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MISC 7(81)1
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CABINET
NUCLEAR DEFENCE POLICY

UNITED KINGDOM STRATEGIC DETERRENT
Memorandum by the Secretary of State for Defence

I enclose a memorandum on Trident. As a consequence of President Reagan's decision to cease the deployment of the US C4 system earlier than originally planned, it recommends that we proceed with a Trident II 4-boat D5 force costing some £5,900M (on the same basis as the publicly announced £5,000M C4 programme) which is equivalent to £7,500M up dated to September 1981 prices and to current exchange rates ($1.78 to the £1).

2. I do not seek to hide the problem which that price-tag brings. I have considered exhaustively again the other options contained in the original paper considered by MISC 7 in 1979. None of them in my view would provide a cheaper independent deterrent. A submarine launched cruise missile for example, which seems the most attractive, could not provide the necessary degree of assured deterrence and hence credibility. A land based system is still ruled out.

3. I have also considered more briefly two new options:

a. A 3-boat Trident D5 force, with the same striking power as a 4-boat C4 force, but accepting the risk that any interruption in the availability of one of the boats could put the continuous coverage of the deterrent at risk (para 20).

b. That we run on the existing Polaris submarines until the late 1990s but convert them to the C4 missile, saving substantial sums in the next few years by deferring the construction of the new submarines. Overall cost would

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however be higher, and running on the Polaris boats carries considerable technical risk (para 21).

4. My own conclusion is that Trident is overwhelmingly the best choice (and indeed the only credible strategic deterrent) for this country - and that the D5 system certainly will be cheaper up to 1987/88 and will probably be cheaper over its entire life than C4. Whilst the option of running on the existing submarines with the C4 missile might provide a fig leaf of a kind to cover a sea change in Conservative policy, I am inclined to the view that it would probably be better to get out of this business now altogether than go for a cheap second best solution with no assured and continuing credibility. The credibility of our existing Polaris force would also begin to be undermined by an apparent lack of resolve to accept a realistic replacement plan.

5. I attach at Annex A a chart showing the capital equipment costs of an independent strategic capability beside those of our other defence commitments over the next 15 years. It should be noted that the graph shows equipment costs only. If expenditure on manpower and other support costs were included, expenditure on capabilities other than the deterrent would be, relatively, much greater. Polaris (and Trident) are comparatively economical in terms of manpower and running costs.

6. I also attach at Annex B the estimated capital expenditure on a D5 4-boat force compared to the original estimated cost of the C4 force. The cost profile of the D5 option and the savings available in the immediate future by slipping the in-Service date to 1994 (see para 16) are particularly important. On this basis expenditure on Trident before the next election would possibly amount to less than £300M but, thereafter, we would be bearing the burden of the main Trident expenditure together with the existing costs of Polaris. I shall be presenting a separate paper shortly on our plans for providing the special nuclear materials (Plutonium, Tritium, Highly Enriched Uranium (HEU)) needed for the deterrent programme, including the requirement for HEU for fuelling nuclear submarines (project DESTINY). The Trident costs in the present paper assume procurement of these materials in the most economic way, including increased purchases from the United States.

7. In the midst of a recession with no economic growth, low confidence and an understandable preoccupation with our short term economic difficulties it would be all too easy to wash our hands of this commitment. Our predecessors in both major parties also had economic problems which seemed equally pressing to them but they have kept this country with an independent deterrent ever since the 1950s. So far the present Government has got a good story to tell in relation to our election commitments on defence. On an objective analysis of the threat it would be a startling moment to change this policy as the "window of vulnerability" opens wider in the mid 1980s; as Mitterand modernises his independent deterrent; and in the light of all our statements over the past 2½ years to the effect that our independent strategic deterrent is essential for the protection of this country and the maintenance of peace.

8. Would the Conservative Party forgive us - and more important would the nation do so - if the dangers of the world increase? By foregoing Trident we would be abandoning our stake in the only available technology likely to meet both the requirement of invulnerability and penetration up to 2020. There is no cheaper credible alternative, and it would make little sense to maintain all the expensive infrastructure of nuclear warhead development and production to maintain a nuclear capability at a lower level. To decide not to proceed with Trident would be in effect to opt out of the nuclear business. It is also probably inevitable that within our lifetime other smaller nations will acquire a nuclear capability. In the eyes of our allies, and of our enemies, we would seem quite a different nation (and the Conservative Party quite a different party).

9. Colleagues will recognise that this is an issue of tremendous national importance but also one of great technicality. To some extent it is complicated by targetting criteria and judgements about future ABM developments, which it is not possible to touch upon in this particular paper. But in the end - as with all things - it comes down to a simple political judgement. Should we abandon Great Britain's future independent strategic capability now?

10. The answer must surely be 'no', despite the substantial cost increase since our original announcement of about £1B over the original

£5B estimate. This has mainly come about because of the identification of some essential improvements in the new submarines and the choice of the D5 missile. The new price and exchange rate assumptions (the latter will of course change again) are a considerable embarrassment but I think the argument in favour of Trident is sustainable. Indeed we must sustain it.

11. Thus in my opinion we have no choice but to keep in this business and that is what I am asking my colleagues to agree to. If they do so it would greatly help me in presentation if, entirely subject to your views, our decision could be ratified by Cabinet in the normal way.

12. I invite colleagues:-

a. to agree that we should adopt the Trident II (D5) missile for our next generation strategic deterrent and that we should now start negotiations for its purchase with the Americans;

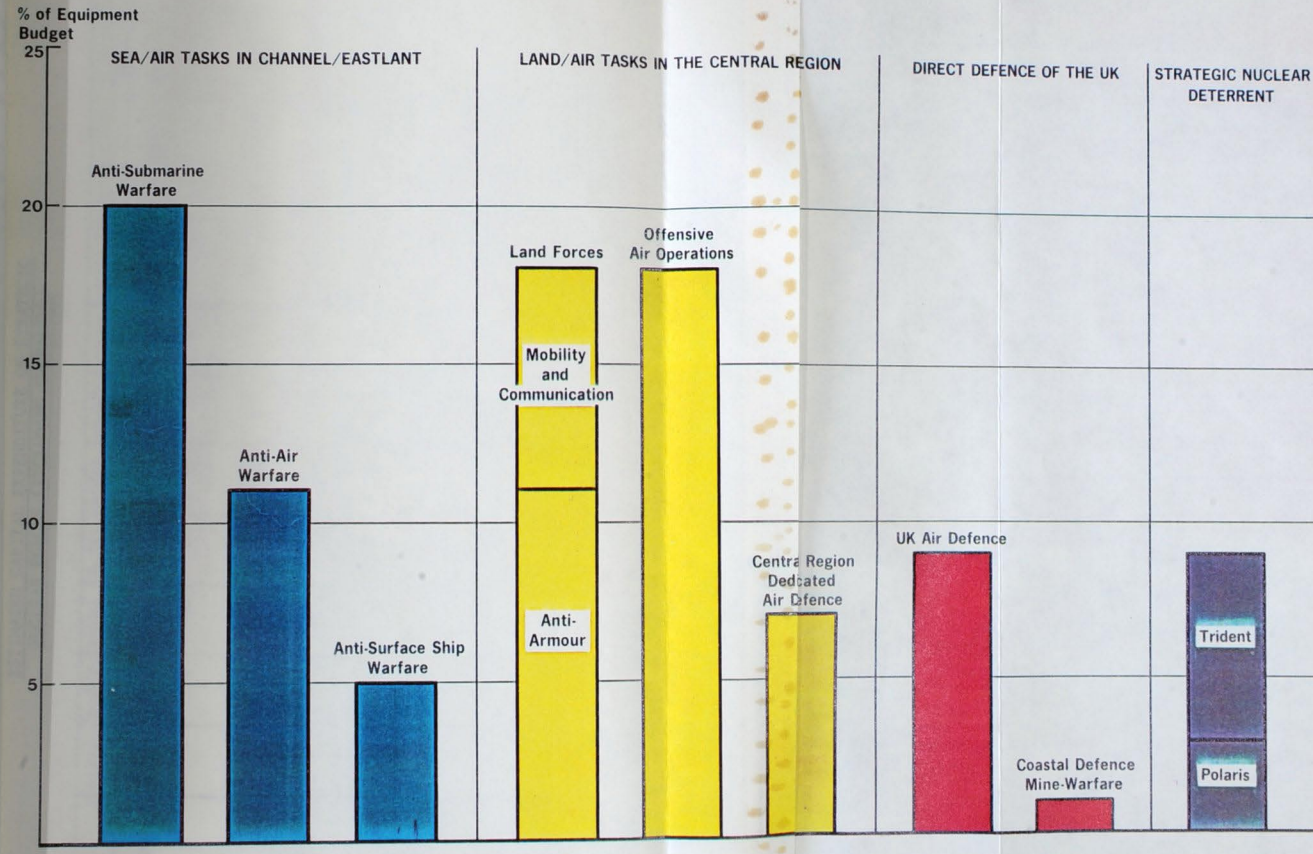
b. to agree that the Trident force should consist of four submarines based on the Ohio class hull with 16 missile tubes, improved tactical weapons and propulsion system and a planned In-Service date of 1994.

JN

Ministry of Defence

17th November 1981

DEFENCE EQUIPMENT EXPENDITURE 1980-1995



NOTE: The attributions to capabilities in this chart are based on expenditure on major equipment projects (those spending more than £70M) in the last Ministry of Defence Long Term Costing. They have been adjusted to take broad account of the effects of the recent Defence Review. Since, for example, equipment may have more than one role or be used in more than one area the attributions in this chart necessarily give only the broad orders of magnitude

[redacted]

ESTIMATED CAPITAL EXPENDITURE ON STRATEGIC NUCLEAR FORCES (EXCLUDING CHEVALINE)

	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	10 YEAR TOTAL	LATER YEARS	TOTAL
a. Defence Budget	9753	10051	10353	10663	10983	10983	10983	10983	10983	10983	106,718		
b. Polaris re-motoring	6	31	53	63	80	67	31	7	–	–	338	–	338
c. C4 four-boat force	64	165	279	413	550	805	903	767	676	645	5,267	1679	6946
d. D5 four-boat force	64	140	249	416	565	694	812	810	742	717	5,209	2311	7520
e. Cash flow adjustment of four-boat D5 force slipped to 1994		-34	-64	-157	-184	-105	-76	+14	+69	+47	-490	+490	
f, D5 four-boat force in-service 1994	64	106	185	259	381	589	736	824	811	764	4,719	2801	7520

Price base: September 1981
Exchange rate £1=$1.78
Figures in £M (VAT inclusive)

Notes: line a: defence budget at 1980 survey prices, as in published plans (Cmnd 8212).
line c: includes improved propulsion and tactical weapons and OHIO class centre section. First boat in service 1992.
line d: Assumes in-service date of 1993 for first D5 boat, with improved propulsion and tactical weapons fit and Ohio class submarine centre section.

ANNEX C
to MISC 7 (81)1

UNITED KINGDOM STRATEGIC DETERRENT

Background

1. The December 1979 decision to replace our existing Polaris fleet with a Trident force was taken on the basis of our adoption of the existing American Trident I (C4) missile to be carried in a new class of submarine based on the US 640 class which currently deploys their Poseidon and C4 missiles. Since that decision was taken, there have been three developments affecting our plans for the future of the UK strategic deterrent:

a. we have now completed the detailed technical and financial studies on the design of the submarine which were only possible after we had made public our decision to acquire Trident;

b. the US have announced their decision to proceed to full development of the Trident II (D5) missile for first deployment in their ballistic missile submarines in 1989. This means they will be ceasing their C4 deployment by 1998, much earlier than expected and this fact has large implications for our own Trident programme;

c. we are about to embark on a programme to remotor our Polaris missiles in order to preserve the credibility of our existing deterrent, and the cost involved has implications for our ability to fund the Trident programme.

2. These developments make it appropriate to review our plans for Trident - and even to consider once again whether there is any other system of lesser cost that would provide us with a credible independent capability.

The Submarine

3. At the time of the original decisions by MISC 7 it was not possible to reach a final judgement on the optimum submarine configuration until feasibility studies had been completed with the US. These studies have shown that the straightforward incorporation of the US 640-class missile compartment into our new submarines will not now be practicable as we had then assumed because much of its associated equipment will be out of production. We should have either to re-design the 640-class missile compartment to accept OHIO class equipment (from the bigger submarine designed to carry the D5 missile) or ourselves adopt an OHIO-class missile compartment.

4. There seems little doubt that even if we remained with C4 it would still make sense to opt for the larger diameter hull based on the OHIO class in order to retain the flexibility throughout the life of the submarine to switch, if necessary, to a later generation missile. It must be recognised that the introduction of these new and larger submarines involves an element of financial and technical risk; contingency allowances have been included in the costings to allow for this, but it is also relevant to note that our past nuclear submarine building programme has been achieved without significant real cost overruns.

5. So far as the remainder of the submarine design is concerned, in order to ensure that our replacement deterrent force remains fully effective into the 21st century, we should incorporate improvements in the submarine's main defensive system of sonars and other sensors - the "tactical weapons fit" (the original plan envisaged using the system currently at sea in our nuclear-powered fleet submarines (SSNs)). We should also adopt the new submarine propulsion plant which will be fitted to our future SSNs. A detailed note on these two aspects of submarine design is at Appendix 1. These improvements to the design of the submarine will give the force a longer operational life, greater availability (two boats at sea for 80% of the time) and a

significantly quieter operational performance, thus reducing the chances of detection. The cost implications are discussed below.

The Choice of Missile

6. President Reagan has offered to make the D5 missile available to us should we require it. The D5 missile will be much larger than the C4, and it could carry up to 14 independently targettable warheads with greater accuracy and with approximately the same range as C4 carrying 8 warheads each. A reduction in the number of warheads carried by D5 would give it a greater range than C4. On present assessments C4 would be sufficient for our deterrent needs but, since under revised US plans it will be retired from US service by 1998, there would at best be only 6 years of commonality. We would thus face the prospect almost from the outset of maintaining a unique system on our own for upwards of 20 years. A note on the logistic and other problems which such uniqueness poses is at Appendix 2.

7. The principal argument for moving to D5 now is to retain commonality with the US, and thereby avoid the penalties of uniqueness. Although it is difficult to produce reliable through-life costings over a period up to 2020 (when we can expect the Trident force to be nearing the end of its life), we have undertaken such costings of a variety of submarines and missile configurations. The results are summarised at Appendix 3. Briefly, the main conclusions to be drawn from the exercise are:

a. the possibility of having to undertake a mid-life UK-unique missile update makes options based on the "stretched" 640-class submarine very unattractive;

b. the larger support costs associated with UK-unique deployment of the C4 missile in the years beyond 1998 broadly balance the extra initial capital expenditure required to procure D5;

c. the discounted saving offered by a mid-life switch from C4 to D5 is not sufficient to outweigh the advantages in terms of avoidance of any lack of commonality, be it logistic or operational, which an initial purchase of D5 would provide. The mid-life switch is, of course, significantly more expensive in undiscounted terms.

8. Given the uncertainties attendant upon any through-life costing of this sort, and the potential for capital savings in a D5 programme rather than a C4, the results of this exercise do not call into question the wisdom of an initial purchase of D5: indeed, D5 in the long term is likely to prove the cheaper option.

The Number of Missile Tubes

9. Our current Polaris boats carry 16 missiles, and our original plan was that the replacement boats would carry 16 Trident C4 missiles. With one boat on patrol at all times, this would have given us at least 128 warheads continuously at sea. The ability of the D5 missile to carry up to 14 warheads means that much the same deterrent potential could be provided for example by reducing the number of tubes in the submarine to 12, and fitting 10 warheads to each missile. (A submarine design involving fewer than 12 tubes is not feasible). Such a reduction would save around £80M[1] in the capital cost of four submarines over the 15 year procurement period. However, with D5 we should be unlikely, initially at least, to want to fill all the tubes and the larger numbers of tubes will, with little impact on the total cost, give us flexibility to cope with the possibility of improved Soviet anti-ballistic missile defences.

Capital Costs including Support

10. The latest cost estimate for the C4 force originally considered by MISC 7, and the cost of an equivalent D5 force are compared below with the original December 1979 figure of £3900M for the "baseline" C4 force, and with the publicly announced cost

(1) Unless otherwise stated, all cost figures in this paper are at September 1981 prices, £1=$1.78.

of £4500M-£5000M. Comparisons are made at September 1980 prices, and at the exchange rate of $2.36 to £1 prevailing at that date.

£M	Estimates at price levels and exchange rates then prevailing	Estimates at September 1980 prices and $2.36 to £1
1. Original cost estimate presented to MISC 7 (4 boat, 16 tube, C4 force)	3900 (at September 1979 prices)	4521
2. Revised estimate in July 1980 and publicly announced. Increase due to re-assessment of costs and greater margin for contingency.	4500-5000 (at July 1980 prices)	4600-5125
3. Current estimate of baseline C4 force following detailed studies only possible after public announcement.		5102
4. Increment for adoption of minimum D5 force:		
a. Ohio hull section.		+220
b. D5 missile system and fewer missiles.		+391
5. Cost of basic D5 capability (3+4) equivalent to baseline C4 force.		5713

11. On the same price and exchange rate basis, the current estimate of £5102M for the baseline C4 force considered originally by MISC7 is within the publicly announced cost range. It represents an increase of 13% in real terms over the cost estimate considered by MISC 7. Whilst most unwelcome, it was almost inevitable given that the original estimate was based on the scant information gained during the extremely limited contacts we could make both with UK industry and with the US authorities in advance of our public announcement.

12. Until we undertake detailed discussions on D5 with the US authorities it is impossible to predict with precise accuracy what a UK D5 system would cost. But by making some broad assumptions about the likely relationship to existing C4 costs, it is estimated that a 4-boat D5 force equivalent to the baseline C4 force in striking power would cost about £5713M. The increase of £611M (about 12%) over the C4 programme is accounted for by the extra cost of the D5 strategic weapon system and of the missiles themselves (albeit that we should need fewer to provide the same striking power as a C4 force) and the larger OHIO hull needed to take the missiles. It also includes a relatively small nugatory spend on C4 ($50M).

13. Paras 3 to 5 above set out good reasons for moving from the original "baseline" configuration of the submarine. The improved propulsion plant and tactical weapons system in the basic D5 force would have the following effect on costs:

	Estimates at September 1980 prices and $2.36 to £1	
1. Cost of basic D5 force equivalent to C4 baseline force (16 tubes, only 12 filled).	5713	
2. Increment for adoption of improved propulsion system.		+165
3. Increment for adoption of improved tactical weapons fit.		+100
4. Capital cost of preferred D5 force (1+2+3).	5978	

The adoption of these improvements increases the cost of the basic D5 force by £265M to £5978M, some 5%. It is broadly in the range which we described to the HCDC and is less costly than more recent speculation. Taken back to July 1980 prices (the basis of the public announcement) this figure is £5900M.

14. But the problem is that in view of the significant initial capital costs arising in the US on both options, the estimates are very sensitive to exchange rate movements. On the preferred D5 programme, changing the basis of the estimates from $2.36 to £1 (the September 1980 rate) to $1.78 to £1 adds some £720M to the cost at September 1980 prices. When allowance is also made to bring the costs to September 1981 price levels, the total cost of the preferred D5 force (4 in para 13) becomes £7520M. A spread of these costs is at Annex B to the covering paper, but must be subject to further refinement.

15. Because of the substantial increases in the cost of the total programme we have considered a number of possible ways both to reduce the total cost and to ease the impact on the defence budget. Firstly we have examined the possibility of some delay in the date of introduction of the Trident force. Secondly we have considered various ways of achieving savings within the planned Trident programme itself. Thirdly we have reviewed the main alternatives to Trident that were considered and rejected by MISC 7 when the decision to opt for Trident was taken in 1979. These possibilities are summarised below.

Delaying the Trident Programme

16. It can be seen from Annex B to the covering paper that Trident will put considerable pressure on the defence budget in the years beyond 1985/86. The possibility of slipping the planned initial deployment of Trident from 1992/3 to 1994 has therefore been considered. It is impossible to define now exactly when the Polaris force will have to be phased out. There are complex operational and technical factors, some of them hard to predict. It is clear from our own and US experience that hull life can last beyond the 20 years originally envisaged; but it is not extensible indefinitely, and in any event the on-board equipment - propulsion machinery, missile support systems and the like - is ageing and posing an increasingly heavy maintenance

load, with a growing risk that refit periods may be so prolonged or unexpected defects at other times so serious that continuous patrol might be lost. The withdrawal of Polaris missiles from US service will make their support increasingly expensive and risky. Against this background our replacement force has been planned to begin entering service in 1992 although with D5 the earliest in-service date would be 1993. This is still the most economic course. But given the pressures on the defence budget it is now proposed to slip the in-service date of Trident to 1994 in order to ease the strains on the conventional programme. The change in cash flow which such a slip will produce is shown in Annex B - it throws up useful savings until 1988/9. There is no doubt that such slippage will increase the total cost of the programme as a whole, but this effect is not quantifiable at this stage. Slippage beyond 1994 is not attractive; apart from the increasing risks to the continuity and credibility of our deterrent, it would involve extra costly refits for our Polaris boats and the ordering of at least one additional SSN (costing £200M) in order to preserve our submarine-building capacity.

Potential Cost Savings in a D5 Programme

17. There are three major areas where cost savings may be possible with a D5 programme which could bring the cost significantly below £7520M. First, reductions in the capital costs and perhaps also the running cost of the force might be achieved by arranging for the processing and storage of our missiles in the United States instead of building a much expanded facility at Coulport in Scotland. The details of such a scheme have only been discussed with the Americans in broad terms up to now, but our preliminary in-house estimates are that the potential savings could be some £150-350M. Mr Weinberger has indicated willingness to help, and a study of this has been set in hand with the Americans, covering the operational and financial aspects. We shall also need to consider the potential political

problems in terms of the extent to which such a reliance might be used by critics to call into question the independence of our deterrent. But the D5 missile is expected to be extremely reliable which will give a long period between the occasions on which missiles will need to be removed from the SSBNs for processing. Even if we process D5 missiles in the US, this will not in practice reduce the independence of our SSBNs: once they are at sea they are wholly independent.

18. Secondly, although the cost figures for the D5 programme assume that we shall, in the first instance, fill 12 tubes in each boat with missiles carrying 10 warheads each, the precise numbers of missiles and warheads we shall require to provide adequate margins for maintenance, tests and trial firings will need further study, and there may be some scope for reducing expenditure in this area.

19. Thirdly, the attitude of this US Administration, and in particular their willingness to help us overcome some of the difficulties thrown up by the recent defence programme review, suggests that the re-negotiation of the Polaris Sales Agreement which will be necessary with a switch to D5 might result in the US being willing to take special steps to minimise the cost of the programme to us. Mr Weinberger has made several encouraging remarks in this respect. This could result in their agreement either to waive completely or at least to reduce such US Government charges to us as the R&D levy, which is currently estimated at some £80M, although we must not discount the possibility of an adverse reaction by the Congressional Committees to this. We shall be discussing this with the Americans.

Alternative Programmes

20. Three main alternatives to the proposed 4 boat Trident D5 programme, all of which were considered in 1979, have been re-examined. Firstly to limit the Trident force to three boats only. The detailed implications of this option are set out in Appendix 4. With the improved PWR 2 propulsion system the Trident submarines should have a significantly greater at-sea availability than the Polaris boats, and it would be theoretically possible to maintain one SSBN continuously on patrol out of a force of three. However this would provide no margin of insurance against accident or industrial unrest and would thus put at risk the fundamental requirement for our strategic deterrent of continuous readiness and invulnerability. Although this option would probably represent the next best solution to a 4-boat D5 force it still represents a very poor second choice and has therefore been rejected.

21. Secondly to run on the Polaris boats until the later 1990s, but to convert them to take C4 missiles around the end of this decade. The consequences are set out in Appendix 5. This would provide the greater deterrent capability of Trident at an earlier date than if installed in new submarines. Against this the effect would only be to defer the introduction of OHIO/D5; the total extra cost would eventually be some £1700M, although there would be significant deferment of cost over the next seven years. In addition to the extra cost the severe risks attached to this course make the earlier acquisition of C4 an unattractive option.

22. Thirdly the possibility of reverting to a solution other than a submarine-launched ballistic missile system. Various options for a possible land-based system were examined in 1979 and rejected principally on the grounds of vulnerability. These arguments still remain valid. Careful consideration was also given to various

possibilities of a submarine-launched cruise missile (SLCM) force, and these continue to attract some attention in public debate, particularly in view of the United States decision to develop a SLCM capability as part of their strategic reserve force. The possibility of equipping each of our existing hunter-killer submarines (SSNs) with a small number of cruise missiles has to be ruled out because, apart from the very limited striking power this would provide, such a role would be incompatible with the main task of the SSNs as an anti-submarine warfare (ASW) force. The alternative of building new submarines for a dedicated SLCM force was rejected in 1979 on technical, operational and cost grounds; these factors still remain valid. A detailed assessment of the SLCM option is at Appendix 6.

Implications for the Defence Budget

23. A key question, and one which will certainly arise when any public announcement is made, is whether we can afford Trident at the increased cost without having to pay an unacceptable penalty in terms of our planned conventional defence programme.

24. The defence programme is in a transitional phase following the outcome of this summer's defence review announced in Cmnd 8288. The main achievement of the review was to put the conventional programme on a lower profile from 1986 onwards (the figures given in Annex B to the main paper). The difficulties over the next few years of moving the defence budget on to its new path are considerable, and were fully explained to OD (OD(81)11th meeting). Subsequently Cabinet agreed to plan on 3% volume growth annually up to 1985/86 and agreed that there should be a realistic translation of the programme from volume into cash. This is under discussion by Ministers at present. Nevertheless even with full cash provision there will be serious pressure on the defence budget

in the next year or two before the changes, such as dockyard closures and greatly reduced Service and civilian manpower, have fully worked through into reduced costs. The cash flow on Trident in these early years is however not great, and D5 has the advantage of being less costly than C4 in this period, since we are no longer in the position of having to buy the missiles early before the US production lines close. The proposed slippage of the in-service date of D5 to 1994 also reduces the impact on the budget in these years (see Annex B).

25. The position is more problematical for the years after 1985/86 when D5 will be at a peak of expenditure (and absorbing over 15% of the new equipment money in the defence budget). When Cabinet discussed the defence budget in these later years in June it concluded that the Government could not commit itself to a view on whether further growth in the defence budget would be possible. The MOD planning assumption is, therefore, of no growth in this period. Whatever decision is taken on the strategic deterrent this budget assumption poses difficulties for the conventional defence programme since real cost growth from one generation of equipment to the next will almost certainly remain a major problem. The increase in cost in the Trident D5 proposal in these years is an additional factor - but it is only one of many. A sustained and determined effort will be required to keep down the costs of the conventional forces needed to meet our likely commitments within forecast resources. This will almost certainly mean a major reduction in the defence R&D effort and the purchase of more conventional equipment from the end of long US production runs. This will pose difficult political and industrial problems, but these will have to be faced whether or not the additional costs of D5 have to be accommodated.

Next Steps

26. Assuming MISC 7 agreement to the recommendations in the covering paper, it is for consideration whether the choice of D5 should be endorsed by the full Cabinet. We shall then have to enter into detailed negotiations with the Americans on the precise terms for the purchase of D5 and the necessary amendments to the Polaris Sales Agreement. However it should not be necessary to await the outcome of these discussions before making a statement to the House, although we should of course need to confirm with the Americans that they were content for such an announcement to be made. An early announcement would be helpful in two respects: it would enable us to give a full reply to the Defence Committee's Report on Strategic Nuclear Weapons Policy, and it would also put an end to the increasing speculation as to our intentions.

TRIDENT SUBMARINE: PROPULSION AND TACTICAL WEAPONS SYSTEMS

A. Propulsion

The propulsion system envisaged for the new class of SSBNs at the time of the original MISC 7 decision to replace Polaris with Trident was that which powers our hunter-killer submarines (SSNs) currently under construction. We have under development a new propulsion system - PWR2 - to power the next class of SSNs. This development programme is designed primarily to give longer reactor core life, reduced operating noise as compared with the current system, increased power and improved nuclear safety. The first two factors are particularly important for the maintenance of a continuous and invulnerable deterrent. The longer core life of PWR2 will provide a greater interval between refits, thereby offering the possibility of a reduction in the total number of refits and consequently a substantial reduction in through-life costs, while providing a significant increase in the operational availability of the boats. This last advantage should give two boats on patrol for about 80% of the time with a four-boat force, thus providing increased insurance against accident or loss as well as increased deterrent capability. The reduced noise will be very important in the context of possible Soviet anti-submarine warfare improvements during the life of the force. The PWR2 plant should also meet more stringent safety criteria which might be introduced in the future. The additional cost of fitting PWR2 to the force rather than the current system is £190M.

B. Tactical Weapon System

In order to meet the required standards of invulnerability to detection, the low noise of the propulsion system must be complemented by an effective sonar fit. The assumption made in the original presentation of the Trident programme to MISC 7 was that, as with the propulsion system, the tactical weapon system to be fitted to the new SSBNs should be that of our current SSNs. This system, with some modification, would be capable of meeting the threat of the 1990s but has very limited stretch potential and is likely to be inadequate by the end of the century, and, in particular, is based on technology which is 10 to 15 years old. By adopting improved bow-mounted sonars and towed arrays it will be possible to provide a significantly improved defensive capability for the submarines, and one which will have the potential for further improvement to counter increased Soviet capabilities during the life of the force. The increase in cost involved in adopting the advanced tactical weapon system is £110M over the four-boat force.

UNIQUENESS

1. The situation in which the UK continues to deploy a US designed weapon system after the US have themselves withdrawn it from service has come to be known as uniqueness.

2. The penalties resulting from uniqueness stem from two causes. The first is that of logistic support, where we increasingly have to make judgements without the benefit of detailed knowledge of the technology involved or of the design information. The second results, paradoxically, from the very high priority that the US give to their strategic nuclear forces. While we retain commonality we get all the benefits that accrue from that priority; when we become unique we only get such services which the Americans can fit into their programme and we can afford to pay for.

3. Age-related problems occur in Polaris and are bound to occur in Trident as in any other weapon system, but the wide range of technology involved means that they are numerous and varied. Their significance is exacerbated by the high reliability required from the strategic deterrence force - the system must be available for launch at notice for months at a time over a period exceeding a quarter of a century. No other weapon system has to meet such a demanding requirement.

4. So far as Polaris is concerned, no problem resulting from uniqueness has yet proved impossible of solution, but there is a long way to go and, on both sides of the Atlantic, those responsible are acutely aware that by 1994 we will be dealing with a system designed 40 years before, with the technology quite impossible of

reproduction and many of the vendors either out of business or with no interest in re-involvement in technology now obsolete. The imminence of US phase-out of Polaris has already reduced UK Polaris reliability and availability standards. The US have stopped their programme of operational test firings, and we cannot fund a replacement. It was missile motor failures shown up in the US programme which led directly to our decision to re-motor Polaris. It is because we are becoming unique that we have had to take that decision alone; we could otherwise have depended on the US need to maintain the reliability of its own inventory.

5. The US first deployed Trident I in 1979. If we were to purchase it with a view to deployment in 1992/5, we would be many years further behind their Trident programme than we were with Polaris. Trident I would be leaving US service at about the time our last boat was deployed. Operational test firings show the system is very reliable, so it should be able to last beyond the early 1990s in UK service even if unique. But its ability to last a further 25 years or so beyond that time must be questionable.

6. From our experience to date it must be assumed to be likely that Trident I would need to be remotored in the early 2000s. Furthermore, with the pace of modern technology it would seem to be imprudent to exclude the possibility of a need to improve Trident I in the 2000s to counter improved Soviet capabilities, eg to carry larger or more accurate warheads; or to provide manoeuvering Re-Entry vehicles. The cost and technical risk associated with such programmes to the UK, acting alone, is impossible to quantify so far ahead, but would be high by any standards.

THROUGH LIFE COSTS

Through life costs of Trident were examined, on a very broad order of cost basis, by a joint MOD/Treasury/PSA Working Group. Various submarine/missile configurations and programme options were studied. A 5% discount factor was applied to compare expenditure at present values.

2. The through-life costs of various 4-boat forces are summarised below:

£M

CONFIGURATION*/OPTION	TOTAL Ø	RANK	PRESENT VALUE	RANK
1. 16-tube OHIO submarine deploying D5 missiles in 12 out of 16 tubes	13567	3	7664	5
2. 12-tube OHIO submarine deploying the same number of D5 missiles as at 1.	13467	1	7618	4
3. 16-tube OHIO submarine deploying C4 missiles	13793	4	7337	2
3a 16-tube OHIO submarine deploying C4 missiles, but switching to D5 at mid-life	13894	5	7516	3
4. 16-tube 640 submarine deploying C4 missiles	13550	2	7211	1
4a 16-tube 640 submarine deploying C4 missiles, but with a mid-life UK-unique missile update	14926	6	7689	6

* PWR 2 propulsion and improved tactical weapon system assumed in each case.

Ø September 1981 prices and £1 = $1.78

3. The following conclusions are drawn:

a. the possibility of having to undertake a mid-life UK-unique missile update makes options based on a "stretched" 640 Class submarine (4. and 4a) very unattractive;

b. the heavier projected support costs associated with UK-unique deployment of the C4 missile broadly balance the extra initial capital expenditure required to procure D5;

c. the discounted saving offered by a mid-life switch from C4 to D5 is not sufficient to outweigh the advantages in terms of preservation of commonality, whether logistic or operational, which an initial purchase of D5 would provide. The mid-life switch is significantly more expensive in undiscounted terms, since two complete outfits of missiles would have to be purchased.

CONVERSION OF RESOLUTION CLASS SSBNs TO TAKE C4 MISSILES

We have considered ways in which the procurement of the OHIO/D5 missile system might be deferred to the late 1990s.

2. One option would be to extend the life of the RESOLUTION Class (R Class) submarines and the A3TK (Chevaline) system. By the early 1990s the ability of Chevaline to penetrate the expected Moscow defences would become doubtful, and its limited range, which reduces the sea room available to our submarines, would increase the risk of their detection by the steadily improving Russian ASW capabilities. Unless therefore we lower our deterrent criteria and go back on our publicly stated position, we must begin to replace Chevaline in the early 1990s ie in the current timescale envisaged for the introduction of a new SSBN and the Trident missile system.

3. Another post Chevaline option, with greater possibilities, would be to run on the RESOLUTION Class as long as possible but converted to take the C4 missile. This would meet our deterrent criteria until D5 was deployed later in the century.

4. The necessary conversion of the SSBNs could be done during an extended and demanding refit. The availability of US supply items would enable us to start conversions with either REPULSE (1984-86), RENOWN (1986-88) or REVENGE (1988-1990). REPULSE would require contracts to be placed in the US by January 1982. There are difficulties about converting either REPULSE or RENOWN first. We would need to purchase new C4 missiles, since the US would not have any available to release to us so early. The cost of these would not be offset even if, with some risk, we were to abandon our current plans to remotor

Polaris. There would also be problems in providing sufficient warheads for C4 while still meeting the requirement for Chevaline which would remain in service until 1991. In addition we could not provide the necessary missile processing and handling facilities in UK in time, even if the US were to provide some assistance which again would be unlikely in the timescale.

5. We would therefore have to consider starting the conversion programme in 1988-1990 with REVENGE. It would overcome the warhead problem; and offer the prospects both of processing the missile in the US, and acquiring surplus C4 missiles as the US commenced introduction of D5, currently planned to start in 1989 although the first surplus missiles would not be available until 1991 at the earliest. This would make it necessary to proceed with remotoring Polaris; and would necessitate giving at least two of the SSBNs a fourth refit. If nearer the time it became apparent that the US would not release surplus C4 missiles until significantly later, it would be necessary to delay the first conversion to RESOLUTION's refit in 1990-1992. This would delay the introduction of C4 to 1993, and the final withdrawal of Chevaline until 1996.

6. The period during which we could operate the R Class, backfitted with C4, would depend on how long the SSBNs could be kept running safety, and remain effective operationally. It is difficult to be categoric about the first. The boats, which are our first generation nuclear powered submarines, were designed for a 20 year life, and we are already planning to extend this to 25 years. Even now, at 13/14 years of age, the submarines experience demanding maintenance problems. These are likely to increase as the submarines run on into the 1990s, leading to extensive restorative work, and growing doubts about their safety and effectiveness. Extensions to refit times could also threaten the continuity of the deterrent.

7. The risk of detection of the SSBNs by Russian ASW forces will increase. Currently detection is very unlikely; by the 1990s, without the quieter systems and improved sonar fit proposed for the new class of SSBNs, the vulnerability to detection of the R-Class by improved Russian ASW forces would rise significantly, despite the extra sea room which C4 would give.

8. For these reasons and to avoid further costly and difficult refits, it is judged that if we were to back-fit C4 in the R-Class, the first replacement SSBN should enter service by the end of 1996 ie only some 2 years after the currently proposed date for the OHIO/D5 submarines. This would be the point at which the fourth R-Class submarine ended its fourth commission. This plan would involve running the submarines to between 27 and 30 years age. To delay the replacement SSBN until 2000, say, would require extending our existing submarines to between 30 and 33 years age ie as much as eight years beyond their already extended planned life despite the severe engineering and operational doubts which would be involved.

9. Deferring the construction of a replacement SSBN in this way would necessitate taking steps to maintain Vickers and certain key subcontractors. With an in-service date for the first replacement SSBN in 1996, this would set back the start of fabrication to 1987. It would then be necessary to substitute two SSN orders (SSN 20 and SSN 21 costing £200M each) to maintain our SSBN building capacity in that period.

10. Extension of the R-Class would also call for replanning the dockyard refit programme. The closure of Chatham has committed all remaining nuclear refitting capacity in the early 1990s. A further SSBN would need a fourth refit in 1992-1994, and the only way to accommodate this (since commercial yards are not currently equipped

to handle the nuclear aspects of the refit) would be to drop planned refits for two SSNs. These SSNs would therefore have to lie idle or, more probably, given the lack of spare refit capacity elsewhere, go for early disposal.

11. The cost of converting the RESOLUTION Class submarines to operate C4 would be some £1700M. The net effect, allowing for the deferment of the OHIO/D5 procurement would be to move significant expenditure (some £850M) out of the period up to 1987/88. After that the cost of procurement of the OHIO/D5 system would begin to bite; and extension of the R Class submarines and the acquisition of C4 would ultimately lead to a net increase in total expenditure. Compared with expenditure of about £7400M on OHIO/D5 over the next 15 years assuming an in-service date of 1995, after allowing for converting the R-Class submarines, acquiring surplus C4 missiles, and additional SSNs, we would expect to spend some £8700M.

THE SUBMARINE-LAUNCHED CRUISE MISSILE OPTION

It would be possible to equip our current hunter-killer nuclear powered submarines (SSNs) with cruise missiles. If all available SSNs were modified to carry 8 submarine-launched cruise missiles (SLCMs) between 60 and 80 missiles could be available on a quasi-continuous basis to pose the strategic deterrent threat. But our assessment is that if the Soviet Union were to deploy large numbers of surface-to-air missiles, fighters with the ability to shoot down cruise missiles, and airborne early warning (all of which are within their capability by 1990) a cruise missile force might suffer losses of over 80%. A SLCM force would therefore fall significantly short of the minimum assessed deterrent criteria.

2. There would also be other major disadvantages in such a force. In order to achieve the required accuracy of landfall the SLCM should be launched not more than 1100nm from the coast. The limited effective range of the missiles (a maximum of 2000nm) would also reduce the available sea-room from which they could be launched. These considerations would make the submarines of a SLCM force much more vulnerable to Soviet ASW defences than are SSBNs with their much larger area of operation, and would effectively mean that our SSN force could not undertake its own primary task of ASW throughout the Eastern Atlantic and Channel. Command and control arrangements for a SLCM force would be exceedingly complicated, and the force would be dependent throughout its life on the availability of US intelligence information for flight planning and navigation purposes. For these

reasons, a SLCM force based upon our existing SSNs could not provide a credible strategic deterrent.

3. In the light of the recent US decision to produce nuclear SLCMs for their own Navy as part of the strategic reserve, we have also considered again whether a UK SLCM force based upon dedicated cruise missile carrying submarines would be a realistic alternative to an SSBN force. Because of the vulnerability of the missiles in flight, we assess that we should require to deploy continuously more than 400 SLCMs in order to meet the least demanding deterrent criterion. To provide such a capability would require a force of at least 11 boats, which would make the programme significantly more expensive than Trident, while providing a lesser deterrent capability.