options involved 3 sets of transportations while the rest involved only 2. It was agreed that 2 sets of transportations should merit a score of 5 while 3 sets of transportations should merit a 6.

The mean of the final scores provided for Option 0 was 7.0
The mean of the final scores provided for Options 1D, 1R, 2D and 2B were 6.0.
The mean of the final scores provided for Option 1B and 2B were 5.9.
The mean of the final scores provided for Options 3D, 3R, 4D and 4B were 5.0.
The mean of the final scores provided for Option 3B and 4B were 4.9.
The mean of the final scores provided for Options 5D and 5R were 6.0.
The mean of the final scores provided for Option 5B was 5.9.
The mean of the final scores provided for Options 6D, 6R, 7D, 7R, 8D and 8R were 4.9.
The mean of the final scores provided for Option 6B, 7B and 8B were 4.7.

Criterion 4-POL – Unauthorised Access to Classified Waste

Option 0 – Do Minimum

At the outset it was noted that safeguards would be put in place to stop commercial sites being sold to foreign companies whilst MOD waste is being stored there. One delegate stated that waste in transit would be no more vulnerable than if it was at a store.

The mean of the final scores provided was 7.0.

Option 1 – RC Separation – Storage at point of waste generation

It was agreed to group the variants. One delegate commented that the length of time in interim storage increased the chances of people accessing information. Afloat it is more difficult to access the submarines and that although there will be physical barriers when RC is laid bare it is at risk, can be photographed or measured while people are working on it and more people will have access.

The mean of the final scores provided for 1D and 1R were 6 and for 1B the final score was 5.9.

Option 2 – RPV Removal - Storage at point of waste generation

It was agreed to group the variants. The mean of the final scores provided for 2D and 2R were 5.3 and for 2B the final score was 4.9.

Option 3 – RPV Removal - Storage at remote commercial site

It was agreed to group the variants. One delegate believed that there would be increased potential for unauthorised access at a commercial site, but another noted that even MOD sites are contractor operated. Nonetheless, it was stated that MOD have more control over who has access to MOD sites, whereas non-UK nationals can have access to commercial sites. It was concluded that there will be adequate security at any site, with one delegate noting that Devonport & Rosyth are as good as a MOD site.

Another strand of discussion was that it was stated that RPV whole storage does not shape destroy, although nor does size reduction.

The mean of the final scores provided for 3D and 3R were 3.7 and for 3B the final score was 3.6.

Option 4 – RPV Removal - Storage at remote MOD site

It was agreed to group the variants. The mean of the final scores provided for 4D and 4R were 4.9 and for 4B the final score was 4.7.

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)
Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

It was agreed to group these variants. It was concluded that there are opportunities for declassification in size reduction, and in terms of through life the waste is in the most secure form and safest place for the longest period of time, even accounting for the risk posed by cutting up and exposing the waste.

The mean of the final scores provided was 6.7.

Option 5B – Packaged Waste - Storage at point of waste generation (Dual site)

The difference with Options 5D and 5R was seen to lie in the movement of RPV, although there are a small number of transports which will not be advertised and should be easily manageable.

The mean of the final scores provided was 6.0.

Option 6D – Packaged Waste - Storage at remote commercial site (Devonport)
Option 6R – Packaged Waste - Storage at remote commercial site (Rosyth)

Grouping was agreed and the mean of the final scores provided was 5.3.

Option 6B – Packaged Waste - Storage at remote commercial site (Dual Site)

The score was less than for 6D and 6R due to transport and the mean of the final scores provided was 4.9

Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

These options were considered together. It was noted that there was a potential security benefit of storing boxes in a building with lots of other radioactive waste boxes, and that NDA stores are difficult to access. Scores for variants 7B and 8B were slightly lower due to RPV movement.

The mean of the final scores provided for 7D, 7R, 8D, 8R were 6.6.
The mean of the final scores provided for 7B, 8B were 6.0.

Criterion 5-POL – Compliance with UK Decommissioning Policy

Option 0 – Do Minimum

It was concluded that the scoring scheme mirrors POL-2. SDP has defended its funding on the basis that Do Minimum fails to comply with policy and that it is unacceptable for the MOD to continue afloat storage indefinitely. Another viewpoint expressed was that storage afloat is largely compliant with UK decommissioning (safe store) approach and that interim storage is not an improvement given that the proposed GDF is not available. Overall it was concluded that policy is woolly and there is not yet a NDA strategy on ILW storage; although there may be an opportunity for SDP to make policy and set precedent.

The mean of the final scores provided was 2.9.

Option 1 – RC Separation – Storage at point of waste generation

The variants were discussed together. It was proposed that this option defers the main element of decommissioning work which goes against the spirit of policy to 'get on with the job'. It was, however, noted that it would bring the UK into line with how other countries deal with submarine dismantling.

The mean of the final scores provided was 4.4 for 1D and 1R and 4.3 for 1B.

Option 2 – RPV Removal - Storage at point of waste generation
Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

The options were grouped. Point of waste generation is a feature of Waste Management Policy and these options would demonstrate a commitment to moving forward, and going further than the RPV to size reduction could foreclose opportunities. It was noted that the bulk of radioactivity is inside RPV not RC. Another viewpoint expressed was that there was little difference between RC and RPV storage.

The mean of the final scores provided were 6.6.

Option 5 – Packaged Waste - Storage at point of waste generation
Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

The options were grouped. One view expressed was that this should score lower than RPV due to the foreclosure of opportunities. On the other hand it was noted that it demonstrates a commitment to completing the job.

The mean of the final scores provided were 6.4.

Criterion 1-H&S – Worker Dose, Dismantling, Storage and Transportation

There was a presentation on the understanding of worker dose and how the scoring scales were determined. The values were determined from an estimate provided by Babcock on similar works carried by them at the dockyards. It has been assumed that SDP will be dismantling one submarine per year. The Babcock estimate is based on annual dose, so the figures correlate. On collective dose the Basic Safety Objective (BSO) = 50 man mSv and the Basic Safety Limit (BSL) = 100 man mSv. The BSO is the tipping point and the BSL is the planning limit (not legal limit), therefore;

1 = 20 mSv/year
3 = 100 mSv/year
3 – 7 = where you think it should be
8 = close to zero dose
9 = zero dose

A delegate asked if the Babcock estimate had been analysed. It was explained that from the figures in the Babcock estimate the following dose had been determined for each technical option;

RC separation = ~ 9 man mSv
RPV removal = ~ 40 – 50 man mSv
Packaged Waste = ~ 40 – 50 man mSv

One delegate asked what was meant by best estimate. Babcock answered by saying that the data was the best available data, some of which has been taken from the more 'dosey' submarines e.g. Conqueror, and as a site licensee Babcock are obliged to perform these estimates. They also confirmed that there is also real time data available from maintenance and de-fuelling activities. One delegate asked if the estimate was a 3 point estimate i.e. best, worst, most likely. [redacted] answered that this is a bounding estimate and is enough data for insertion into the IA and it was confirmed that this had been done and it has been found not be of great financial significance. It was explained that the Babcock estimate is based on collective dose and the assumption was for 50 people. There is only a legal limit on individuals. [redacted] suggested that we should clearly state 50 people and the scoring scale for collective dose was also presented;

1 = 1000 mSv
3 = 100 mSv (BSL)
7 = 50 mSv (BSO)
9 = zero

Option 0 – Do Minimum

Initial scores were 8s and 9s. One delegate stated that it was not a true zero dose but only 10s of microsieverts.

The mean of the final scores provided was 8.1.

Option 1 – RC Separation – Storage at point of waste generation

It was agreed to group variants; under the assumption of one submarine per year and the process will be the same at both sites. The initial scores were in the range 7 – 8.

Consistent score based on 9 man mSv annual collective dose. The mean of the final scores provided were 7.9.

Option 2 – RPV Removal - Storage at point of waste generation
Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

It was agreed to group the options. It was noted that there was uncertainty around numbers, and that the possible dose could be worse, although it was noted that the numbers presented are based on a worse case vessel, but that there was uncertainty. Initial scores were in the range 6 – 7.

Consistent score based on 47 man mSv annual collective dose. The mean of the final scores provided were 6.9.

Option 5 – Packaged Waste - Storage at point of waste generation
Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

The options were grouped. A discussion started and established that whilst the Babcock figures do not include transport aspects this is well controlled under policy and legislation. It was also established that there would be minimal dose for the RPV cut up because it would be a remote operation and experience in the civil nuclear industry shows that dose uptake for facility maintenance is also low through good design. When storage was discussed it was thought that there may be more inspections required for the storage of RPVs than ILW boxes, but both could be done remotely and would be controlled.

The initial scores were in the range 6 – 7. A consistent score was developed based on 50 man mSv annual collective dose.

The mean of the final scores provided were 6.9.

Criterion 2-H&S – Non-Radiological Impact on Workers

Option 0 – Do Minimum

A discussion covered the issue of hazardous materials being in the submarines and this was the reason that a score of zero could not be given. It was thought by some that the risk would increase with time as the submarines deteriorate although from experience one delegate said that the conditions inside of submarines were surprisingly good, quoting lagging as an example. Initial scores were in the range 5 – 7

The mean of the final scores provided was 6.4.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)
Option 1R – RC Separation – Storage at point of waste generation (Rosyth)

It was agreed to group 1D and 1R. The discussion covered the fact that there will be an impact on the people doing the RC separation by the fact that a lot of work is required to clear the bulkheads before the separation cuts are made. This will include confined space type working (although this was seen as being more relevant for RPV removal), and the removal of asbestos etc. Whilst the actual cutting would be relatively conventional dockyard work, there was still potential for accidents commensurate with current activities. Initial scores were in the range 3 – 6

The mean of the final scores provided were 4.1.

Option 1B – RC Separation – Storage at point of waste generation (Dual Site)

Some felt that there is more potential for accidents because of the large distance moves required for the RCs. Initial scores were in the range 2 – 4.

The mean of the final scores provided was 3.1.

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)
Option 2R – RPV Removal - Storage at point of waste generation (Rosyth)

The variants were grouped. One delegate thought that these variants were marginally safer than RC separation, but it was thought by others very important not to over simplify the work required to remove an RPV. Initial scores were in the range 5 – 8 (mainly 5's).

The mean of the final scores provided were 5.1.

Option 2B – RPV Removal - Storage at point of waste generation (Dual site)

This variant was generally thought to be lower because of the inter site moves required. Initial scores were in the range 4 -5.

The mean of the final scores provided was 4.3.

Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

The grouping was agreed. The general view was that more transportation was involved with these options. Initial scores were in the range 3 -5.

The mean of the final scores provided were 4.1.

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)
Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

Grouping was agreed. It was considered that the difference with these options is the amount of transport required. Initial scores were in the range 5 - 7.

The mean of the final scores provided were 5.7.

Option 5B – Packaged Waste - Storage at point of waste generation (Dual site)

Initial scores were in the range 5 - 7.

The mean of the final scores provided was 4.9.

Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

The grouping was agreed. Initial scores were in the range 5 – 7.

The mean of the final scores provided for the D and R variants were 5.
The mean of the final scores provided for the B variants was 4.9.

Criterion U-H&S – Potential for Unplanned Release

It was clarified that these criteria covered the release or exposure to workers and that the public were covered in the environmental criteria group, although it was possible that the public were potentially impacted by the transport aspect through accident. The environmental criterion concentrates on the environmental receptors. The discussion considered the type of release or exposure and examples were given such as the loss of shielding by manipulator or window failure in a hot cell type facility, (from civil nuclear industry experience), or the release of contamination through process failure. [redacted] stated that it is important to look at credible releases by understanding source terms rather than maximum possible releases. Most thought that the RC and RPVs were fairly inert although the possibility of sabotage was considered.

A delegate asked whether the workshop should include dismantling in the Do Minimum option at a later date, but this was confirmed as being outside the SDP scope, so for this exercise assume that afloat storage will be indefinite.

Criterion 3-H&S – Potential for Unplanned Release During Dismantling

Option 0 – Do Minimum

It was suggested and confirmed that this option could be used as a comparator. Initial scores in the range 7 – 9

The mean of the final scores provided was 8.0.

Option 1 – RC Separation – Storage at point of waste generation

The grouping was agreed. The discussion generally thought it unlikely for a release because of the comparatively clean state of the systems in the submarine (drained and dry) although it was recognised that the final method of RC separation was not completely understood at this stage. The benefit of time decay was also discussed as a consideration. The initial scores were in the range 4 – 8.

The mean of the final scores provided was 6.7.

Option 2 – RPV Removal - Storage at point of waste generation

Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

The grouping was agreed. These options were generally thought to be lower than RC separation although some thought it similar. One delegate based his score on the timing of the actual work, stating that packaged waste options were early, RPV removal less early and RC separation inordinately long. It was felt very important to clearly contextualise the options for the public consultation. It was reiterated that scoring was against the potential for an accidental release and the impact was not being considered. The initial scores were in the range 4 – 7

The mean of the final scores provided for Option 2 was 5.9 and for Options 3 and 4, 5.7.

Option 5 – Packaged Waste - Storage at point of waste generation
Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

The grouping was agreed. It was generally felt that RPV removal was worse than the packaged waste options although the storage of ILW boxes for a long time may involve re-packing of boxes, which would increase the potential for unplanned release. The initial scores were in the range 4 – 5

The mean of the final scores provided for Option 5 was 5.4 and for Options 6, 7 and 8, 5.3.

Criterion 4-H&S – Potential for Unplanned Release During Transportation

Option 0 – Do Minimum

After some discussion the mean of the final scores provided was 8.1.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)
Option 1R – RC Separation – Storage at point of waste generation (Rosyth)

Grouping was agreed. A question was raised about the possibility about doubling up on transport scoring, which was answered by confirming that the focus is the quality of the transportation and the different packages, and not the quantity of transportation A delegate suggested that the transportation of complete submarines was less likely to give a release. It was agreed that the dual site option should be scored separately. The range of initial scores was 6 – 8.

The mean of the final scores provided were 6.9.

Option 1B – RC Separation – Storage at point of waste generation (Dual Site)

This variant was scored one point lower than single site due to inter site transport of RCs by sea. Initial scores were in the range 5 – 7

The mean of the final scores provided was 6.6.

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)

Option 2R – RPV Removal - Storage at point of waste generation (Rosyth)

Grouping agreed. Initial scores were in the range 6 -8. One delegate thought that these variants has to be better in terms of the amount of transportation required.

The mean of the final scores provided were 6.6.

Option 2B – RPV Removal - Storage at point of waste generation (Dual site)

Through discussion it was generally felt that this was a slight increase due to the moves required between both sites. The fact that all packages will be approved and controlled including the transport package for an RPV was considered. An example of a problem in Russia was given where afloat storage of RCs is used, where an RC started to leak, so it was beached and no release was detected. Initial scores lay in the range 5 – 7

The mean of the final scores provided was 5.7.

Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

Grouping agreed. These variants were generally thought similar to option 2, but the increased number of movements of RPVs needs to be considered. It was thought that the highest potential for unplanned release would be at the point of preparation, dispatch and to a lesser extent receipt. Initial scores lay in the range 4 – 7.

The mean of the final scores provided was 5.7.

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)
Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

One delegate thought the impact as higher for packaged waste, but the potential for unplanned release was the same. Another suggested that it was better to do the work early because of potential corrosion issues. Initial scores lay in the range 5 – 7.

The mean of the final scores provided was 6.7.

Option 5B – Packaged Waste - Storage at point of waste generation (Dual site)

Slight increase in risk due to additional moves between sites. The mean of the final scores provided was 5.9.

Option 6D – Packaged Waste - Storage at remote commercial site (Devonport)
Option 6R – Packaged Waste - Storage at remote commercial site (Rosyth)
Option 7D – Packaged Waste - Storage at remote MOD site (Devonport)
Option 7R – Packaged Waste - Storage at remote MOD site (Rosyth)
Option 8D – Packaged Waste - Storage at an NDA site (Devonport)
Option 8R – Packaged Waste - Storage at an NDA site (Rosyth)

Grouping agreed. Initial scores were in the range 4 – 7

The mean of the final scores provided was 6.0.

Option 6B – Packaged Waste - Storage at remote commercial site (Dual Site)
Option 7B – Packaged Waste - Storage at remote MOD site (Dual Site)
Option 8B – Packaged Waste - Storage at an NDA site (Dual site)

Grouping agreed. There was a reduction in score due to transport of RPVs. Initial scores were in the range 5 – 7.

The mean of the final scores provided was 5.4.

Criterion 5-H&S – Potential for Unplanned Release During Storage

Option 0 – Do Minimum

Discussion agreed that this was the same as 3-H&S and 4-H&S.

The mean of the final scores provided was 6.6.

Option 1 – RC Separation – Storage at point of waste generation

Grouping agreed as scoring will only change with mode of storage. This was generally thought to have a low potential and certainly lower than afloat storage, but similar to RPV storage. The fact that the RC was a structure that was designed to let people in and therefore had the potential for unplanned release during routine inspections and maintenance was considered. The argument was put forward that the RCs would be stored in a controlled area with all the required infrastructure and controls in place, and also be passively safe. This was, however, questioned and it was stated that the RC was not defined as passively safe by the NII, or only passively safe when in a facility. Initial scores were in the range 4 – 8.

The mean of the final scores provided was 5.9.

Option 2 – RPV Removal - Storage at point of waste generation
Option 3 – RPV Removal - Storage at remote commercial site
Option 4 – RPV Removal - Storage at remote MOD site

Grouping agreed. The discussion covered the fact that the RPV was not defined as passively safe in a similar way to the RC. It was explained that the RPV would be in a shielded container if was to be stored in a simple building, but if in a shielded store it would not be in a container. Initial scores were in the range 5 – 7.

The mean of the final scores provided was 6.6.

Option 5 – Packaged Waste - Storage at point of waste generation
Option 6 – Packaged Waste - Storage at remote commercial site
Option 7 – Packaged Waste - Storage at remote MOD site
Option 8 – Packaged Waste – Storage at an NDA site

Initial scores were in the range 7 – 9.

The mean of the final scores provided was 7.7.

Other Comments

A number of positive comments were raised about the workshop: it was thought positive that different opinions had been respected, the quality of debate was praised, and the conclusion was that the process had been conducted in a mature manner.

E Annex E: Scoring Workshop Summary Notes (Operations Syndicate)

Context

This Annex forms a record of the Operations Syndicate of the SDP MCDA Scoring Workshop held on 23-24 May 2011 at DE&S Foxhill. The notes take the form of a summary of the discussions which accompanied scoring and do not represent a complete record, serving instead to summarise key assumptions, debates and conclusions.

Due to the number of criteria (20) and options (25 including variants), scoring for MCDA was divided into three parallel syndicates:

- Policy and Health & Safety
- Operations
- Environment

Summary notes for the other two syndicates are presented as separate Annexes.

Attendees

Delegates:

[redacted]	MOD, ISM-PDSA ST MOD, Cap DUWC BMT MOD, NBC(D) MOD, ISM-SDP App3 MOD, MCP MOD, ISM-SUSM MOD, NP-NRPA MOD, ISM-PDSA ST

Informers:

[redacted]	Babcock Nuvia (periodic attendance) Deloitte

Observer:

Paul Dorfman	SDP Advisory Group (periodic attendance)

Facilitator:

[redacted]	BMT

Recorder:

[redacted]	Nuvia

Introduction

The facilitator explained the details of the scoring process. The process throughout was for delegates to provide an initial score (by holding up printed cards with a score from 0 to 9), followed by a discussion, after which they were asked to mark their scoring sheets. These notes make reference to the final scores recorded on the sheets, although these were not discussed at the workshop.

In the notes which follow some Options are not explicitly discussed, as variants and options were grouped, where appropriate, and scored together.

Criterion 1-OP - Impact on the Maritime Enterprise

The facilitator explained that the score of 7 represents the current impact of laid-up submarines on maritime enterprise, and that a score of 0 represented an impact so severe that an option was not viable.

Option 0 – Do Minimum

Initial scores lay in the range of 0 – 5, with mostly 0's and 1's. The discussion concluded that the impact of additional berthing on the maritime enterprise, including MCP, would be very serious, with one delegate remaining convinced that the impact made the option non-viable (score 0) although the majority felt that it would be possible, but difficult. The mean of the final scores provided was 1.1, with one delegate scoring it as 0 and non-viable.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

Initial scores lay in the range 2 – 5. Jonathan Mail confirmed that the storage of 27 RCs would require a space of 10,000m^2 and had to be land based. One delegate expressed the opinion was that this option was only slightly better than Do Minimum although another questioned the impact except for the need for a large footprint to store the RCs. The mean of the final scores provided was 3.3.

Option 1R – RC Separation – Storage at point of waste generation (Rosyth)

Initial scores lay in the range 0 – 2. One delegate expressed the opinion was that the impact could be such that the maritime enterprise could be jeopardised and the ability to decommission or develop Rosyth removed. Even those scoring higher than 0 felt that the impact would be great. The mean of the final scores provided was 1.2, with one delegate scoring it as 0 and non-viable.

Option 1B – RC Separation – Storage at point of waste generation (Dual Site)

Initial scores lay in the range 1 – 4. The project assumptions regarding dual site dismantling were discussed; unlike RC storage at Devonport or Rosyth alone, RCs would be cut-out at both sites and transported to one of the two sites for storage pending eventual size reduction. It was noted that this actually led to two sub-options: storage at Devonport and storage at Rosyth. Jonathan Mail noted that the assumption was to transport the minimum amount of RCs throughout all options, so the facilitator recorded a working assumption that scoring would be applied to dual site dismantling and storage at Devonport, for the purposes of this syndicate. [redacted] claimed that a lot of work would be required to prepare the RC for

transport with regard to other hazardous materials such as lead and PCB's as well as radioactive material. The mean of the final scores provided was 2.3.

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)

Initial scores lay in the range 4 – 6. It was noted that the RC would need to be gutted to allow RPV removal and that the assumption is that the submarine will go to a ship breaker after RPV removal. It was also commented that the welding requirement for plating the submarine after RPV removal is much less onerous than for an operational submarine. A delegate asked if it should be assumed that the remaining submarine is clean (all LLW gone) after RPV removal. [redacted] suggested that this should be assumed, although it would be very difficult to demonstrate. It was confirmed that the assumption was that RPV transport would be by road or rail. One delegate expressed the opinion was that this option was very similar to RC separation in the respect that it requires control and containment and a storage facility for 100 years. However, the general opinion was that it presented significantly less risk to the maritime enterprise than Option 1. The mean of the final scores provided was 5.3.

Option 2R – RPV Removal - Storage at point of waste generation (Rosyth)

Initial scores lay in the range 1 – 4. One delegate with a low initial score (1) thought that it was not logical to transport all submarines South to North and that it would remove the ability to develop Rosyth. [redacted] stated that all resins will be gone from Rosyth by 2015 and that if the SDP did not utilise the AWAF for RPV storage it would require decommissioning. Another delegate expressed the view was that this option was not dissimilar to the Devonport option. The mean of the final scores provided was 2.7.

The potential for using the AWAF as an interim store was raised and noted as a potential project opportunity but excluded from the scoring.

Option 2B – RPV Removal - Storage at point of waste generation (Dual site)

Initial scores lay in the range 2 – 8. The facilitator re-iterated, from discussion of Option 1B, that the working assumption was transport of RPVs to Devonport from Rosyth. One delegate thought that it was positive to transport them to Devonport and scored it at 8 (better than current impact). It was generally thought that there was space at Devonport for RPVs and concluded that moving submarines represented a more emotive subject with regard to the public, whereas movement of RPVs by rail or road is fairly normal business. The mean of the final scores provided was 6.3.

Option 3D – RPV Removal - Storage at remote commercial site (Devonport)

Initial scores lay in the range 5 – 8. One delegate suggested that this option could imply the movement of submarines to Devonport for dismantling and then storage at Rosyth. The facilitator agreed that this could be possible but that commercial sites other than Devonport and Rosyth may be tenable. The facilitator confirmed the assumption that the RPV storage facility would be close to the eventual RPV size reduction facility. One delegate lowered their score by one from storage at point of waste generation because of the security implications, but others thought these option preferable because it would release space, (or reduce the space required), at

a MOD site and the ability to perform other work down the line at the MOD site(s). The facilitator stressed that security was being discussed in the Policy syndicate and should not effect this criterion.

Because the delegates agreed that the variants and options for storage at remote sites were similar the discussion moved on to Options 3R, 3B and then Option 4.

The delegates concluded that given storage time could be lengthy then storing on a MOD site would definitely have an impact on the maritime enterprise.

The mean of the final scores provided were: 3D (6.8), 3R (5.0), 3B (7.8), 4D (6.3), 4R (4.7), 4B (7.6).

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)

Initial scores lay in the range 4 – 8 (mainly 6's). One delegate who scored low thought that it was important to MOD reputation to create an enduring waste stream although processing at Devonport could be an issue. Another delegate said that the feedback from Devonport received to date was that dismantling at Devonport would be generally accepted, but that long term ILW storage posed more of a challenge. The facilitator stated that the cost is covered in the IA and that the public consultation will capture matters of perception, and that the purpose of this exercise was to score impact on the maritime enterprise. One delegate expressed the view was that this option could allow the capture of new opportunities to move the waste early. The facilitator reminded the delegates that the packaged waste would be proposed GDF compliant in line with current National policy. The mean of the final scores provided was 4.4.

Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

Initial scores lay in the range 1 – 4. These were lower than for Devonport; and one delegate who scored low believed that there would be of high impact if a size reduction facility were to be built at Rosyth. Another added that it could impact Babcock's strategic plans for their sites. The mean of the final scores provided was 2.3.

Option 5B – Packaged Waste - Storage at point of waste generation (Dual site)

Initial scores lay in the range 4 – 6. The facilitator restated the working assumption that the RPVs would be removed at dual sites, but transported to Devonport for storage. There was no further discussion. The mean of the final scores provided was 5.1.

Option 6 – Packaged Waste - Storage at remote commercial site (Devonport)

The facilitator asked if the delegates thought there was a difference between a remote commercial site and a remote NDA site. One delegate expressed the opinion that there was a considerable difference due to the fact that the liability could be handed over to the NDA on one of their sites. One delegate asked if there are any remote commercial sites and the facilitator suggested that aside from Devonport and Rosyth, others might emerge. [redacted] confirmed that the civil nuclear industry store ILW at the point of generation, which is line with current policy, and

that in the case of submarines this is at the point they are docked at the dismantling site.

Because the variants and options were similar the scoring was extended to cover Option 6 Packaged Waste – Storage at remote commercial site and Option 7 Packaged Waste – Storage at remote MOD site, but not Option 8 – Storage at a NDA site.

The mean of the final scores provided were: 6D (5.4), 6R (4.0), 6B (5.7), 7D (5.3), 7R (3.6), 7B (5.6).

Option 8D – Packaged Waste - Storage at an NDA site (Devonport)

Initial scores lay in the range 6 – 9. One delegate saw the option as positive because it is not on an MOD site, although it was noted that there was still a requirement for a facility and resources to size reduce it on an MOD site. A discussion followed where some delegates felt this could have a positive effect on the maritime enterprise although the majority view was that it would have a slightly negative impact. A delegate asked if there would be an opportunity to dismantle the RPVs at an NDA site and the facilitator replied that this should be seen as an opportunity, but not an option. The mean of the final scores provided was 7.2.

Option 8R – Packaged Waste - Storage at an NDA site (Rosyth)

Initial scores lay in the range 2 – 6. In general this variant was seen as being less favourable than 8D because of the requirement to move 20 submarines north, although it was pointed out that this would happen over a long period. The mean of the final scores provided was 3.7.

Option 8B – Packaged Waste - Storage at an NDA site (Dual site)

Initial scores lay in the range 5 – 9. One of the delegates expressed an opinion that it was logical to dismantle the submarines at the sites that they are located. The mean of the final scores provided was 7.6.

Criterion 2-OP – Flexibility of dismantling approach to managing future classes

There was a preliminary discussion on RPV size; [redacted] stated that the weight of a PWR1 is approximately 60 tonnes, whilst the PWR2 is 100 tonnes. One delegate said there is no data for PWR3 yet, although it was noted that this criterion is capturing the ease with which designs and facilities could be modified to accommodate future classes. [redacted] suggested that the key lies with the size of the RPV packaging. The facilitator suggested that there would be fewer problems for the different packaged waste options, but that this would not be the case with RPV storage. One of the delegates noted that it would probably be 2045 before Astute would be dismantled and 2060 for Successor, so it was very probable that a re-tool/re-fit would be required in the cut facility in 40 years, making it infeasible to assess this criterion in too much detail. It was noted that under current plans Rosyth will be closed long before 2045.

The facilitator suggested that there was scope to group options on this criteria and that only the technical options would be differentiators, and this was agreed.

Option 0 – Do Minimum

Initial score of 0 (all). It was concluded that this had no impact on future dismantling as it is purely stacking up submarines. The mean of the final scores provided was 0 (consensus), although with this criterion a score of 0 does not mean non-compliance, as it represents a fully tradeable requirement.

Option 1 – RC Separation

Initial scores lay in the range 4 – 8. Following discussion it was broadly agreed that the separation of the RC would be the least problematic of the technical options for future flexibility, although some delegates noted that there are few available details surrounding the design of the new submarines as yet. There may be modifications required to facilities, however, and if the RC is a lot heavier, then there may be different lifting/handling challenges. The mean of the final scores provided was 5.6.

Options 2, 3 & 4 – RPV Removal

Initial scores lay in the range 3 – 7 (mainly 3's). One delegate providing a high score thought that these options could easily be made flexible enough to cover new designs. Others expressed the opinion that there is uncertainty and that modification to manage larger RPVs could be more complicated. Another delegate noted that Successor will be fuelled for life, but this does not significantly change the volume of ILW. The mean of the final scores provided was 3.8.

Options 5 to 8 – Packaged Waste

Initial scores lay in the range 2 – 3 (all 3's apart from one delegate). The delegates expressed the view than these options would be more complicated that RPV storage. Some concerns were raised over the grouping of these options and the facilitator was asked if differences between options were covered in the weighting. The facilitator reiterated that weightings would not be revealed before scoring as part of the discipline of the system and re-iterated that Rosyth had to be assumed to be a viable site. The mean of the final scores provided was 2.8.

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Criterion 3-OP - Threat to skill and experience set

The facilitator explained the criterion and noted that a score of 7 represented the balancing point between positive and negative impacts of skills on the submarine enterprise.

Option 0 – Do Minimum

Initial scores lay in the range 2 – 6. One delegate who had scored low thought that this option represented a significant risk because of the long timescales involved giving rise to the loss of skills and knowledge; whilst others thought that doing nothing meant that the skills were not required. [redacted] stated that submarines have different systems and the knowledge of those individual systems would be lost so that good provenance could not be established for the submarines eventual 'free release'. It was stated that during afloat storage there would still be a requirement to carry out regular inspections and maintenance so that there would be an element of training available, although it will be restricted to just keeping the

submarine afloat. The timescales were assessed and as the last submarine is not scheduled for completion until around 2040 then all operational history would be lost. HMS Dreadnought was given as an example where data was lost. The mean of the final scores provided was 4.8.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

Initial scores lay in the range 1 – 6. A number of delegates suggested that this option did not represent a problem to MOD as similar work will be carried out by the civil nuclear industry, although one delegate stated that something will have to be done about the RC in the future and that there may not be SQEP available then, so there are risks. Some delegates thought that RC separation represented basic engineering and there will be a certain amount of SQEP available, and so allocated it a moderate risk. The mean of the final scores provided was 3.7.

The facilitator then suggested moving on to score Options 1R and 1B as they were not necessarily very different (although not identical due to different pools of skilled labour being available at both sites). It was agreed that there was little difference for Rosyth although conceivably it was better for dual sites.

The mean of the final scores provided were: 1R (3.6) and 1B (4.0).

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)

Initial scores lay in the range 4 – 7. One delegate stated that RPV removal represented a novel approach and that there is no SQEP available at the moment, although this would change after one submarine was dismantled. Another delegate noted that there would be different skill sets required for removal of the RPV and final size reduction. [redacted] suggested that knowledge of systems would not be needed to cut up RPVs in the future. There was a recognition that resources may be available for the civil nuclear industry but [redacted] mentioned that the NII (now ONR) already recognise that a lack of skills is a problem and are positioning themselves to counter this.

The facilitator asked if there was a difference between this variant and Rosyth or dual site. A number of delegates expressed the opinion that there would be a bigger workforce required for the dual site option, although others dismissed this as Babcock run both sites. Another delegate countered that the resource probably wouldn't be moved, but there will be training packages to allow training of local resource. The dual site option could therefore be seen as a positive or a negative. The facilitator asked if delegates were happy to score options 2D, 2R and 2B at the same time and they agreed.

The mean of the final scores provided were: 2D (5.0), 1R (4.8), 1B (5.2).

Option 3 – RPV Removal - Storage at remote commercial site

The facilitator asked if the delegates thought that this option and Option 4 differed from storage at the point of generation, whilst not forgetting that it is likely that the RPV will be cut up there at a later date. One delegate suggested that to do this on a remote MOD site would mean the generation of SQEP and an impact on the site. One delegate thought that that if a remote non MOD site was already dealing with ILW then it may take MOD SQEP, which would represent a risk but less of an

impact on the maritime enterprise. There was some debate which concluded that a commercial site was marginally more favourable.

The mean of the final scores provided were: 3D (5.7), 3R (5.6), 3B (5.7), 4D (5.0), 4R (4.9), 4B (5.1).

Option 5D – Packaged Waste - Storage at point of waste generation (Devonport)

Initial scores lay in the range 2 – 6. It was clarified that size reduction under this option was scheduled to commence in 2020 although the demonstrator would start work earlier. The delegates considered that the demand for SQEP would reduce once the facility was operational and that the resource available now would move into the SDP. There will also be training available through the STEP system once the project had gone through Main Gate. A number of delegates felt that size reduction was a demanding requirement although the use of skills from the civil sector represented an opportunity. The mean of the final scores provided was 4.3.

Option 5R – Packaged Waste - Storage at point of waste generation (Rosyth)

The facilitator asked if there was any difference between this variant and 5D. One delegate thought it would be perverse to do dismantling at Rosyth given the SQEP resources at Devonport. The facilitator stated that the assumption remained defuelling at Devonport, which would necessitate transport to Rosyth for size reduction. The mean of the final scores provided was 3.1.

The delegates then moved on to score Option 5B. The mean of the final scores provided was 4.0.

Options 6, 7 & 8 – Packaged Waste – Storage at remote sites including NDA

The facilitator asked if the delegate thought that there was any difference between remote siting options, and it was agreed that whilst there were potential differences, they could be scored at the same time.

The mean of the final scores provided were: 6D (4.2), 6R (3.1), 6B (3.9), 7D (4.3), 7R (3.3), 7B (4.1), 8D (4.7), 8R (3.7), 8B (4.4).

Criterion 4-OP – Transferrable dismantling knowledge

Following discussion a consensus was reached that this criterion measures the benefit of knowledge transfer to and from the MOD, with exchange within the MOD and UK as a primary consideration and overseas exchange as a secondary consideration. The facilitator suggested that this criterion would only differentiate between technical options and could be scored in these groups, and this was agreed by the delegates.

Option 0 – Do Minimum

Initial scores lay in the range 0 – 3. One delegate stated that the MOD are currently benefiting from knowledge and information from the UK oil industry with regard to controlling corrosion, and that in the future the maintenance of the laid up submarines could provide spin off knowledge to third parties. The mean of the final scores provided was 2.7.

Option 1 – RC Separation

Initial scores lay in the range 0 – 3. The general consensus of the delegates was that this was basic engineering and has been completed at the dockyards for years. [redacted] confirmed that this approach is used in Russia and is definitely not high tech, although he suggested that there is always something useful to learn. [redacted] suggested that the biggest issue would be the radioactive clearance of the remaining submarine following RC separation. It was recognised that there could be lessons learned on the minimisation of exposure to radiation and other hazards and possibly the reduction of waste. The mean of the final scores provided was 4.2.

Options 2 to 4 – RPV removal

Initial scores lay in the range 4 – 6. The majority of delegates thought that this option would be fairly new and novel and that no one else had done it so successful completion would be a saleable skill. A discussion about whether there were differences between option 2 and options 3 & 4, but it was generally thought that if there were they were marginal.

There were minor differences in the means of the final scores: 2 (5.4), 3 (5.6), 4 (5.6).

Options 5 to 8 – Packaged Waste

Initial scores lay in the range 6 – 7. It was also generally felt that this was new and novel and that if achieved early would be of great benefit.

There were minor differences in the means of the final scores: 5 (6.9), 6 (7.0), 7 (7.1), 8 (7.4).

Other Comments

As stated above, it was noted that the working assumption for the dual site options associated with ILW storage at the point of waste generation (1B, 2B and 5B) was that storage would be at Devonport (necessitating the movement of RCs, RPVs or packaged waste from Rosyth to Devonport). An informal effort was made to score the same options with storage at Rosyth. Whilst not conducted rigorously the results show a reduction in the scores due to issues with the future of Rosyth and the need to transport a larger number of RCs, RPVs or packaged waste containers between the sites.

F Annex F: Scoring Workshop Summary Notes (Environment Syndicate)

Context

This Annex forms a record of the Environment Syndicate of the SDP MCDA Scoring Workshop held on 23-24 May 2011 at DE&S Foxhill. The notes take the form of a summary of the discussions which accompanied scoring and do not represent a complete record, serving instead to summarise key assumptions, debates and conclusions.

Due to the number of criteria (20) and options (25 including variants), scoring for MCDA was divided into three parallel syndicates:

- Policy and Health & Safety
- Operations
- Environment

Summary notes for the other two syndicates are presented as separate Annexes.

Attendees

Delegates:

[redacted]	MOD, NBC(C)
	AMEC
	MOD, ISM-SDP App1
	AMEC
	MOD, DIO
	MOD, ISM-SUSM
	MOD, DIO

Informers:

[redacted]	Deloitte
	Babcock

Observers:

Les Netherton	Chairman, SDP Advisory Group

Facilitator:

[redacted]	Nuvia

Recorder:

[redacted]	Nuvia

Introduction

The facilitator explained the details of the scoring process. The process throughout was for the SEA authors to set the context for the criteria and scoring system, and then for delegates to provide an initial score (by holding up printed cards with a score from 0 to 9), followed by a discussion, after which they were asked to mark their scoring sheets. These notes make reference to the final scores recorded on the sheets, although these were not discussed at the workshop.

The scoring scales for the Environmental criteria were developed prior to the workshop by the SEA authors with assistance from the MCDA team. Zero means not acceptable or not compliant and a score of 9 means no further improvements are meaningful. A score of 5 means that the environmental impact was unchanged.

It was noted that some of the options (storage at point of generation) allow for much more detailed consideration of storage sites that other options which merely name generic groups of sites. It was agreed that consideration of site specific factors for storage sites could only be taken into account in a general way.

Following a request for clarification, it was stated that the word 'remote' when describing the store location meant separate from the dismantling site and not far from a population centre.

Criterion 1-ENV Radiological Discharges to the Public

Option 0 – Do Minimum

The initial scores provided were mainly 5's. It was confirmed that the IA assumes the cost of keeping the submarines in a fit state will increase over time, but that this additional expenditure will lead to the same level of protection being maintained.

It was suggested that continued afloat storage provides a less controlled environment than packaged waste (or other options), and unplanned releases need to be considered. A discussion resulted on the potential implications of a hole on the hull. It was stated that activity could not get into the water unless the water penetrated the pressure hull and that the metal was activated (which is only theoretical) and corroding. Contamination would be at a very low level. Isotopes of C-14 and H-3 levels only just detected above levels of detection (LOD) on some submarines at Rosyth which would have zero effect on public if unplanned discharge occurs. No Co-60 has been found outside the RC. Therefore under good maintenance conditions there appears to be very little potential for increased discharges to the public.

The mean of the final scores provided was 4.9.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

The initial scores provided were mainly 5's. Delegates were directed and agreed to score based on mitigated risk i.e. those eventualities you can conceive. One delegate mentioned that there was a need to remember that there could be small amounts of residual heels needing removal or fixing which could cause a risk when cutting pipes and result in potential release to the public. It was stated that the

activity takes place in a dry dock and could lead to unplanned airborne release to the receptor.

The delegates also considered the sensitivity of the receptors to release; how population could be affected, any future changes anticipated to occur to the local population (Devonport population adjacent to the dockyard should double over next 15 years but no change is expected at Rosyth). Dose exposure to the critical group was also considered from current activities (not just submarine dismantling). It was noted that the dose from all activities has to be modelled as it is too low to measure. The Devonport environmental report demonstrates the annual exposure to the public as being no greater than 2.6 uSv/y, which is 0.3% of the statutory limit.

The RC goes to an interim storage site but eventually undergoes size reduction, but the risk of discharge to the public would be negligible. Some delegates, however, did not think this could be considered as neutral as it required activity in the future which would affect a new population.

In response to a request for clarification from the observer, it was stated that the Co-60 content controls the dose so we can take good advantage of decay due to the 5 year half-life. When considering releases, Co-60 is a big issue but experts cannot see a mechanism for release. The average submarine will be 20 years out of service when dismantling begins so all submarines have undergone significant decay. Another delegate noted that, if released, Co-60 is easy to clean up but C-14 and H-3 are difficult to detect as they are naturally occurring, very mobile, nuclides. Activated steel is difficult to cause a release to the environment with the only possible way being though the cutting processes, but in mitigation this will be conducted in a controlled and ventilated environment.

The mean of the final scores provided was 4.4.

Option 1R – RC Separation – Storage at point of waste generation (Rosyth)

The initial scores provided were mainly 4’s and 5’s. See the discussion under Option 1D. By way of differences it was noted that the population directly around Rosyth base is small but Edinburgh is across the water. The nature of aerial or liquid discharges means that any contamination released would spread very quickly over a large area.

The mean of the final scores provided was 4.3.

Option 1B – RC Separation – Storage at point of waste generation (Dual Site)

The initial scores provided were mainly 4’s and 5’s. See the discussion under Option 1D. It was stated that the RCs will be passively safe with no mobile contaminants so no big issues would be encountered in the transportation from initial dismantling site to Devonport for storage.. It is not anticipated that the scores allocated would vary significantly if Rosyth were selected as the storage location.

The mean of the final scores provided was 4.3.

Option 2D – RPV Removal - Storage at point of waste generation (Devonport)

The initial scores provided were 3's, 4's and 5's. There was discussion as to whether the site variants would lead to a differentiation in scoring for Option 2. It was suggested that Devonport, in theory, presents a more sensitive population due to numbers relative to Rosyth and also the potential for growth at Devonport is expected to be significant. In general it was commented that RPV options create greater potential for discharge than the RC option. A comment on pathways was made stating that unless you have a complete breakdown in containment the only discharge route is via the effluent treatment plant or by gaseous discharge. Containment not likely to fail as RPV will be cut up inside the submarine which provides the first level of containment, with a second level of containment provided by the dock and the EA now require docks to be sealed. It is possible that early cut up close to RPV could give rise to more aqueous arisings to the effluent plant and therefore increase discharges but this could be minimal.

The mean of the final scores provided was 4.0.

Option 2R – RPV Removal - Storage at point of waste generation (Rosyth)

In general, the delegates did not feel there was any significant different between Rosyth and Devonport as, although the proximity of population centres is different, aerial or liquid discharges would very quickly dissipate over a large area.

The mean of the final scores provided was 3.9.

Option 2B – RPV Removal - Storage at point of waste generation (Dual site)

It was stated that there is no potential to produce discharge to the public when transporting the RPV and no greater risk transporting by road, rail or sea.

The mean of the final scores provided was 3.9.

Option 3 – RPV Removal - Storage at remote commercial site

The initial scores for Option 3D provided were 2's, 4's and 5's. It was noted that if stored occurred at a remote site there would be an additional site affected although no additional activities (apart from the transportation which is not anticipated to result in any radiological discharges). There is a requirement to minimise discharges regardless of site. It was suggested that there could be a reduction in control by MOD if a store is accommodated on a commercial site. However, it was noted that control can never be handed over and that everyone has to work to the same discharge limits.

The mean of the final scores provided was 3.9.

No new issues were identified with variants 3R and 3B. The mean values of the final scores were 3R (3.9); 3B (3.9).

Option 4: RPV Removal - Storage at remote MOD site

It was suggested that Option 4 would score in that same way as Options 3. It was agreed that there was no way of differentiating between the options. The mean values for variants 4D, 4R and 4B were all 3.9.

Option 5 – Packaged Waste – Storage at point of waste generation

The initial scores for variant 5D provided were 2's, 4's and 5's. There was discussion that the immediate packaging of waste will result in a higher dose rate and hence higher potential for possible dose to the public following an unplanned release. It was noted, however, that there is an assumption that there will be a minimum 10 years decay period following defuelling of the submarine (which could be up to 30 years). It was noted that most of the dose comes from working in the RC whereas working in the size reduction and packing facility is generally remote handling and hence should not result in dose to the public.

It was agreed to score variants 5D, 5R and 5B in the same way, with a resulting means score of 3.7.

Option 6: Packaged waste - Storage at remote commercial site

The initial scores for variant 6D provided were 2's and 4's. There was some discussion about the additional transport of packages by road in an overpack which could result in increased radiological discharges. It was noted, however, there are no liquids or dust and the waste is grouted in the boxes prior to transport. Therefore the potential for dose to the public is negligible.

After discussion it was agreed to score variants 6D, 6R and 6B in the same way, with a resulting means score of 3.7.

Further discussion led to agreement to group remote commercial sites with remote MOD sites and remote NDA sites for storage was agreed, resulting in mean scores of 3.7 for all these options and variants.

Criterion 2-ENV – Radiological Discharges to the Environment

Preliminary discussion on this criterion determined that relevant issues are proximity to European Designated sites, with both Devonport and Rosyth being situated on estuaries which are designated due to their habitat. Despite looking at the sensitivity of the environment, it was not possible to find a discernable effect between Criteria 1 and 2. Discussion followed as to whether it could be implied that at Devonport the areas of protection are closer to site than at Rosyth, but it was noted that at Rosyth there is no impact on environmental policy with current discharge limits. If an unplanned spillage occurred the nature of the mitigation would be to prevent environmental impact; however, the chance of any release being big enough to impact on the environment is unlikely. Any release would not impact on water quality and there are no measurable effects.

All delegates agreed that the scoring of this criterion would be identical to that for Criterion 1 Radiological discharges to the public.

Criterion 3-ENV - Non-radiological impact on the public

The issues associated with this criterion are related to nuisance (complaint), dust, vibration, noise, congestion. A zero score means non-compliance with statutory nuisance levels. The impact on air quality and how it affects the public is also considered.

The quantifiable economic benefit is included in Criterion 4-ENV Impact on the Environment. Planning permission and any work required to surrounding community is included in the IA. The improvement of roads to the site could be a positive benefit as more infrastructure would minimise disruption and should be considered during discussions. This criterion does not consider socio-economic factors.

Option 0 – Do Minimum

The initial scores provided were all 5's. In discussion it was noted that every 10 years afloat stored submarines are taken out of the water for maintenance which could have a negative impact. The potential for discharges from sanding, painting etc are therefore increased. Some environmental controls are in place but they cannot completely control airborne particulates and traditional maintenance can also cause nuisance. No construction is required for this maintenance activity and all the risk from this work is to the workers and not the public.

The mean of the final scores provided was 4.9.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

The relevant issues to be considered are size of the ILW store footprint, which represents a significant construction project with potential demolition activities to be considered at Devonport. It was recognised that certain effects may diminish with time but it's assumed the amount of disruption will still be acceptable. Having two phases to the construction work could be considered as a benefit or a disbenefit.

A delegate asked if any lessons have been learnt through the build at Rosyth associated with the Trident programme. It is proposed that the unused Trident facility will be re-fitted into a container port but this has met stiff competition as it is a local beauty spot. There are no envisaged problems, however, with large construction at Devonport. The observer noted that at Devonport the Construction Code of Practise is adhered to in a proficient fashion and that noise limits are very well defined and regulated.

The initial scores provided were in the range 2 -4. The discussion agreed that breaking up of the remaining submarine does not need to be done at Devonport. The SEA assumes it's done at an unknown site but the impact of that activity could be negative due to the associated scrap metal moves and asbestos issues etc. A new RC storage facility would be a very big structure to house 27 RCs and would be on the docks but not on the site boundary. The identification of a suitable area at Devonport is possible if certain operational decisions were made.

The mean of the final scores provided was 3.1.

Option 1R: RC Separation – Storage at point of waste generation (Rosyth)

The initial scores provided were mainly 3's and 4's. The discussion determined that the scores are slightly higher than for Devonport as its felt Rosyth is more able to accommodate an RC store with less potential conflict. More space is available in the centre of the site which reduces visual impact. The population at Rosyth are further away than those at Devonport so the effect from noise is less than compared with Devonport. There is also the potential for the Devonport population to increase significantly with time.

The mean of the final scores provided was 3.9.

Option 1B: RC Separation – Storage at point of waste generation (Dual Site)

On the assumption that storage of the RC takes place at Devonport (a working assumption established in the operations Syndicate) then issues discussed under Option 1D are relevant. If storage were to take place at Rosyth, issues discussed under Option 1R would dominate. Based on the working assumption, the mean of the final scores was 3.0.

Option 2D – RPV Removal – Storage at point of waste generation (Devonport)

The issues are similar to the ones for the RC store but the footprint is an order of magnitude smaller so less construction materials are required, reducing transportation requirements and therefore nuisance. Phased activities exist for RPV option as well and there is a potential difference in sensitivities between the two communities.

The initial scores provided were mainly 3's and 4's. The mean of the final scores provided was 3.9.

Option 2R – RPV Removal – Storage at point of waste generation (Rosyth)

The delegates determined that the issues are similar to the ones for the RC store but the footprint is an order of magnitude smaller. The mean of the final scores provided was 4.3.

Option 2B – RPV Removal – Storage at point of waste generation (Dual Site)

The delegates determined that the issues are similar to the ones for the RC store but the footprint is an order of magnitude smaller. The mean of the final scores provided was 3.7.

Option 3D - RPV Removal - Storage at remote commercial site (Devonport)

There will be one RPV move to the commercial site per year which could be by rail. Movement of packaged waste will take place at a later date, size reduction facilities will require construction at the storage facility.

The initial scores provided were mainly 4's and 5's. Delegates felt there would still be some disturbances; however, construction and transportation are not significant problems and can be mitigated with good practise. Transporting heavy packages in Plymouth area is normal business. The mean of the final scores provided was 4.6.

Option 3R - RPV Removal - Storage at remote commercial site (Rosyth)

The initial scores provided were mainly 4's and 5's. Delegates felt there would still be some disturbances; however, construction and transportation are not significant problems and can be mitigated with good practise. Transporting heavy packages in Rosyth area is normal business. The mean of the final scores provided was 4.6.

Option 3B - RPV Removal - Storage at remote commercial site (Dual Site)

The delegates concluded that transportation of heavy loads in both areas is normal business. The mean of the final scores provided was 4.4.

Option 4 - RPV Removal - storage at remote MOD site

No factors were identified that would result in this option being scored differently to Option 3 so scores were allocated as for Option 3.

Option 5D: Packaged waste - Storage at point of waste generation (Devonport)

The required interim store is comparable in size to that required for RPV storage. Potential effects occur sooner, however, than with delayed size reduction. No loose materials will be transported, however, and thereby not creating dust. There will also only be approximately 6 boxes per submarine, with a maximum of 8 boxes (although there remain uncertainties over the number of boxes required).

The initial scores provided were 3's and 4's. All work is done on one site so need more space for size reduction facility and storage facility. It was noted that space is a premium at Devonport.

The mean of the final scores provided was 3.6.

Option 5R: Packaged waste - Storage at point of waste generation (Rosyth)

The initial scores provided were 4's and 5's. Rosyth scores slightly higher scores than for Devonport option due to the population being smaller and located further away from the site, hence reducing the potential for nuisance and disruption. The mean of the final scores provided was 4.1.

Option 5B: Packaged waste - Storage at point of waste generation (Dual Site)

The discussion concluded that some impact may be felt at both sites, although storage is assumed at Devonport through the working assumption for scoring, and so factors discussed under Option 5D will be relevant.

The mean of the final scores provided was 3.6.

Option 6D: Packaged waste - Storage at remote commercial site (Devonport)

The only difference from option 5 is the store is constructed on a different site. The movement of packaged waste from the size reduction facility to the store must, however, be considered. Each package requires an overpack and is transported one per lorry which implies a maximum of 8 transports per year. Packaged waste could be transported by rail or road but for rail movements infrastructure is needed at either end to load and unload. It is difficult given the generic nature of storage locations to decide the best transport option.

The initial scores provided were 4's and 5's. The mean of the final scores provided was 4.1.

Option 6R: Packaged waste - Storage at remote commercial site (Rosyth)

The initial scores provided were 4's and 5's. No new issues were identified, however, so the mean of the final scores provided was 4.6.

Similarly, the same scores were given for Option 6B as Option 6D: 4.1.

Option 7: Packaged waste – Storage at a remote MOD site

It was also agreed by the delegates to group the remote MOD sites with the commercial sites and score them the same.

Option 8: Packaged waste – storage at a NDA site

The initial scores provided for Option 8D ranged from 4 to 6. Using existing stores is a positive benefit although the construction of a size reduction facility will still be required. There is no dis-benefit to using an existing NDA store, which is assumed to have spare capacity, rather than being enlarged to contain the MOD waste.

The panel moved on to score the Rosyth and dual site dismantling options as well. The mean of the final scores provided was 8D (5.0), 8R (5.1), 8B (4.7).

Criterion 4-ENV: Non-Radiological Impact on the Environment

This criterion includes the greatest number of SEA criteria. It captures potential discharges to water, emissions to air, potential effects of discharges to sensitive biota, and allows for consideration of waste and recycling. A score of zero means non-compliance with statutory limits for discharges or emissions. The European Habitat regulations say there must be no adverse effects on conservation objectives, although a country can be in breach of these regulations under various circumstances. Devonport is adjacent to the Plymouth estuary which is a designated site. There is no legislation to re-use building materials but there are compliance targets (MOD policy is to design for whole of life). The issue of building disposal should be considered but also the effect all materials have on the environment. Significant volumes of waste will be produced during dismantling.

If submarines are moved on a float on-float off barge or powered vessel, the channel to Devonport would require capital dredging at the point of transfer from the barge to the dock as there is currently no point with sufficient depth of water. However, there is sufficient depth of water at Rosyth (this information was extracted from a SALMO report). Dredging would not be required if the submarine is towed, although a long tow line would be required and so security could be an issue.

It was noted that at Devonport the sea bed is not silt but bedrock. Dredging close to the dock could de-stabilise the dock, therefore the site selected would be further from the dock. The environmental issues associated with dredging would have the biggest impact on the environmental strategy. The options have been scored assuming there is no capital dredging, with submarines towed in or out of Devonport.

Other important points to consider during the scoring of this criteria were environmental effects during construction, discharges to water during construction, particulates to air, waste recyclability. If activities are delayed to enable later size reduction, standards could potentially have stricter thresholds than now, although this is not considered as part of the project assumptions.

The submarines are de-watered, and drained prior to afloat storage so everything has been done in accordance with the Environmental Permit .

Option 0 – Do Minimum

The initial scores provided were 4's and 5's. Discharges could increase with time as maintenance requirements increase. The potential of recycling metal is not possible with this option.

The mean of the final scores provided was 4.1.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

The main issues with this option relate to construction. The RC footprint is an order of magnitude greater than that for the storage of RPVs or Packaged Waste. There is a range of potential discharges from construction and operations and Devonport is adjacent to a European designated site so an unplanned release could be an issue.

The initial scores provided included 1's, 3's and 4's. It was noted that over the last 14 years temporary consent has always been granted to discharge treated waste water from construction activities. This is now not possible as the Environment Agency regulations state that discharges cannot be made within 500m of a designated site, requiring now that treated water is discharged to sewage facilities; regulations generally becoming stricter over the years. Treated water is now discharged to sewage treatment facilities so more effort is required as the regulations have changed. Some delegates felt that the potential impact on the environment was greater than the potential impact on the public discussed under Criterion 3.

The mean of the final scores provided was 3.3.

Option 1R: RC Separation – Storage at point of waste generation (Rosyth)

The initial scores provided were mainly 3's and 4's. This option was seen as being similar to Option 1D; the only difference is the proximity of designated sites. The mean of the final scores provided was 3.3.

Option 1B: RC Separation – Storage at point of waste generation (Dual Site)

Similar to Option 1D; the only difference is the proximity to two designated sites. The mean of the final scores provided was 3.3.

Option 2D – RPV Removal – Storage at point of waste generation (Devonport)

The initial scores provided were mainly 3's and 4's. Delegates considered that the scores should be slightly higher than RC option due to the smaller size of the storage facility therefore reducing the amount of construction materials; it may be possible to re-use aggregate from site demolition programmes. More materials go for recycling in the short term. The RPVs are self shielding and hence little shielding will be required for the storage facility. The impact of construction at Devonport requires consideration as the land has historic uses so contaminated land surveys may be required. This should be captured in the IA as it will primarily affect the cost

of construction. This is probably the case at Rosyth too. Devonport is situated on made ground with bedrock at increasing depth towards the river

The mean of the final scores provided was 3.9.

Option 2R – RPV Removal – Storage at point of waste generation (Rosyth)

The initial scores provided were mainly 3's and 4's. See discussion under Option 2D. The mean of the final scores provided was 3.9.

Option 2B – RPV Removal – Storage at point of waste generation (Dual Site)

See discussion under Option 2D. The mean of the final scores provided was 3.9.

Option 3D - RPV Removal - Storage at remote commercial site (Devonport)

The initial scores provided were in the range 3 to 5. Non-radiological impact from transportation is considered to be minimal as the number of transportations is low. It was assumed that the commercial site is not adjacent to a designated site which would be a benefit over storage at Rosyth or Devonport (although these sites are also candidates for acting as remote commercial sites).

The mean of the final scores provided was 4.1.

Option 3R - RPV Removal - Storage at remote commercial site (Rosyth)

See discussion under Option 3D. The mean of the final scores provided was 4.1.

Option 3B - RPV Removal - Storage at remote commercial site (Dual Site)

See discussion under Option 3D. The mean of the final scores provided was 4.1.

Option 4 - RPV Removal - storage at remote MOD site

Scores were considered identical to those allocated for Option 3.

Option 5: Packaged waste - Storage at point of waste generation

The potential of emissions or discharges during operations are the same as previously discussed. The size of facility required is smaller so less construction materials are required. If size reduction activities are delayed and regulations become stricter then there could be a negative impact. The actual effect on the biota is small and a potential benefit from recycling of non-active components should be considered.

The initial scores recorded for 5D were 3's and 4's. The discussion encompassed all of the variants for Option 5 and the means of the final scores were 5D (3.9), 5R (3.9) and 5B (3.9).

Option 6: Packaged waste - Storage at remote commercial site

The non-radiological impact from transportation is considered to be minimal as the number of transportations is low. It is assumed that the commercial site is not

adjacent to a designated site which is a benefit over storage at Rosyth or Devonport. This option requires transportation of up to 8 boxes a years, as opposed to one RPV per year. These alternatives are considered broadly equivalent and both to have minimal impact.

Initial scores recorded for 6D were in the range 3 to 5. The discussion encompassed all of the variants for Option 6 and the means of the final scores were 6D (4.0), 6R (4.0) and 6B (4.0).

Option 7: Packaged waste - storage at remote MOD site

The variants for Option 7 were assessed to have the same scores as Option 6.

Option 8: Packaged waste - storage at remote NDA site

Assume the use of an existing NDA store, so that the environmental impact from construction will be reduced. This is the case for each of the dismantling alternatives. The initial scores for Option 8D were 4's and 5's. The discussion encompassed all of the variants for Option 6 and the means of the final scores were 8D (4.7), 8R (4.7) and 8B (4.7).

Criterion 5-ENV – Impact on the built environment

The MCDA data report defines the built environment criterion which draws on three separate SEA assessment objectives:

- Cultural heritage including architectural and agricultural
- Landscape
- Land use

This criterion considers the use of previously developed land, where the greater the use of previously developed land, the better. Also included in this criterion are quantity of build and by proxy carbon footprint. Indirectly, issues related to embodied carbon and operational carbon are included and visual impact is considered. It was noted that a dismantling facility at an existing dock with some sort of temporary covering/structure etc may not be beautiful but the impact is on the dockside and not the public. The design of the store is sufficiently unique to require a new build facility, rather than re-use of existing facilities. There is spare space available at Rosyth but not currently at Devonport but both sites would require additional land to be brought into the nuclear licensed site.

Option 0 – Do Minimum

The initial scores provided were in the range 3 to 5. The majority of delegates considered that this option had no impact on the built environment. However, it was questioned whether the visual impact could be more significant if the condition of the submarines deteriorates. The number of submarines requiring afloat storage is going to increase so more berth space will be required so the construction of a new facilities to accommodate the submarines will be needed creating an impact, although this may be very minor. Plymouth has significant plans for regeneration so this increase in numbers would not necessarily comply with the plans.

The mean of the final scores provided was 4.4.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

Issues relevant to this option are the size of the storage facility required (11,000m^2). The storage of 27 RCs would require some reinforcement of foundations and construction work requiring concrete etc, being brought to the site. The footprint would probably necessitate some demolition work in order to accommodate the store, which would involve a large embodied carbon effect, dust, noise etc. Devonport has a more sensitive environment (85 licensed buildings) although facilities have been built and demolished on site. Once size reduction starts, one benefit could be a substantially lower carbon generation (2030/2040), although the visual impact would constitute a detrimental effect.

The initial scores provided were in the range 3 to 4. One dock at Devonport (No 8, which is a Grade II listed structure) could take the submarines for dismantling and this is a listed building. The storage building could, however, be located next to the dock or elsewhere on site. It is possible the authorised site can be increased slightly and a study is being undertaken to determine the availability of additional land.

The mean of the final scores provided was 3.0.

Option 1R: RC Separation – Storage at point of waste generation (Rosyth)

The initial scores provided were in the range 3 to 7. It was noted that Rosyth does not have the same degree of sensitivity in the built environment as Devonport, lacking listed buildings, and that the scoring guidance recognised the importance of re-using land. Rosyth has a significant area of previously developed land but is a highly visible site so putting up a big shed could have a negative impact. However, Fife council would like Rosyth to be an industrial area and there are plans to build a container port so dismantling and storage facilities may not present a significant visual impact.

The mean of the final scores provided was 5.7.

Option 1B: RC Separation – Storage at point of waste generation (Dual Site)

The initial dismantling site could be at either/both sites however the storage facility is assumed (under the working assumption) to be at Devonport, and hence would be influenced by the factors affected Option 1D (if storage were assumed at Rosyth the Option 1R discussion would be more relevant).

The mean of the final scores provided was 3.3.

Option 2D – RPV Removal – Storage at point of waste generation (Devonport)

Relevant issues from the SEA are similar to those previously discussed for RC storage although the scale of the facility would be less (~801m^2) and hence the potential impact on the build environment are smaller. It was noted that RPV transport is business as usual in terms of transporting large objects; a large permanent crane is not required at the facility so the visual impact and carbon footprint are the most important factors for consideration with this option. Overall

the delegates considered the impact to be as for Option 1D, although scale of storage facility is much reduced.

The mean of the final scores provided was 4.1.

Option 2R – RPV Removal – Storage at point of waste generation (Rosyth)

The initial scores were the same as for Option 2D. The mean of the final scores provided was 5.3.

Option 2B – RPV Removal – Storage at point of waste generation (Dual Site)

The initial scores comprised 4's and 5's. The delegates considered the option to be similar to 1B, although scale of storage facility is much reduced. The mean of the final scores provided was 4.3.

Option 3D - RPV Removal - Storage at remote commercial site (Devonport)

Assumption: for this Option it is not possible to differentiate on the store location as no information is available, therefore it is only possible to look at the impact on the dismantling facility

The initial scores provided were in the range 4 to 6. The delegates considered that issues of dismantling activities at Devonport are much less of an issue once the need to construct a storage facility on site have been removed. Construction at a remote commercial site may bring previously developed land back into use.

The mean of the final scores provided was 4.9.

Option 3R - RPV Removal - Storage at remote commercial site (Rosyth)

The initial scores provided were 5's and 6's. A large development at Rosyth is not going to be easy, however, so a remote commercial site it may have less impact on the build environment, and potentially a lower visual impact.

The mean of the final scores provided was 5.3.

Option 3B - RPV Removal - Storage at remote commercial site (Dual Site)

This option is influenced by the need to build a dismantling facility at both sites, but the development at a remote commercial location may have less impact on the build environment, and potentially a lower visual impact than at either dismantling location.

The mean of the final scores provided was 5.1.

Option 4 - RPV Removal - storage at remote MOD site

It was suggested that this may score in the same way as Option 3. It was felt this option could increase the re-use of MOD land, but as this is National policy the majority of delegates felt there would be no difference between the two options.

Initial scores recorded for 4D were in the range 4 to 6, and 5 to 6 for 4R and 4B.

An additional discussion point was noted with regard to visual impact; if dismantling is undertaken at a single site, especially Rosyth, there will be a significant increase in the number of submarines moving to that site. The constraint placed on Rosyth could be varied i.e. it could take more than 7 submarines (up to 12) but any negative impact would not be significant as they would not all be moved to Rosyth at once. The means of the final scores were 4D (5.0), 4R (5.4) and 4B (5.3).

Option 5: Packaged waste - Storage at point of waste generation

Issues relevant to this option are that early dismantling and packaging of waste removes the carbon degeneration problem. Nonetheless, sensitive landscapes could be affected by the construction of a storage facility (of a similar size to that required for packaged waste).

Initial scores recorded for 5D and 5B were in the range 3 to 5, and 4 to 6 for 5R.

Regarding Devonport (5D) it was noted that accommodating two large facilities (store and size reduction) at Devonport could be difficult, although the storage facility is much smaller than for RC storage. In addition there would need to be a covered dock on the site for dismantling. With Option 5B, the RPVs are extracted at both sites but transports the RPVs at Rosyth to Devonport (working assumption) for size reduction, packaging and storage. The RPVs are dry so only non-mobile steel would be transported to Devonport.

The means of the final scores were 5D (3.7), 5R (5.4) and 5B (4.3).

Option 6D: Packaged waste - storage at remote commercial site (Devonport)

Re-use of land on the commercial site is considered. A size reduction facility would still be required at Devonport.

The initial scores were 4's and 5's. There will be a requirement for a size reduction facility at Devonport . Issues discussed under Option 1D and 2D are relevant concerning the number of listed buildings at Devonport. The mean of the final scores was 4.4.

Option 6R: Packaged waste - storage at remote commercial site (Rosyth)

The initial scores were in the range 4 to 6. There will be a requirement for a size reduction facility at Rosyth. Issues discussed under Option 1R and 2R concerning visual impact are relevant to 6R. The mean of the final scores was 5.4.

Option 6B: Packaged waste - storage at remote commercial site (Dual Sites)

The initial scores were 4's and 5's. Issues discussed under Option 1D and 2D are relevant, concerning the number of listed building at Devonport. The mean of the final scores was 4.6.

The suggestion to group remote commercial sites with remote MOD sites and remote NDA sites for storage was discussed. It was decided that storage on NDA sites would give more flexibility due to the numbers of available stores. Therefore, it was decided to score options 7 & 8 separately.

Option 7: Packaged waste - storage at remote MOD site

The delegates viewed this Option as similar to Option 6, but not identical as storage at a MOD site would enable more control over re-use of the land. The means of the final scores were 7D (4.6), 7R (5.6) and 7B (4.7).

Option 8: Packaged waste - storage at remote NDA site

Storage of SDP waste on an NDA site could make use of existing NDA stores for packaged waste, giving more flexibility. Initial scores for 8D were in the range 4 to 6; for 8R in the range 5 to 7; and 8B in the range 4 to 6. The means of the final scores were 8D (5.1), 8R (6.1) and 8B (5.1).

Criterion 6-ENV - Impact from the natural environment

This criterion includes potential effects from climate change (eg changes in weather patterns, flood frequency and significance), geological and seismic stability, and coastal change. There is an existing flood risk on both sites but the majority of Devonport is a low risk except for some small areas whereas Rosyth has flood incidence of 1 in 200. The overall category of flood risk is higher for Rosyth than for Devonport.

ILW storage and size reduction facilities are not impacted greatly by climate change. Safety cases use current best information and take into account sea and flood changes. In theory, if the radiological liability (store) is near to the coast it is potentially more vulnerable to weather but if the packaged waste store is inland then the impact reduces. If activities are undertaken earlier then the risk of weather changes decreases however delaying the build could allow base slabs to be built higher to prevent flooding. Virtually all commercial, MOD and NDA sites are coastal.

Climate change is relatively insignificant when considering storage, with flood risk being the main risk. Neither site has a significant seismic risk.

Option 0 – Do Minimum

Previous experience and testing has shown that submarines can withstand significant impacts. A storm could theoretically sink a submarine but this should not result in environmental impact and the submarine could be recovered. Studies on climate change effects and their impact on the Tamar estuary at Devonport show that the river comes through natural narrows which influence the potential for tsunamis and hence the potential for the submarine to be pushed ashore is minimal.

The initial scores provided were 4’s and 5’s. The afloat storage of submarines is therefore robust to weather conditions and climate change, although it may be that they become more susceptible as time goes on and maintenance requirements increase.

The mean of the final scores provided was 4.9.

Option 1D – RC Separation – Storage at point of waste generation (Devonport)

As discussed, the flood risk at Devonport is confined to small areas compared to Rosyth where all areas are at a risk of flooding. To protect facilities the flood defences may be boosted which would protect the wider environmental area. Planning permission applications address the issue of flood risk. The project does not anticipate doing anything with major positive impact, as the risk is low and little action will be required, but this could develop as planning progresses.

The initial scores provided were in the range 3 to 5. The mean of the final scores provided was 4.1.

Option 1R: RC Separation – Storage at point of waste generation (Rosyth)

The initial scores provided were in the range 3 to 5. More areas of the Rosyth site are at risk from flooding. The mean of the final scores provided was 4.3.

Option 1B: RC Separation – Storage at point of waste generation (Dual Site)

There may be a marginal benefit to having dual dismantling sites, to spread the risk of activities being disrupted. The mean of the final scores provided was 4.3.

Option 2 – RPV Removal – Storage at point of waste generation

The initial scores for Option 2D provided were in the range 3 to 5. Delegates considered that this option had the same issues and score as for Option 1D. The same scores were attributed to Options 2R and 2B. There may be climate differences between Devonport and Rosyth that affect travel to work, transportation of materials etc, but this is not considered significant as weather factors are factored into transportation and planning of operations. The mean of the final scores provided was for 2D (4.1), 2R (4.3), 2B (4.3).

Option 3 - RPV Removal - Storage at remote commercial site

The initial scores provided for 3D were in the range 4 to 5. Some delegates assumed an advantage for this option over storage at site of generation as this site could potentially be away from the coast. However, the commercial site could be coastal and flooding could occur at an inland site, so any assumed benefit is uncertain. The same scores were attributed to Options 2R and 2B. The mean of the final scores provided was 4.4.

Option 4 - RPV Removal - storage at remote MOD site

Issues and scores for the Option 4 variants are assessed to be the same as those allocated to the Option 3 variants.

Option 5D: Packaged waste - Storage at point of waste generation (Devonport)

The initial scores provided for 5D were in the range 3 to 5. There is a flood risk for small areas of the Devonport site. One view presented by delegates was that the risk is reduced for this option compared to the equivalent RC and RPV options as the activities are finished earlier so if natural problems grow worse the effects will not matter. The mean of the final scores provided was for 5D (4.1), 5R (4.3), 5B (4.3).

Option 5R: Packaged waste - Storage at point of waste generation (Rosyth)

As for Option 5D, the risk from climate change could be considered reduced as more activities are undertaken in the shorter term. The mean of the final scores provided was 4.6.

Option 5B: Packaged waste - Storage at point of waste generation (Dual Site)

As for Option 5D, the risk from climate change could be considered reduced as more activities are undertaken in the shorter term. The mean of the final scores provided was 4.6.

Option 6: Packaged waste - Storage at remote commercial site

Initial scores recorded for 6D were in the range 4 to 5. Higher scores were allocated for this option as the packaged waste has been moved away from the known point of risk i.e. coast and it's a finished process. The mean of the final scores provided for all the Option 6 variants was 4.6.

Option 7: Packaged waste - storage at remote MOD site

Issues and scores for the Option 7 variants are assessed to be the same as those allocated to the Option 6 variants.

Option 8: Packaged waste - storage at remote NDA site

Issues and scores for the Option 8 variants are assessed to be the same as those allocated to the Option 6 variants.

Other Comments

As stated above, it was noted that the working assumption for the dual site options associated with ILW storage at the point of waste generation (1B, 2B and 5B) was that storage would be at Devonport (necessitating the movement of RCs, RPVs or packaged waste from Rosyth to Devonport). The delegates were largely uncomfortable with this decision but it was necessary to allow scoring to continue and reflects the assumption of the project that it is better to move the smallest number of submarines between sites.

Overall, the following general themes arose from the scoring process and associated discussion:

- There is no real difference in environmental effects as all processes will be tightly regulated
- In general Devonport has scored slightly lower than Rosyth due to its environmental location, historical significance and receptors.
- The RC option scored lower due to the large facility footprint required and the resultant environmental effects.

It was noted that the title of the option should read "storage at one point of waste generation" and not "point of waste generation". It is suggested this change takes place before the public consultation.

G Annex G: Assumptions Made at the Scoring Workshop

Issue	Discussion	Proposal
A	There may be more than one Dismantling site (Dual Site option). Under the dual site option, the WLC model assumes that the cut-up facility, if required, will be at Devonport, with the transport of seven RPVs from Rosyth. Concerns were expressed that this assumption would not sit well during consultation. The working assumption, for the purposes of the workshop alone, in the Operations Syndicate was that transport was from Rosyth to Devonport as this minimised the number of submarine movements. This issue is discussed in Annex E.	1. For purposes of Options Analysis, assume that size reduction could be at either site, and hence RPV transport could be in either direction, either seven or twenty RPVs. Place in an 'Options Analysis' section of the MDAL. 2. Note that if RCs cannot be transported, Option 1B is invalid. 3. Assumptions B&C should be placed in MDAL.
B	There will only be one Interim Storage Facility (2 would be very expensive)	
C	There will only be one Size Reduction Facility (2 would be very expensive)	
D	Because of the uncertainty over the physical condition of RCs and RPVs after interim storage, the interim storage facility and size reduction facility will be on the same site.	4. For purposes of Options Analysis, RC storage and dismantling will be on the same site. Place in 'Options Analysis' section of the MDAL. 5. This assumption is used to adequately define the Options for purposes of Options Analysis but it is not assumed that transport post storage is infeasible. Re-word as: "For purposes of Options Analysis, it is assumed that the size reduction facility for RC and RPV storage options will be on the same site as the interim store." Conduct sensitivity analysis within IA on this assumption. Place in 'Options Analysis' section of the MDAL.
E	For single site dismantling, if size reduction takes place immediately after initial dismantling, the initial dismantling facility and the size reduction facility will be on the same site.	6. Place in 'Options Analysis' section of MDAL.

F	The transport of submarines in either direction between Rosyth and Devonport may require dredging to allow a submersible barge or heavy lift ship load/unload a submarine, within a short tow of the Devonport Dockyard. A new capital dredging approval would be required, and would be associated with a significant environmental impact. The need for dredging would have to be determined through further technical work. The Environmental syndicate assumed that no dredging was required.	7. Assume that no dredging will be required for transportation of submarines. Place in 'SEA' section of the MDAL 8. Consider need to score dredging as part of the sensitivity tests. If necessary, seek additional scores for impact of dredging. 9. Scope future study to assess the impact of dredging on submarine transport options.