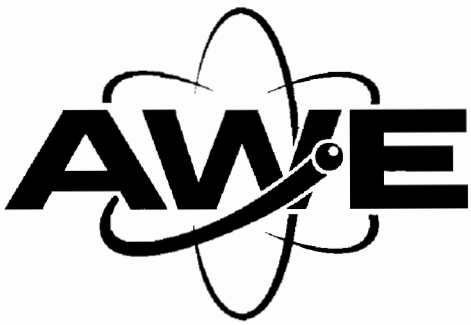
30th April 2007

[redacted]

AWE/PLAN/RAS/20050017



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AWE Proposal for TP1 for the Implementation of the Nuclear Warhead Capability Sustainment Programme

VOLUME 1

ANNEX H

Capability Curve & Rationale

[redacted]

30th April 2007 [redacted] AWE/PLAN/RAS/20050017

[redacted]

Document Title: Capability Curve and Rationale
Document Ref: AWE/PLAN/RAS/20050017
Issue: Issue 4.0

DOCUMENT APPROVAL

Prepared By	Approved for Issue By
[redacted] Technical Programme Co-ordinator	R Fletcher Head of Corporate Business Planning
Date:	Date:

DOCUMENT ISSUE RECORD

Issue	DESCRIPTION OF AMENDMENT	Date	Originator	Approved
Version 1a	Issued as an annex in the 14th January NWCSP submission to the MoD Ref AWE/PLAN/RAF/2005/0001	14 January 2005		
Version 1	Issued to support the 18th January NWCSP submission to the AWEML The following new events added to describe the capability curves: 2007-Life assessment; CPF; MBA; MBE and SI	18th January 2005		
Version 2	This profile has been re-issued to reflect the new Facility delivery portfolio dates revised in line with the May 06 Re-Baseline Review.	06-Jun-06		
Version 2.1	Distribution list amended to include named Directorate members.	12-Jun-06		

Issue	DESCRIPTION OF AMENDMENT	Date	Originator	Approved
Issue 3	This profile has been re-issued to reflect the new Facility delivery portfolio dates revised in line with the August 06 Affordability Review.	15-Aug-06		
Issue 3.1	This document has been up-issued to reflect the[redacted] on the curve[redacted] are considered to be when the[redacted] is available to be[redacted] The x-axis scale of the report has been altered to reflect the beginning of contract year (as per the underlying data).	16-Nov-06		
Issue 3.2	Jan 14th Costs removed from the top of the curve.	23-Nov-06		
Issue 3.3	Up-issued for the TP1 Submission (internal review). Baseline data verified with system owners. Level 2/3 Technical Schedule cross reference report added.	05-Mar-07		
Issue 3.4	Document up-issued following internal review. Amendments made to the issues summary (above) to reflect the current situation.	06-Mar-07		
Issue 3.5	Up issued to show predicted August Site Development Totals.	14-Mar-07		
Issue 3.6	Changes implemented following the Parent Company Review prior to issue.	27-Mar-07		
Issue 4.0	Capability Curve Rationale merged into Appendix 1 prior to issue.	23-Apr-07		

[redacted]

Capability Curve Profile Analysis - August 2006 Affordability Review Vs April 2007 TP1 Submissior

1 - Trident Profile

The Trident Capability remains unchanged since the August Affordability Review.

2 - [redacted]

There has been no reported change to the [redacted] Profile for this period. The [redacted] profile is modelled on [redacted] until April 2010 and either [redacted] thereafter. It is assumed that if [redacted] takes place, this profile will accelerate and occur earlier.

3 - Capability

Changes to the overall capability profile are attributable to changes to the facilies and utility capability index. The site demolition profile shows a greater area identified for demolition but an increased footprint does not affect the capability calculation. The calculation is the annual percentage being demolished. Although only 3 facility end dates have changed (see below), internal FEL gate movement has been noted on a number of facilities. There are 75 facilities each having an identical weighting on the profile. Therefore, minor movement to the FEL gate dates will not have a dramatic effect on the overall Capability Base. Detailed analysis of the facility changes can be seen in Ref A. A summary of changes to the profile can be seen below:

The Site Development profile does not reach 100% for this submission in 2014/15 (as in previous Capability Curve Submissions) which results in an overall profile difference of -1.5% (for the Financial Year 2014/15).

FEL Gate Dates

Facility	Baseline	New Date
[redacted]	[redacted]	[redacted]

Utilitiy Capability Index

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
August 2006 Baseline Review	10%	16%	25%	33%	45%	55%	65%	80%	85%	100%
April 2007 TP1 Submission	7%	11%	20%	28%	38%	48%	60%	80%	83%	94%
Difference	**-3%**	**-5%**	**-5%**	**-5%**	**-7%**	**-7%**	**-5%**	**0%**	**-2%**	**-6%**
Site Development Total										
August 2006 Baseline Review	**14.2**	**28.6**	**44.1**	**68.3**	**75.4**	**80.4**	**85.7**	**91.7**	**94.8**	**100.0**
April 2007 TP1 Submission	**13.7**	**26.0**	**37.7**	**65.8**	**74.5**	**79.6**	**85.1**	**90.9**	**94.6**	**98.5**
Difference	**-0.6**	**-2.6**	**-6.4**	**-2.5**	**-0.9**	**-0.8**	**-0.6**	**-0.8**	**-0.2**	**-1.5**

Capability

[redacted]

[redacted]

[redacted]

Total Capability for AWE

[redacted]

Capability

[redacted]

[redacted]

Key Events April 2008 to March 2013 - TP1 Submission April 2007

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[redacted]

[redacted]

APPENDIX I
To
ANNEX H

Table of Contents

1 Introduction

The purpose of this document is to provide working-level guidance to those staff who have to maintain and update the Nuclear Weapon Capability Sustainment Programme (NWCSP) Capability Curves. The document contains a brief background to the development of the curves; provides the detailed information on how the supporting data underpinning the curves are derived and details from whom the data are obtained.

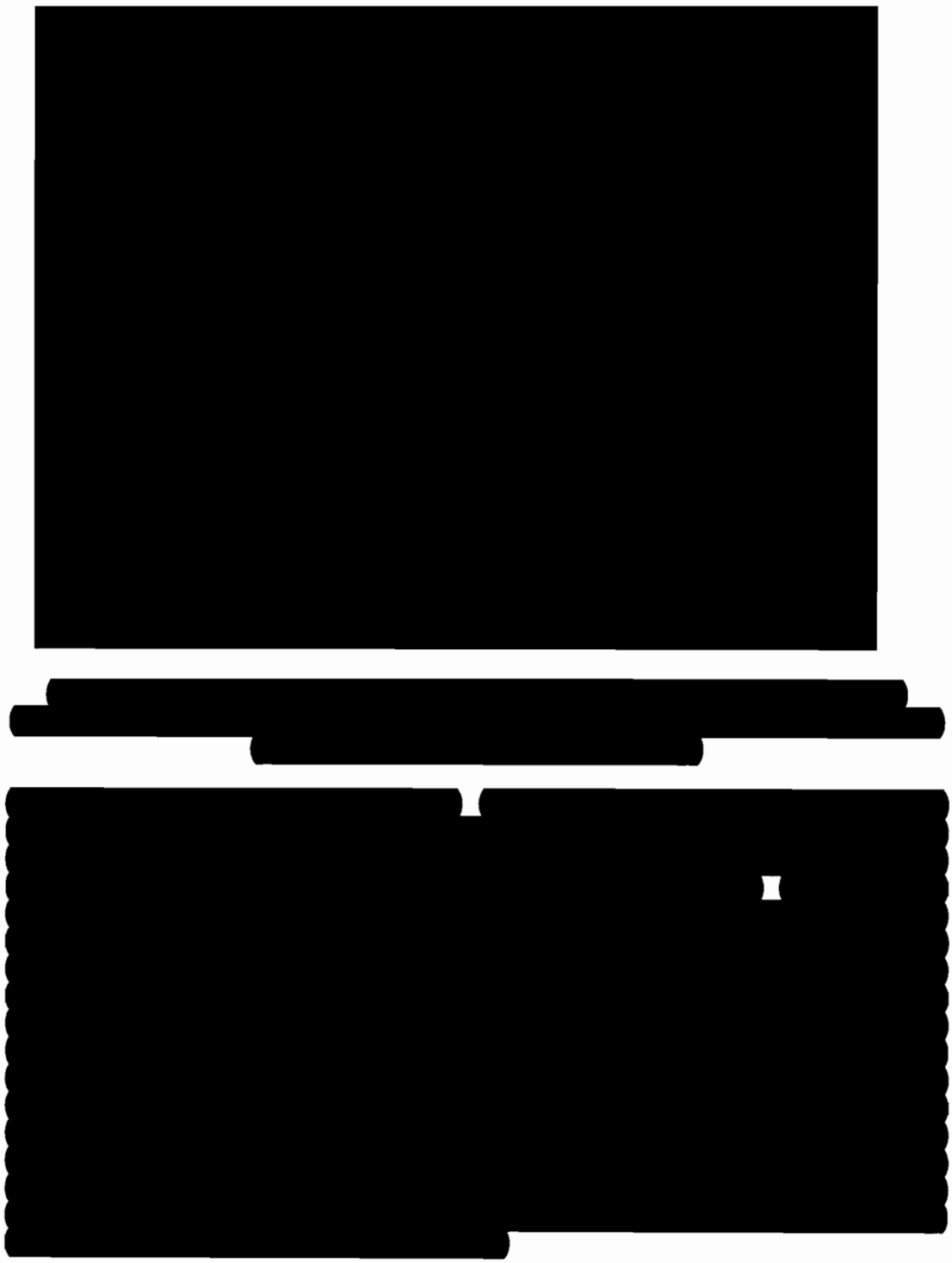
The document is designed to provide clear guidelines to allow staff new to the process to be able to update the curves and also to provide a background to other AWE staff on how the curves are generated.

The Capability Curve is produced by staff within Head of Corporate Business Planning (HCBP). Currently the curves are updated every six months or at other intervals, agreed with Director of Nuclear Weapons (D/NW) to support wider programme reviews. Progress in updating the underpinning data and general updates to the curves are discussed at the quarterly Programme Progress Review Meetings (chaired by D/NW) or at reviews of the overall programme as appropriate. The Capability Curves are maintained under configuration control by HCBP staff.

2 Background

When the requirement for the NWCSP was initially identified a key issue for both MoD and AWE was to be able to demonstrate the increased capability AWE derived from the additional funding. This was particularly important because of the large number of long-lead and later years' activities that comprised the programme. Traditional measures did not identify any capability increase in the early years if the programme when it was especially important to demonstrate AWE's increasing ability to meet future programme demands as it provided confidence that the NWCSP was delivering its objectives and to show that AWE could deliver the increased programme.

Early attempts to demonstrate the increased capability, compared with a continuation of the then Management and Operations (M&O) contract were based on a small number of key parameters used to define an ability to underwrite the In-Service warhead and to develop a successor. An example of one of these early charts is reproduced below.



[redacted]

[redacted]

[redacted]

[redacted]

Figure 2: NWCSP Capability Curve Issue 3.1

A number of strategic programme activities and dates are also shown on the graph. These data points are overlaid on the graph as text boxes. Because of the the scale of the x-axis of the graph the strategic dates plotted on the graph are to illustrate the key points in the programme and are not direct measures or examples of the confidence level associated of capability as all of the underpinning data is of equal weighting. To assist with configuration control the graph identifies the date of production of the current issue (November 2006 in Figure 2).

A second graph is also issued to the customer that provides a detailed view of the current priced contract period of the contract and represents a much more detailed view of the capability when compared to the 25 year curve.

4 Trident Profile

The Trident Profile is an amalgamation of the following underpinning data streams:

a) [redacted]

b) [redacted]

c) Trident Design Reviews;

d) [redacted]

e) [redacted]

[redacted]

Figure 3: Example of the Trident Profile underpinning worksheet.

The Trident profile was originally modelled by Head of Stockpile Management and is reviewed against the current capability whenever the Capability Curve is updated. The Trident Profile is an average of all of the underpinning data for that period. This information is mapped directly on to the Capability Curve and is displayed as a blue trace. The curve is generated to model programme capability by allocating values to the

achievement of elements of the programme. The underlying data streams are then changed to reflect any programme changes by moving the scores in accordance with the perceived change. An example is provided below.

[redacted]

However, if this programme deliverable slipped to the right the scores may read as follows:

[redacted]

Scores are then modified to reflect any change in the programme.

4.1 Surveillance Programme

There are no specific metrics used to model the Surveillance Programme profile. The underpinning data is a sliding scale from 0 to 100 and professional judgement has been used to allocate increasing scores across the years of the programme.

4.2 [redacted]

[redacted]

4.3 Trident Design Review

Trident Design Reviews are conducted at regular intervals. Capability is modelled around the review dates and increases after each programmed review date to reflect the experience and knowledge gained by the relevant staff.

4.4 [redacted]

The [redacted] profile is modelled to demonstrate AWE's capability to [redacted]

4.5 Refurbishment Programme / [redacted]

The term [redacted] is used to describe [redacted] programme as in [redacted] It is when the [redacted] is available at [redacted] before the [redacted]

5 [redacted] Profile

The [redacted] profile has been modelled to show a future [redacted] profile as perceived in the January 14th submission to the MoD. The score commences at [redacted] in April 2004 to reflect the measure in the early estimates of capability. The [redacted]

[redacted]

programme is demonstrated on the table below and was constructed to show the perceived [redacted] as seen by The Head of the [redacted] It is based on the relative weighting given to the achievement of the various [redacted] and the progress towards achieving each level.

[redacted]

Figure 4: Example of the [redacted] worksheet.

The table is updated to reflect any movement in the [redacted] dates (i.e. move the entire profile in accordance with the slippage). The annual total is an average of the underpinning data for that period. This information is mapped directly on to the Capability Curve: the baseline trace is also presented.

6 Capability Curve Profile

The main Capability Curve reflects the following data sources:

a) Facilities list;

b) Strategic Manpower Review;

c) Site development plan;

d) Underpinning technology profile;

e) [redacted]

The data streams are consolidated onto the Capability Base worksheet. The Capability Base Worksheet is the underpinning data resource for the main Capability Curve. It comprises of the five individual profiles, shown against the contract year and also a graph showing the profiles detailed above and over time.

6.1 Facilities List

Input for the facilities list is obtained from the Directorate of Major Projects the underlying data are the number of facilities FEL gates 1, 3 & 5 at points in time. (All facilities (regardless of type) have been allocated equal weighting.) Only FEL gates 1, 3 & 5 are modelled as this provides an overall assessment of capability over all projects. It is recognised that some facilities may have some capability prior to FEL gate 5 (e.g. [redacted]

	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25
	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25
% Facilities @ FEL 1	17%	35%	50%	53%	57%	57%	60%	76%	83%	86%	91%	95%	95%	95%	98%	98%	100%	100%	100%	100%	100%
% Facilities @ FEL 3	5%	11%	19%	35%	41%	48%	56%	67%	78%	83%	85%	93%	96%	96%	96%	98%	98%	100%	100%	100%	100%
% Facilities @ FEL 5	0%	5%	0%	7%	12%	18%	25%	32%	34%	40%	52%	59%	63%	73%	79%	85%	90%	90%	90%	93%	100%
Total (August 06 Affordability Review)	**7%**	**17%**	**23%**	**32%**	**37%**	**41%**	**47%**	**58%**	**65%**	**70%**	**76%**	**82%**	**85%**	**88%**	**91%**	**94%**	**96%**	**97%**	**97%**	**98%**	**100%**

Figure 6. Example of the Facilities Sheet

Updates for the facilities sheet are obtained from the Integrated Facilities Planning team.

6.2 Strategic Manpower Review

The Strategic Manpower Review data are obtained from DCS HR staff and reflect the increased skill levels within the company delivered through the staff recruitment programme. The manpower demand over the current contractual period is reviewed regularly in accordance with programme baseline reviews. The underlying data contains the following information:

a) Graduates;

b) Professionals;

c) Craftsmen;

d) Process Operators;

e) Student / Trainees.

Each data stream is assessed on its operational effectiveness and is rolled up on this basis into the annual total. Graduates are considered to be 50% effective within their first year and the annual total will reflect this whereas experienced professionals are considered to be 100% effective and their annual total will be on a continuous scale. The data run up to 2011 when it has been assessed that AWE's increased manpower requirement will be satisfied and future recruitment will be to off-set losses and required changes in the skills mix of the manpower base. Consequently the manpower impact on changes in capability beyond 2011 are minimal and have been discounted from the capability curves.

New Employees (August 06 Affordability Review)		2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Graduate	26	84	49	80	50	36	36
Professional	61	230	196	150	240	171	171
Craft	3	7	1	20	0	0	0
Process operators	3	35	38	27	21	15	15
Student/Trainees	1	50	27	34	39	28	28
Effectiveness							
Graduate	13	68	134.5	199	264	307	343
Professional	61	291	487	637	877	1048	1219
Craft	3	10	11	31	31	31	31
Process operators	1.5	20.5	57	89.5	114	132	147
Student/Trainees	0.25	13	32.75	73	105	139	172
Note: Graduate/Student/Trainees 25% in first year, Process 50% in first year							
Total	79	403	722	1030	1391	1657	1912
Total (sum)	79	482	1204	2233	3624	5281	7193
Manpower (Norm)	**1.1**	**6.7**	**16.7**	**31.0**	**50.4**	**73.4**	**100.0**

Figure 7: Example of the Strategic Manpower Review.

The overall total can be found using the following equation:
Manpower Total = (Annual Total / Maximum value)*100 eg the manpower total for year 7 = ((1204/7193)*100) = 16.7%.

6.3 Site Development Plan

The site development plan is made up from the following data strands:

a) The number of work spaces provided as a percentage of the anticipated total requirement;

b) The area of land freed by demolition for new facilities as a percentage of the total expected to be made available

c) Percentage of site deemed to present an environmental concern which has been remediated;

d) Utilities capability index.

The site development figures are the mean of the annual values for all disciplines. Underpinning data are obtained from the Manager of Infrastructure Strategy.

Measures (plan)	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Work spaces % of anticipated total	0%	8%	28%	38%	74%	74%	74%	74%	74%	74%	74%	74%
Demolished area available for development % of site required	0%	19%	40%	86%	100%	100%	100%	100%	100%	100%	100%	100%
Areas of Environmental concern	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%	100%
Utilites Capability Index	6%	10%	16%	25%	33%	45%	55%	65%	80%	85%	100%	100%
Site Development (May 06 Baseline)	**4.0**	**14.1**	**28.6**	**47.1**	**64.2**	**69.7**	**74.7**	**79.7**	**85.9**	**88.4**	**93.4**	**93.4**

Figure 8: Site Development Plan

6.4 Underpinning Technology Profile

The Underpinning Technology profile is a scientific-based profile which describes the activities required to underpin the Trident [redacted] programmes and consists of four major strands:

a) [redacted]

b) [redacted]

c) [redacted]

d) Engineering Technology (MBA/MBE).

6.4.1 [redacted]

The metrics contained within this section of the Capability Curve model the effectiveness of the [redacted] across the [redacted] programme. Critical events for example the [redacted] experiments are modelled on this profile.

6.4.2 [redacted]

This profile has been modelled to reach 100% in [redacted] ie when the Trident [redacted] is planned to be issued.

6.4.3 [redacted]

[redacted]

6.4.4 Engineering Technology (MBA/MBE)

Model Based Assurance (MBA) and Model Based Engineering (MBE) are also methods used to help underwrite warheads in a CTBT regime.

Figure 9: an example of the Underpinning Technology worksheet.

A number of strategic activities have been added to the underpinning data to demonstrate when key events are scheduled. The information contained within this worksheet is obtained directly from the [redacted] programme. The mean of the individual contributions provides an input to the Capability worksheet and underpins the overall Capability Curve.

6.5 [redacted]

The Trident [redacted] forms the final component of the Capability Curve. An example of the manufacturing profile can be seen below. The [redacted] the current stock pile and also supports the certification of the current stockpile [redacted] warheads, and [redacted]

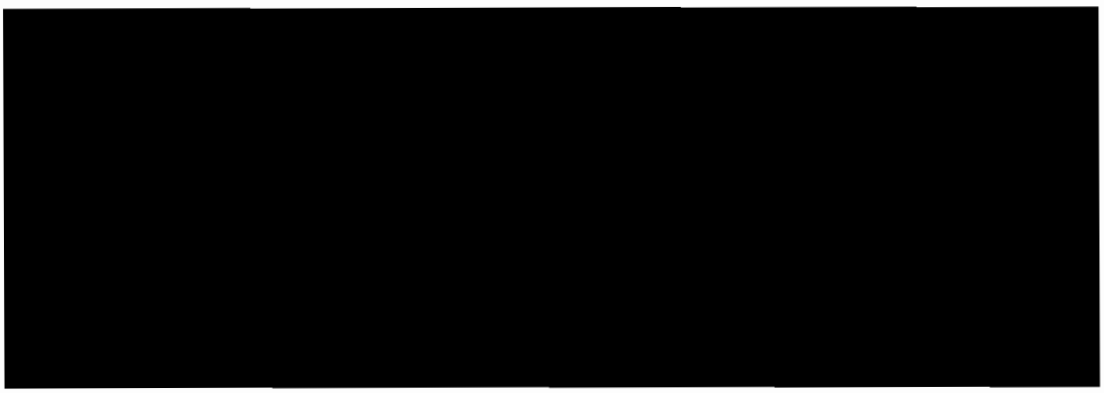


Figure 10: Example of the DRAS[redacted]used in the Capability Curve

[redacted]

6.6 Capability Base

All of the above contribute to the shape of the profile for this curve as shown below:

Figure 5: Example of Capability (Base) worksheet

The individual data streams are ***equally weighted*** and the total figure (highlighted in Figure 5) is the mean of the separate components.

The capability at a given time is defined as the assessed capability in 2004/05 (read from the early version of the curve and determined as 55) added to product of the Capability required to be achieved at the start of the programme and the current data streams total divided by the total in [redacted] ie;

Capability = capability at start of the programme *((the capability yet to be achieved (Data Streams Total/Total in [redacted]. This calculation gives normalised values between 0 and 100.

7 Conclusion

The above methodologies demonstrate that the capability curves are developed using a wide variety of data that reflect all stages of the progress towards delivering the NWCSP. Necessarily not all of the achievements in any given period are reflected in the curves but every effort has been made to ensure that key developments are represented. In all cases the values ascribed to the elements that comprise the curves have been normalised to help ensure that the curves are not distorted by any single achievement. The curves are kept under regular review to ensure that they reflect the thrust of the programme demands and that the reflect the increases in capability achieved.

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[redacted]