

**DEFE 25/434**

E3 p4-6

BM options listed by US.

- a) Polaris A3TK
- b) Polaris A4
- c) Poseidon C3
- d) Trident 1 C4

Details in Annex A – a US-supplied handout.

- b) In relation to b) A4 the US emphasised the considerable extent of payload redesign and costs.
- c) Poseidon C3 depended on UK purchase of redundant US kit.
- d) Two C4 options were offered.
  - 1. C4 complete (with MIRVs).
  - 2. C4 Flat-Top, with UK added front-end of A3T or A3TK

Also mentioned Mark 500 Evader system.

Also mentioned Safety Arcs for C4.

UK said: Lack of commonality after US phrase-out was why UK rejected Poseidon C3. Polaris A4 had similar disadvantage, but certain PSA had the right framework although a huge task to rewrite them.

If C4 design were changed even slightly to incorporate alternative components then extensive flight tests required.

CEP of C4 was 500 yards.

E3 p6-9

Cruise Missiles.

SLCM "Clever Routing" was the counter to the Soviet SAM 10.

SLCM looked rather well against Soviet SAM 6.

Data on capability of SAMs 6, 8, 10 against CMs rather limited.

Used in saturation, strategic CMs more survivable than small numbers used in theatre role. ECM destined for SLCM, but not ALCM.

Large numbers of CMs needed by UK to ensure penetration.

SLCM designed to be capable of a 500 nm stand off from landfall.

800 nm a challenge. 1100 nm demonstrated from aircraft launch

SLCM confirmed ranges were 1100 nm over the sea, 2000 nm overall.

Necessary to allow 25-30% of range for evasion kinks in routing. Percentage might be less on long missions, esp over sea where long straight-line stretches were possible.

E3 p12-13

LRTNF replacement for Vulcan. US view was that the Tornado range issue was crucial. US did not regard Tornado as a true replacement for Vulcan. If GLCMs were to replace Vulcan, then more Tornados would be available in non-nuclear roles. US regarded that as important. Dual-key arrangements for UK TNF GCLMs were not appealing to the US. UK warhead production shortages.

E3 p14-16

UK summary of UK officials thinking on the rationale for deterrence.

BM numbers considered were 100 C4 each with 8 REBs or 3-400 CMs

E3 p16-17

"The emphasis UK warhead development had been towards small, conical REBs with high-beta warheads. The latest weapon was to be tested in Nevada at the end of the month, [August 1979] and notional agreement had been obtained from Livermore for three more to be inserted in the testing programme next year [1980]; the possibility of a test ban was a factor in our minds. We were following the same path as US development. It would be useful to know the physical boundary conditions for accommodating warheads in the C4 front end. CTBT permitting, we hoped to have a

successful weapon system tested by the end of 1980 or mid-1981 at latest; which should permit us to produce warheads in time for a successor missile in the very early 1990s. The Polaris Sales Agreement did not permit the sale of warheads, but allowed the transfer of warhead design, and indeed such information had been transferred at the time of Polaris A3T. Testing was necessary in order to guarantee that a warhead, even where design information had been copied, was workable.”

“The US asked why, given that the UK with its high-beta designs was following the same path as the US, it was necessary for us to see the US designs. The UK explained that US design information, particularly over the configuration of US warheads, would enable us to confirm that we were working on the right, parallel path; it was a question of confirmation of UK work, rather than of total dependence by the UK on the US.”

E3 p17-20

UK short term loan of plutonium from the US.

UK could not produce warheads for UK LRTNF GLCMs much before 1986 or 1987. Only two options for UK-based weapons were therefore US weapons or a custodial arrangement. The production rate was determined by production capacity, rather than technical capability. Production capacity was fully committed to Chevaline and also to the renovation of WE.177.

There was a risk that C4 would be unique by the early 21st-century.

US asked whether the UK had in mind a full complement of warheads for five boats. UK said that the UK was much nearer the cliff-edge of their capability than what the US. UK said that the UK could not afford to re-equip its strategic force on a rolling basis, - the successor system would need to last for 30 years. Had a fifth Polaris boat being built, as originally intended, Chevaline might possibly have been unnecessary.

Losing commonality would increase cost, and the only response we could make might be to cut numbers, but the loss would also be damaging in other ways.

SACEUR regarded Polaris, for its own purposes, as TNF, and assigned it targets accordingly.

The UK regarded the national deterrent task as a “floor”.

The key characteristic of the UK force was not its numerical contribution, but as a second centre of decision-taking, and the UK attached importance to the NATO role, but this did not in itself determine the nature of our requirement. The UK requirement was determined by the national role.

E4-2 2pps  
E4-2 15 pps

Commentary on Duff-Mason Report. Cover letter.

Commentary on Duff-Mason Report. page 11 missing.

E4-2 p6-9

CRITERIA FOR DETERRENCE.

“ ... The objective would be to deploy an independent capability which has a high probability of inflicting unacceptable damage on the Soviet Union. The unacceptability of such damage could be measured, first, by its relationship to any potential Soviet gain from aggression; and secondly, in relation to its effect on the Soviet Union's ability to compete with other superpowers. The UK could therefore threaten functions of key importance to the Soviet State; or cities as a whole; or a combination of the two. [The Duff-Mason Report]

Part 2 derives for illustrative options which the authors believe would be judged unacceptable. [to the Soviet Union].

- a) redacted
- b) redacted
- c) redacted
- d) Option 3B: Grave, but not necessarily breakdown level, damage to 30 major targets outside ABM coverage.

The Commentary authors believe that the number of detonations needs to be much larger than 30.

E4-2 p9-12

The best ballistic missile solution on technical and cost grounds is C4. A cruise missile solution would require purpose-built submarines. There would be elements of UK-uniqueness in both solutions. Damage Criteria Option 1 requires approximately double the number of warheads delivered by ballistic missiles than any other option. GLCMs could be pre-empted by a "blanket" nuclear attack on a country as small as the UK. That would not detract from the value of GLCMs as LRTNF weapons as long as an ultimate UK strategic deterrent existed in another form to deter a "blanket" strike.

E4-2 p12-13

CM solution would be a force of dedicated nuclear powered submarines each with 80 CMs. UK unique. 4 submarines at sea to meet the least demanding of the Damage Criteria. Very expensive and carrying high technical risk. Solutions consisting of a few CMs in existing SSN submarines would be quite inadequate to meet the Damage Criteria: there would be a token "poor man's deterrent".

E4-2 p13

SSBN numbers. Figures in annex B of Part 3 shows that Damage Criteria Option 1 is almost met by 2 x 16-tube boatloads of C4 missiles at sea and let the other options could all be adequately met. A single boatload at sea would meet only Option 3a and below. This establishes the case for a force of 5 SSBNs, each with 16 missile tubes with C4 missiles, giving two boats also on patrol.

E4-2 p15

difficult position of our nuclear warhead design and production facilities.

E4-2 p17

CONCLUSIONS  
Polaris successor force should be:  
5 SSBNs each with 16 missile tubes  
Trident C4 MIRVed missiles.

E11 p1

CABINET STEERING GROUP ON NUCLEAR MATTERS  
Cabinet Secretary Sir John Hunt as Chairman  
FCO (Sir Michael Palliser)  
CDS  
PUS MoD  
Treasury (Sir Douglas Wass)  
Secretary: Mr R.M.Hastie-Smith (Cabinet Office)

CABINET NUCLEAR DEFENCE POLICY COMMITTEE (MISC 7)  
PM as chairman  
Chancellor of the Exchequer  
SoS @ MoD  
SoS @ Home Office  
SoS @ FCO

Secretary: Sir John Hunt (Cabinet Office).

E14 p2

US believe that our geography makes ALCM a poor choice.  
US believe that C4 would be most effective choice.  
US believe that amended PSA would be OK as a basis.

E16 p2

1. The critical feature of an ALCM-based strategic force is that it would have to use airfields. There is no prospect whatever that an aircraft with large CM carrying capacity yet not dependent on runways will be available this century.
2. The location of airfields in the UK will be known to the Soviet Union, which has ample land and sea-based missiles will be able to destroy them accurately. The size of the UK and its proximity to the USSR mean that missile flight times could be a very few minutes. This makes the UK situation widely different from that of the US, whose ALCM-carrying fleet (besides being only one of three large and complementary strategic forces) would have warning time long enough for a large proportion to take off from ground-based alert and get clear of any pre-emptive strike.
3. It follows that unless the UK were content to go back in the 1990s to a standard of pre-emptability which was abandoned as unacceptable in the 1960s (when Soviet pre-emptive power was far less than now), an ALCM force would have to be capable of maintaining an air alert posture for long periods, if not permanently. The number of missiles kept airborne would have to be capable of meeting whatever damage criteria Ministers judge deterrence to require in the post-Polaris era.
4. Computation of how many missiles airborne this entails depends not only on the damage criteria laid down and on system reliability, but also on assumptions about in-flight losses to future enemy air defences. Decision now is impossible. However, the work being done on the SLCM option, which will be set out fully in the autumn report to Ministers, is based on a minimum requirement to launch 300 CMs. The current US concept of a purpose-built ALCM-carrier for the 1990s envisages an aircraft carrying 28 CMs (and costing \$75M-\$100M). Eleven would be needed to launch 300 CMs.
5. Even if a force capable of airborne alert on this scale were provided, there would remain the difficulty (unless redundant base support facilities were provided on a multiple scale) that a small-scale pre-emptive Soviet strike on its home airfields would be reduced to a matter of a few days, or even of hours, the time for which we could keep our capability operational.
6. This last point aside, to provide and maintain for (say) 20 years a force capable of maintaining 11 aircraft on airborne alert would be likely to require the purchase of not less than some 40-50 aircraft. Officials judge it most unlikely that such a force, plus weapons, bases and all aspects of support, could prove materially cheaper than submarine-launched forces (BM or CM) of equivalent damage-inflicting capability; it could well be much more expensive. A broad costing could be developed in parallel with that of the submarine-launched options. Before further staff effort is assigned to this, however, Ministers may wish to consider whether the concept of a force which entailed having some hundreds of strategic nuclear warheads permanently or frequently airborne in or near UK airspace, and which remained also subject to the operational drawback noted in

paragraph 5 above, offers enough promise of acceptability to warrant continuing study.

E17 p2

Latest options 5 Sep 1979.

C4  
A4  
SLCM  
ALCM

E17a annex A p1

Updated version of E16 p2 ....

4 minute warning.

15 minute QRA ....

Whole force dispersed and at 15 min readiness and ...

Whole force at 5 min readiness for periods up to 4 hours (crews in a/c)

At 2 mins readiness for very brief periods (engines running at end runway).

E19-1 p4-6

Now five main options: dated 5 Sep 1979.

1. Trident 2 D5 with the capability to attack multiple targets (MIRV), and equipped with high or low yield warheads and a "high beta" front-end (compared with the "low beta" types in Polaris or Chevaline, these are more accurate and, because they descend through the atmosphere faster, more difficult for terminal ABM defences to engage).
2. Trident 1 C4 missile with a fully MIRVed "high beta" front-end and low yield warheads, which is currently being developed for the USN for fitting in modified Poseidon and purpose-built submarines.
3. Poseidon C3 missile. MIRV, "high beta" front-end with from ... redacted ... low yield warheads, and is currently deployed in 30 US SSBNs; but production of this missile has now ceased and is being replaced by the C4 missile. By 1982 only 19 SSBNs will carry Poseidon with the final phase out completing by 1992.
4. Lockheed A4 missile, which would be a unique development of Polaris using proven C3 and C4 technology in propulsion, structures and missile electronics with a range of between 3000-4000 nm, but would involve the UK in MIRV and front-end development at high cost.
5. French M4. Multiple high yield warheads with some capability for target spacing, but not up to MIRV standards, and with a "low beta" design of front-end. It has a range of 2160 nm, will be retrofitted into four of the French SSBNs and by the 1990s should be a proven system.

If the US was unwilling to provide a MIRV weapon system or if Ministers considered it inappropriate, possible "fall-back" positions would be a de-MIRVed C4 system (termed "C4 flat-top" by the US) or the A4 missile. These would, however, represent "UK unique" developments with clear drawbacks in comparison with the Trident C4 solution above. Both A4 and "C4 flat-top" are likely to be superior technically to the French M4 which does not have either a true MIRV capability (the separation of M4's warheads is not lateral) or the longer range. C3 as an alternative MIRV system to C4, phrases out in the US just as the UK would be introducing its own successor system, with the resultant penalty of a lack of commonality with the US should this system be offered. Furthermore, there have been recurring technical problems with the C3 missile.

E19-1 p7

Furthermore, we understand that the reliability of C3 missile motors has not come up to US expectations.

	There are clear technical drawbacks in adopting a French system, since the technology is at least a generation behind that of the US.
	The forecast missile range of M4 of 2200 nm is marginal for strategic use in this timescale.
	Missile costs would be likely to exceed the C4 alternative. As between C4 and D5, the main operational difference is the increased range ... redacted ...
E19-1 p8	Without MIRV, the fall-back options of C4 "flat-top" and A4 with Polaris A3 or Chevaline warheads would meet Damage Criteria Option 3a with one SSBN at sea but would probably not meet any of the others even with 2 SSBNs on patrol. Whilst a UK programme for MIRV is within our technical grasp this path could prove very costly, it would be a high-risk in terms of the timescale involved .....
E19-1 p8-9	Size of SSBN missile tube compartment.
E19-1 p11-16	CM options and vulnerability.
E19-1 p17-18	Polaris A3 Missile motor life. Average build date 1966. Showing significant signs of developing defects for which there are no known remedies. Motor replacement options.
E19-1 p26	Strategic GLCMs. Would not meet pre-launch survivability criteria.
E19-1 p27	Strategic ALCMs.
E19-1 p28-31	System costs. Excluding fismat.
E19-1 p32	Table. Costs. SSBM alternatives. 4-boat force.
E19-1 p33	Table. Costs. SSBM alternatives. 5-boat force.
E19-1 p34	Table. Costs. SSBM alternatives. 8-boat force of CM or C4.
E20 p1-6	Preferred system for an independent UK LRTNF. ALCM.
E25b p20	French M4. Low-beta not to MIRV standard.
E25b p26	A4 options. To meet Damage Criteria 3a. 5 boats.
E25b p27	C4 options. To meet Damage Criteria 2 or 3a requires 5 boats and Damage Criteria 3a or even 2 could be met if one boat was lost to pre-emptive attack or lost for any other reason. An 8-boat force would meet Damage Criteria 1.
E25b p28	CM options.
E26 p5	"Ministers decided on Chevaline – against CoS advice to go for Poseidon on a predicted cost of £200M and an in-service date of 1977 – actual cost £930M, in service 1982. Polaris – a package – was on time, on cost." CDS.
E27 annex A B C	Latest updated version of options analysis 33 pps total.
E27 annex E F G	
E27 annex H p1-3	

E29 p1-2

Telegram. Unclear to who and who from. Press Assn Defence correspondent Robert Hutchinson appears to be one party. Unclear if Hutchinson was merely being quoted.

P2 dated 24 September 1979

"the missiles - a total of 64 - are carried by the four submarines and will carry a new improved warhead within the next two years. There is speculation that the £450M, 4-year development project continued under the Labour government, has resulted in the missile's three separate 200 kt warheads being replaced with 6 of 40 kt yield, capable of wider spacing on impact. The recent Nevada underground test was designed to prove this new warhead. Sources predicted it would take at least 10 years to develop a new system because Britain now had fewer submarine yards than it had in the mid-1960s, and because the vessels themselves are now more complex."

Dated 25 Sep 1979.

"The idea of a purely British ballistic missile has been ruled out and officials stress that an American weapon could be obtained more speedily and cheaply than a French one - and would be better. All the arguments now being assembled for ministers point overwhelmingly to a submarine-launched nuclear deterrent, and while cruise missiles are not yet formally ruled out, these pilotless aircraft are seen as a highly defence-sensitive solution. This means that Russian air defences could shoot down a number of attacking, low-level cruise missiles. I was told that the Americans can deal with that by swamping. Now they are talking of say 20 cruise missiles on each of 120 B-52 strategic bombers."

Dated 25 Sep 1979.

"That's a large bombardment - one would expect a lot to get through, no matter how good the Russians are at grouse shooting. But sources doubted if Britain could deploy that scale of massive attack - at least for the very reason of cost which is reckoned to be at least another £1000M on top of the price of ballistic missile is very basic system. This dressed that nothing in the as-yet unratified Strategic Arms Limitation Treaty (SALT 2) precludes a new Nassau Agreement. Whitehall has detected in the Americans are feeling that the UK still has a very real role to play in the nuclear chess game."

E29 p3

Dated 25 Sep 1979.

"There have been extensive talks with the Americans this summer, including US Defence Secretary Harold Brown, and Pres Carter is aware of the British position. These talks were described to me today as "windowshopping" to find out just what is available and to gauge the cost. After the Cabinet decision the British will go back to Washington and they are expecting the Americans to drive a hard bargain. What does seem certain is that whatever new weapon is settled upon, it will carry a British designed and made nuclear warhead to prevent any difficulties over dual decisions on its use or rows over just how independent British nuclear deterrent is would be."

E29 p4

GUARDIAN article by David Fairhall on Trident dated 26 Sep 1979. Assumes Trident 1 will be the final choice.

E29 p5

Another GUARDIAN article also by David Fairhall on Trident dated 26 Sep 1979. Assumes Trident 1 will be the final choice.

E29 p6

MORNING STAR article by Bill Brookes dated 26 Sep 1979. Alleges decision to acquire Trident 1 was deliberately leaked by UK govt.

E29 p7-8

Ditto in the SUN newspaper and assorted others.

E30 p1 Confirmed as a deliberate leak from DUS to Robert Hutchinson, Press Assn.

E34 p1 Handwritten memo. US-owned GLCMs in UK to increase from 144 to 160.

E35 p1-3 Extensive brief from CoS Cttee on latest developments for Successor Systems, Arms Control, SALT3, LRTNF UK and US owned.

E36 p1 Revised assessments of number of missiles required for Deterrence Criteria at E36 Annex A.  
Full costings of a number of Options at Annex G.  
Draft of substantive paper revised, shortened and made more readable. Further editorial changes before the Final Report (for Ministers) to be discouraged.

E36 p2-22 Revised Draft. 21 pps.

E36 Annex A Revised Draft. 4 pps.

E36 Annex B Revised Draft. 4 pps. All redacted.

E36 Annex C Revised Draft. 7 pps. 1-3 and 7 redacted,

E36 Annex D Revised Draft. 6 pps.

E36 Annex E Revised Draft. 3 pps.

E36 Annex F Revised Draft. 7 pps.

E36 Annex G Revised Draft. 3 pps. Costs.

E40 p1 Handwritten memo from Sec to CAS. Attached paper by DDAWRE on cruise missile vulnerability and penetration ability. Annex 2 is the basis for the figures that appear in the Nuclear Matters Working Party Report Part 3. "Uncertainties .... Are very great".

E42 p1 Nuclear costs.

E42 Annex A p1 Successor warhead dev to begin in 1980 and complete by 1986 (or '88)

LRTNF warhead dev to begin in 1987 and complete by 1991-2.

Successor missiles to be purchased in advance of in-service date.

WE.177B will not be replaced. It will be refurbished and kept in service in the 1980s and replaced by the LRTNF.

WE.177A and WE.177C will be replaced by new weapon entering service in the early-mid-1990s. Development of the new weapon will begin when development of the strategic force warhead is completed. WW.177A and WE.177C will be replaced on a one-for-one basis.

Handwritten note follows:  
WE.177A = 1/3 to 10 kt - RAF & RN  
WE.177B = 400 kt (Vulcan) - RAF  
WE.177C = 190 kt - RAF

E42 Annex B p1 Nuclear Costs Summary @ Sep 1979 prices.

E42 Annex C p1 Defence Budget LTC

E44 p1-2 Press letters comment.

E46 pps 1- 40 Revised Draft of NMWP Report Part 3 – System Options.

E56 p2 Draft minute to the Prime Minister from the chairman of Nuclear Matters.



## Future of the Strategic Deterrent.

1. At the Ministerial Group on Nuclear Defence Policy on 19 September (MISC 7(79)3, Item 2) it was decided on the basis of the interim report covered by Sir John Hunt's minute to you of 14 September that a full report should be submitted on the three options identified for the replacement of Polaris. report is now attached. It has been prepared by working group under the chairmanship of Prof Mason and has been agreed at official level by the Foreign and Commonwealth Office and Treasury.
2. Background study. You'll recall that the Group's meeting on 24 May (MISC 7(79)1, Item 1) had before it a 3-part study by officials entitled "Factors Relating to the Further Consideration of the Future of the United Kingdom Deterrence". Part 1 of that study dealt with the politico military requirement and does not need to be considered further. Part 2 dealt with the criteria for deterrence and remains relevant to your present decision; it is considered in my paragraph 5 below. The report now attached is a revised version of that, which takes account of the extensive information made available to us by the Americans in the interim.
3. System Options. As agreed at MISC 7 on 19 September, the theoretical option of air-launched cruise missiles (ALCM) has been dropped. The report therefore concentrates on the three other options originally identified, viz:
  - (a) Ballistic missiles (BM):
    1. An upgraded Polaris system (A4)
    2. the Trident 1 system (C4)
  - (b) Sea-launched cruise missiles (SLCM)

Other theoretical options are mentioned but only for purposes of comparison; they are not put forward for serious consideration. An important sub-option is however identified in the case of the C4 missile, which could be obtained either with or without it's important MIRV (multiple independently targetable re-entry vehicle) capability. The other BM option, A4, would like Polaris have only a MRV (multiple re-entry vehicle) capability. This distinction does not of course apply to cruise missiles, which have only one warhead each and rely for penetration on their low trajectory and on the greater numbers in which they would typically be fired.

4. Costs. These are summarised at the end of Annex G, on the last page of the report. There are naturally many uncertainties. But it will be seen that the minimum viable SLCM force (11 boats) would cost over £12,000M to acquire and operate over 20 years. This would be about the same as an 8-boat BM force, but is about 50% higher than the estimated cost of the 5-boat BM force which would in fact be large enough for our needs. There does not seem to be any vast disparity in the cost of the BM options (A4 MRV, C4 MRV and C4 MIRV). But surprisingly C4 MIRV looks if anything the cheapest. Although the most sophisticated it would not involve us in as much joy British development work.

5. Whole paragraph redacted. Retained under Section 3(4).
6. Contacts with the Americans. As foreshadowed in the interim report submitted by Sir John Hunt in September there is been a further meeting between our team of officials and their American counterparts led by the Deputy Director of the National Security Council staff. This was encouraging so far as it went. The Americans asked a number of fairly searching questions, which seemed based on a tacit assumption that we were likely to opt for the C4 MIRV system; they seemed fully satisfied with our replies and there was less suggestion than at the August meeting that this might cause them fundamental problems. They will wish to consult Congress after we have made our request; and they mentioned a number of non-nuclear areas in which they would welcome increased British co-operation, while stressing that none of these constituted preconditions to helping us over the replacement of Polaris. They are clearly preoccupied with what they see as the more immediate question of getting NATO agreement on a programme for modernising the Alliance's theatre nuclear forces.

E57-1 p1-2

2. Nuclear costs. Begins at paragraph 2.  
"Apart from suggesting some relatively small changes (to cover necessary staff increases at Aldermaston and the nuclear ROFs and to reflect revised estimates of plant and materials costs), those whom I have consulted agree with the figures. They did, however, have some reservations about the assumptions behind the figures, particularly as regards timing. It was generally felt that these did not take sufficient account of likely constraints on capacity, particularly as regards warhead development. CSA's recent studies of this question have indicated that a significant increase in manpower at AWRE and the nuclear ROF would be needed even to take on one major new development programme and that it would be imprudent to base our planning and two being carried out simultaneously. We might, perhaps, be able to build up development of a second programme before the conclusion of the first; but there is no realistic prospect of our being able to manage to large projects concurrently as is implied in the assumptions at Annex A to your minute. In particular, it was felt to be unrealistic to assume development of a GLCM warhead totally concurrent with that of a warhead for the Polaris successor."
3. "In these circumstances it was felt that the best course would be to show the cost profiles of two alternative sets of assumptions. One of these might envisage all three programs going ahead with a degree of overlap, with the Polaris replacement being followed by a GLCM force and the WE.177 replacement coming third. This would involve the second and third programs in some slippage. Alternatively, it might be assumed that the GLCM proposal is dropped altogether and that NAST 1231 follows the Polaris replacement, with a degree of overlap as regards warhead development."
4. "It might be helpful to deal here with the relationship between the Polaris replacement figures which appear in the attached tables and these shown in the cost annex to the NMWP report. The latter is in overall costing of the Polaris replacement broken down into its main

ingredients, where is the costing in the attached tables is an illustrative cost spread year by year to 1994-95. It also has a somewhat narrower coverage than the NMWP figures. Thus, the NMWP total for procurement of the Polaris replacement is £4580M; but this includes provision for attributable special materials and nuclear facilities costs. In the attached tables these costs are included in line 4. The total NMWP figure (exclusive of materials and plan costs) is £3780M. This compares with £3912M as a total of line 1 (Polaris replacement) in the attached tables. From this latter total, however, we need to subtract £132M, being the cost of running one extra SSBN during the last four years of the 15-year costing period (i.e. £33M PER annum for four years). This gives £3780M as the procurement cost of the Polaris replacement, which reconciles with the NMWP total."

5. "In his minute to 15 October DUS(Navy) expressed misgivings about the Polaris replacement figures. I am advised by DFA (P) that contingency margins has been built into the component figures to reflect uncertainty; and that the Trident missile estimates, which are based on relatively sound cost information provided by the Americans, have hired a 7½% R&D surcharge added to them, compared with 5% for Polaris. As DUS (Navy) suggests, we may have to find another nuclear submarine builder; the costing includes £100M for additional facilities. The figures in the attached tables do not, apart from the extra costs mentioned above, include running costs. The NMWP costing, however, assumes annual running costs £165M a year for a 5-boat force, compared with £125M a year now for the 4-boat Polaris force. Moreover, the latter figure includes an element for "uniqueness"; DFA (P) estimates that the normal running costs of the Polaris fleet are in the region of £100M a year. In effect, therefore, the costing contains a 30% contingency for running costs to take account of the increased complexity of the Trident system. To some extent this would be offset by longer intervals between refits than for Polaris. No significant increase is envisaged in crew numbers (per boat) or in the supporting civilian workforce."
  
7. No paragraph 6 in this text.  
"These comments relate solely to DUS (Navy)'s reservations on costs and simply explain how the figures have been made up. Further comments will be made in DUS (FB)'s reply to your minute of 17 October. Certainly I would agree with DUS (Navy)'s warning that we may be severely stretched for sufficient industrial or dockyard capacity to support a successor deterrent and that a realistic assessment of the position here is needed before decisions are taken."

E57-1 attachment 1 p1

#### ASSUMPTIONS 1.

##### General Assumptions.

1. A replacement for the Polaris force and the force of nuclear-armed GLCMs will be procured; in addition NAST 1231 will be developed and produced to replace WE.177 (A and C variants).

##### Detailed Assumptions.

2. Development of a warhead for the Polaris replacement will begin in 1980 and be complete by 1987.

3. The Polaris replacement will consist of 5 SSBNs, each armed with 16 MIRVed Trident missiles.
4. The missiles will be procured in advance of their in-service date in the interests of economy.
5. An extra shipbuilding 'stream' will be established for production of the SSBNs.
6. Development of warheads for a GLCM force will begin in 1984 and be completed by 1990.
7. The GLCM force will enter service in 1991. Procurement of the GLCM missiles from the United States will take place in advance of this in-service date in the interests of economy.
8. Development of NAST 1231 will begin in 1988 and the new weapon will enter service in the mid-1990s.
9. WE.177 will be replaced on a one-for-one basis.
10. Staff numbers at AWRE will be increased by 1500 (300 scientific, 1200 industrials) by 1984; and there will be an increase of 500 industrials in ROF manpower by 1987, of which 300 will be added by 1984.

E57-1 attachment 1 p2

TABLE.

E57-1 attachment 2 p1

ASSUMPTIONS 2.

General Assumptions.

- 1 A replacement for the Polaris force will be procured; and NAST 1231 will be developed and produced to replace WE.177 (A and C variants).

Detailed Assumptions.

2. Development of a warhead for the Polaris replacement will begin in 1980 and be complete by 1987.
3. The Polaris replacement will consist of 5 SSBNs, each armed with 16 MIRVed Trident missiles.
4. The missiles will be procured in advance of their in-service date in the interests of economy.
5. An extra shipbuilding 'stream' will be established for production of the SSBNs.
6. Development of NAST 1231 will begin in 1984 and the new weapon will enter service in the early 1990s.
7. WE.177 will be replaced on a one-for-one basis.
8. Staff numbers at AWRE will be increased by 1500 (300 scientific, 1200 industrials) by 1984; and there will be an increase of 500

industrials in ROF manpower by 1987, of which 300 will be added by 1984.

E57-1 attachment 2 p2

TABLE.

E58 p1

4. "... ... The recommendations should be firmly for five boats each carrying sixteen C4 MIRVed; ..." dated 23 October 1979. Signed Quinlan. DUS (P).

E59-1 p4-8

Record of meeting with the Americans.

9. Handling of allies and the Soviets, reference increase in warhead numbers carried by the successor system.
10. "We would explain to allies that the government had made clear its intention to maintain the effectiveness of strategic forces; that like Polaris the new system would be fully committed to NATO, that it constituted a unique European contribution to Alliance deterrence, and that the second centre of decision-taking which it provided complicated Soviet calculations. We would stress that our objective was to maintain an existing capability rather than create a new one, but the size and sophistication of the system was determined by the need to offset Soviet development in ABM etc, and to provide sufficient capability to last for a long lifespan. We would add that the system would not be coming into operation for another 10 years or so, and was therefore in a very different timescale from TNF; that the UK would maintain their efforts in the conventional field; and that the force would be of the minimum size to achieve the U.K.'s deterrent objectives, and that we would not expect it to be brought into the SALT negotiations."
11. "... ... A reduction in the UK system, which would already be of minimal size, would not be significant in overall SALT terms, and yet would radically undermine the value of the system to the UK."
12. "We proposed to make two points as necessary to the Soviets: by the 1990s MIRV capability would be common to most strategic systems and the possession by the UK of MIRV system would not give us a technological advantage in comparison with the Russians. We were looking for a minimum deterrent force appropriate to the strategic circumstances of the next 30 years. Secondly, we would make the point that the successor system did not involve a step-change in capability and that the successor force was very small in comparison with total Soviet strategic systems - some 3-4% of Soviet strategic systems or 6-7% of Soviet warheads. In 1970, UK Polaris had been 3-4% of Soviet systems and about 11% of Soviet warheads. There would therefore have to be very deep cuts indeed in SALT 3 before these relative proportions changed significantly. We would therefore argue that the British system is should be excluded on "de minimis" grounds."
13. The Americans in commenting said that "it had to be recognised that although modernised British force would be "de minimis" in strategic terms, it could be regarded as significant in theatre terms."

14. "Turning to warhead design information, Prof Mason said that the UK would need to decide in about mid-1980 between various warhead options under study and reflected in the UK test programme. A copy of the US W76 warhead was among these options. Before a decision could be made, it would be necessary to assess whether the UK could adequately replicate W76 production technology and, if so, whether tests of the British copy of the W76 would be necessary. We would therefore require design information on the W76."  
The Americans commented that ..."as regards the exchange of warhead design information, the US were prepared to help the UK with whatever vehicle we settle on together."
24. On LRTNF the British said: ...  
" the UK regarded the functions of a Polaris successor and LRTNF is quite distinct; we would not rule out the possibility that a strategic force of substantially larger targeting capability than Polaris might have some capacity to spare for LRTNF application, but this would not be likely to arise before the mid-1990s, and might never be more than a contingent option. He emphasised that when Ministers came to take decisions on the possibility of a UK LRTNF component, they would do so against the background of severe limitations in the UK's capacity to develop a warhead for GLCM; it might well not be possible for Aldermaston to do this in any timescale at all closely related to the current Alliance effort. If nevertheless the UK were to go ahead with a new LRTNF program, our studies pointed to a preference for GLCM. The UK would not see such an option as having any substantial bearing on the size of the strategic force."
25. "The UK also had the problem of modernising a series of air-carried weapons which were going out of service in the late 1980s and early 1990s. Prof Mason reaffirmed these remarks about capacity limitations; it was not at all clear that the UK could sustain more than one major warhead project over the next 6 years or so and it was believed that the strategic system would be given priority."

E64 p1

FUTURE OF THE UNITED KINGDOM NUCLEAR DETERRENT.  
CHOICE OF OPTIONS.

1. The enclosed report by a group under the chairmanship of Prof Mason analyses the factors affecting our choice of system to succeed Polaris.
2. The Polaris force will have to be replaced early in the 1990s. We cannot contemplate a purely in national development of successor. The strategic and political, as well as technical, factors point towards continuing cooperation with the Americans, rather than attempting a link with the French. American help would not contravene SALT 2.
3. We have to decide what we want a successor system to be able to do. To deter, it must be able to inflict what the Russians would regard as unacceptable damage. The report uses 4 alternative definitions (paragraph 4) of what this might be, against which to test candidates systems.

4. To ensure against a pre-emptive Soviet attack, there is no real alternative to our strategic deterrent be carried on nuclear-powered submarines.

#### Ballistic Missile Systems.

5. Of the 7 alternatives considered, some would not inflict any of the definitions of unacceptable damage, while others would require unique development programs with uncertain success. The most assured approach would be to move closely in line with planned American systems. The Trident 2 (D5) would exceed our needs at high cost. Trident 1 (C4) provides the right to capability and has a clear advantage over the rest. We cannot say, without further study, which of the others would be the best fall-back options. The C4 (MRV) would necessitate a new United Kingdom warhead development. A comprehensive test ban treaty code, therefore, pose problems.
6. The submarines to carry the missiles should at the same row and stern sections as our other nuclear submarines planned to be in service in the early 1990s. The Central missile section of the submarine could be that of the current American Poseidon submarines which can take missiles up to the size of C4.
7. Except for C4 costs are uncertain and depend heavily on the number of submarines judged to be needed. The report makes cautiously pessimistic assumptions about improvements in Russian anti-ballistic missile defences and anti-submarine warfare techniques, and these assumptions influence the arithmetic. With four submarines carrying C4 missiles (16 each), the cost over 20 years might total £7000M at today's prices. Even then, the most stringent damage criteria could not be met, and there would be no insurance margin to cover a boat being lost through accident or enemy action. The smallest fleet able to meet the most stringent damage criteria would be 5 boats carrying 16 C4 missiles each. The 20 year cost might be £8000M. To provide the insurance margin against losing one boat would require 8 votes of 16 C4 missiles at a cost of around £11,500M. Other likely candidates systems would, in the same number of books as C4, meet fewer, if any, of the damage criteria and cost more.

#### Cruise Missile Systems.

8. The only realistic approach would be to buy American, but they have no plans for a submarine launched cruise missile aimed at land targets. The development would, therefore be uniquely for the United Kingdom, and hence costly and uncertain. Compared with ballistic missiles, defence against cruise missiles is easier, cheaper and likely to be well within Russian capabilities by the 1990s. The report concludes that losses could be over 80%, so the number of missiles needed to be launched to satisfy the most stringent damage criteria is very high. Purpose-built submarines would be needed to carry those large numbers of missiles and even with the size of our present nuclear submarines, a fleet of 11 would be needed to meet even the least stringent damage criteria. 20 year costs might be £12,500M.

#### Resources.

9. All cost figures quoted are tentative and it is not possible to forecast the incidence of expenditure year by year. The peak, however, is likely to be around 1987-88 when, for 5 boat C4 system, the costs might be absorbing around 4½-5% of the Defence Budget.

Conclusions.

10. To provide a deterrent force safe from pre-emptive attack and able to disrupt the Soviet Governmental capability [REDACTED – retained under Section 3(4)] ... would require a prohibitively expensive cruise missile force. This damage criteria could be met by ballistic missiles if a Trident system were bought from the Americans. Trident 1 (C4) would need a force of five submarines each carrying 16 missiles and the total 20 year cost might be around £8000M. To provide an insurance against one boat being lost a total of 8 would be needed, costing around £11,500M. Other ballistic systems could not meet the damage criteria and would probably cost more than a C4 force. If the Americans refused to sell us C4, further work would be needed to decide which is the best fall-back option. Dated 24 October 1979.

E66 p2

DRAFT PAPER BY SECRETARY OF STATE @ MoD FOR MINISTERS.  
Polaris successor.

1. As a Government we have already made clear our commitment to maintaining the effectiveness of the UK's strategic deterrent. To do so, we shall need to replace the existing Polaris force in the early 1990s.
2. Whole paragraph redacted. Retained under Section 3(4).  
Handwritten note in the margin.  
"Also gives flexibility to hit targets of less critical importance?"
3. The report by the Secretary of the Cabinet sets out the options. We have already concluded that only a submarine-launched system offers the required invulnerability to pre-emptive attack. It is clear that the US Trident 1 (C4) missile with its Multiple Independently Targetable Re-entry Vehicle (MIRV) capability is the best missile for our needs. The vulnerability of sub-launched Cruise Missiles to air defence (and hence the large number required) makes them an unattractive alternative on both cost and operational grounds. Trident 2 offers more than we need at extra cost. C4 days, perhaps surprisingly, also the cheapest way of meeting the defence criteria, and also least risk of cost or time overrun; this mainly reflects the economy of purchasing a complete US system off-the-shelf (apart from warheads) thereby avoiding the need for a very costly and technically difficult UK development programme. Polaris experience behind us gives confidence.
4. As for numbers, I believe that we should plan to procure 5 SSBNs each with 16 missiles. This will provide some insurance against the loss of a submarine to improved Soviet anti-submarine warfare methods or in an accident; .....

Four lines redacted. Retained under Section 3(4).



In relation to the relatively small incremental cost - about 15% over four boats - we would obtain a substantial improvement in capability. This is also likely to reduce the need for expensive mid-life improvement programmes, like the Chevaline project for the current force, to counter possible improvements in Soviet defences.

5. We shall clearly face difficulties in accommodating the substantial cost of the successor force within the Defence budget, if we are not to reduce our spending on conventional and theatre capabilities significantly. There will also be serious resource problems in procuring and operating the force in the ship-building industry, in the Royal Navy, and particularly, in our nuclear establishments and dockyards where there are already grave shortages of skilled manpower. Special priority is needed, perhaps at the expense of some non-nuclear effort, and I may need to seek my colleagues agreement to exceptional measures. We cannot in any event planned now on carrying out more than one new project at a time. This one should plainly be the warhead for the new strategic force; theatre weapons must wait. We need not decide now about theatre policy, or close off options such as eventual acquisition of the UK GLCM force; we can review these later when we see how the resource picture develops. Nevertheless I am sure that we are right to continue to devote national and defence resources to strategic deterrent. It is the ultimate safeguard of our national interests and an especially valued contribution to NATO which only we of our European Allies can provide.
6. Accordingly I recommend that we approach the Americans with a view to procuring a 5 boat force of Trident C4 missiles, with MIRV, for introduction into service in the early 1990s. Presentation to our Allies (particularly the French) and the public will need careful handling, but there is no indication that we will face significant opposition. Indeed, I believe that the need for such a force is more widely recognised now than when we decided to procure Polaris in 1962.

E67 p1-6

Whole enclosure of six pages redacted. Retained under Section 3(4).

E68 p2

Suggested amendment to paragraph 3 above.

Delete:

“ It is clear that the US Trident 1 (C4) missile with it Multiple Independently Targetable Re-entry Vehicle (MIRV) capability is the best missile for our needs. The vulnerability of sub-launched Cruise Missiles to air defence (and hence the large number required) makes them an unattractive alternative on both cost and operational grounds. Trident 2 offers more than we need at extra cost. C4 days, perhaps surprisingly, also the cheapest way of meeting the defence criteria, and also least risk of cost or time overrun; this mainly reflects ...”

Substitute:

“ As to the weapon systems, the Cruise Missile is accurate but its ability to penetrate Soviet defences, of the scale and variety that might be deployed in the 1990s, is highly suspect. The very large numbers of Cruise Missiles we would have to deploy to allow for their vulnerability make them an unattractive option on both cost and operational grounds. Of the ballistic missiles, Trident 2 (D5) offers more than we need at high cost; while the ballistic options without Multipoint Independently-Targetable Re-entry Vehicles (MIRV) cannot threaten hardened bunkers, require large numbers of missiles to overcome

replacement for our air-delivered tactical warheads. The delivery systems for these can, unlike those for the strategic and LRTNF role, be maintained indefinitely without US support. In consequence, we see serious doubt about the UK's ability to undertake a cruise missile warhead programme in any operational acceptable timescale.

#### SUMMARY

10. In summary, the work that has been done since August reinforces our previous advice to you that a successor force consisting of 5 SSBNs, each with 16 Trident C4 MIRVed missiles, and entering service in the early 1990s, is the one best fitted to the UK's needs. It appears, moreover, that any arms control difficulties are manageable. Costs and resources remain the biggest problems, but given the will and commitment, and a steady and realistic growth in the defence budget, they should be surmountable.

Signed CDS  
dated 30 October 1979.

E77 p2-3

Redraft. THE SUCCESSOR TO POLARIS. NOTE BY SoS @ MoD.

1. The Secretary of the Cabinet's minute of 29 October explains the three key questions which will be before the Group on 5 November. This note seeks my colleagues agreement that the answers should be as follows.
2. First, we should, as we envisaged when we last discussed this, retain an independent British strategic deterrent. This is a vital safeguard of our national interests and a contribution to NATO which only we of the European members provide. No alternative application of the resources available would offer a comparable contribution to our security and that of our Allies.
3. Secondly, we can never be sure what is required to deter, but I believe that a force capable of threatening Soviet central government must have on any Soviet leadership and more certain effect than one that only threatens centres of population. Remainder of paragraph redacted. Retained under Section 3(4).
4. Thirdly, I consider that the US Trident (C4) missile, with its multiple-independently-targetable re-entry vehicle (MIRV) capability would best answer the operational requirement. Cruise missiles, because of their vulnerability to air defences are unattractive on operational and cost grounds, and the other options considered in the official's report are two marginal in capability [Redacted. Retained under Section 3(4)] against ABMs, and too sensitive to improvements in ASW for a force which must last us well into the next century. C4 is also cheaper than the alternatives, largely because, if we go for this, we would be buying a complete US system (apart from warheads) off-the-shelf, thus avoiding the need for development and subsequent logistics support, a re-entry system unique to the UK, with all the problems to which that could give rise. Nor would there be so much risk of development difficulties affecting the timescale of the project.

5. I recommend that we should plan to have 5 SSBNs each with 16 missiles, the fifth boat giving a major improvement in capability and insurance at a proportionately modest extra cost. If we had five boats we could keep two continuously at sea; this would be an insurance against improvements in Soviet ABMs and ASW, and would reduce the risk of our needing extensive midlife improvements.

Remainder of file deals only with arrangements for modifying shore facilities at RNAD Coulport, to comply with explosives safety distances.