

Ref 24-2122

E10

SECRET U.K. EYES A

From: DIRECTOR PROJECT TEAM (COMARINS) HR S A T WARREN

MINISTRY OF DEFENCE

Foxhill, Bath, BA11 5AB

Telephone: Bath 6911, ext. 2467

ORC

1356A
707

Our reference: D/S/DPT/PT1/56/79
Your reference:

4 April 1979

15/6/14 ✓

CPE

UK SSBN PROGRAMME - SUCCESSOR SYSTEMS

The paper you requested on the task of converting UK SSBN's to carry TRIDENT I (C4) missiles is attached. Our conclusion is that the option, if one exists, is not worth pursuing.

2. A limited number of copies has been retained in DPT, it being assumed you will circulate your copy to other authorities as required.

S A T Warren

S A T WARREN
DPT(S/M)

1 Enc

SECRET
-6 APR 1979
D1010/79

Internal copies to: P10, P11, P15

SHIP DEPARTMENT
BLOCK C
ADMIN. OFFICE
17c/1 4/4

SECRET U.K. EYES A

SECRET - UK EYES A
~~SECRET~~

D/S/10/102/01/1300

UK SSBN PROGRAMME - SUCCESSOR SYSTEMS

Reference A DPT10 memo 368/02/DPT10 dated 26 July 1971
 B PT1 memo DPT/RJD/482/71 dated 7 September 1971
 C PT1 memo PEH/ADM 12.1 dated 5 December 1972

1. This paper examines the problems involved in converting UK SSBN's to carry TRIDENT I (C4) missiles.

2. USN Conversion to C3/C4

All 31 submarines of the 616/640 classes have been converted to POSEIDON (C3). The conversion programme was completed in 1977. The USN plans to backfit C4 missiles to 12 of these submarines (627, 629, 630, 632, 633, 634, 640, 641, 643, 655, 657 and 658). The UK conversion direct from POLARIS (A3) or perhaps A3TK, will, therefore, be unique.

3. C3 conversion of the 616/640 class submarines was accomplished during overhaul with a considerable variation of timescale, minimum being about 14 months and the maximum 29 months.

4. The conversion from C3 to C4 would appear far simpler in that it can apparently be accomplished during a "Tender Availability" - presumably a period of about 12 weeks. The first submarine to complete the conversion to C4 will be SSBN 657, FRANCIS SCOTT KEY in October 1979. The last submarine to undergo conversion will be SSBN 634, completing January 1982. C4 will be deployed from January 1981 (most of the 12 submarines to be converted to C4 will be put on an extended overhaul period of 9 years. This will allow the USN to deploy 10 at any time).

5. Previous UK Studies of Conversion to C3

References A, B and C outline and discuss the engineering changes involved in converting UK SSBN's from A3 to C3. Programming timescales and cost of the conversion is also discussed but these aspects are, of course, now no longer relevant.

6. Summary of Major Sub-System Changes in Converting from A3 to C4a. Navigation

In the change from A3 to C3 a new central computer system replaces the existing NAVDAC's and BRN computer, SINS is updated from MOD3 to MOD6 and BRN(5) replaces LORAN(C). The time/frequency standard is also changed to a caesium beam standard. These changes will all be incorporated in the "New Navigation A & A" to be implemented at REVENGE's second refit and at the third refit of RESOLUTION, REPULSE and RENOWN.

In changing from C3 to C4 the USN additionally install ESCM (Electro Static Gyro Monitor) and the NAV centre equipment ventilation system is changed from open to closed loop. These changes are not essential to support C4 and probably would not be incorporated in UK SSBN's. With the

-6 APR 1979
D1010/79

SECRET

SHIP DEPARTMENT

SECRET - UK EYES A

UK EYES A C
ADMIRALTY OFFICE
107/25 3/28

SECRET

U.K. EYES A

installation of C4 fire control equipment the current UK unique 10K/C amplifiers in the NAV centre can be removed.

b. Fire Control

The current Mk 84 equipment will need to be removed and replaced by the Mk 98 system. This apparently involves a complete rip out of the MCC including ship's wiring. Besides rewiring, new seatings and minor structure work will be involved in the rebuild. It is probable that additional ventilation will be required for the Mk 98 fire control equipment. In the change from A3 (Mk 84) to C3 (Mk 88) fire control equipment, the total air flow requirement increased from 6400 to 8400 cfm and this necessitated a complete rip out of the MCC fan room, the fit of new larger capacity fans and cooling coils. (It is just possible that the C4 (Mk 98) fire control equipment is less demanding on ventilation - this will need to be confirmed). If the ventilation increase is needed this could lead to loss of three bunks in the adjoining accommodation space and the consequent need to revise other accommodation areas.

c. Launcher

C3 and C4 missiles are 74" in diameter compared with A3 which is 54" in diameter. In backfitting C3 it was, consequently, necessary to completely remove the launcher tubes assembly and replace it with a new single skin liner held in place by a new high density grout material. The new liner is supported at the top and this requires machining of the monel ring forming the upper end of the mount tube (EB devised a special milling machine to accomplish this machining). It was also necessary to machine out the Lower Retaining Ring to a larger diameter to act as a locator for the new liner. The existing lock outs and liquid springs are removed and replaced by 10 new design liquid springs. Eleven existing A3 mount tube penetrations are blanked off in converting to C3. Additional penetrations are required for C3 covering the optical windows (19" above A3 windows), 3 new vent valves and modified umbilical housings. The umbilical housings, two per missile tube, are 2" thick HY80 castings which protrude significantly from the mount tube. Two modifications to the missile hatch were incorporated in the A3/C3 change. The hatch canning and plastic foam is modified to provide additional space for the larger missile and the hatch arms and links were strengthened to withstand the greater missile launch force. The access door interlock shafting was also modified to clear the new umbilical housings. A larger gas generator is fitted. TRMPS is replaced by TMPS. The TMPS are situated outboard of the tubes (TRMPS are between tubes), causing problems with ship-side stowage lockers. 16 new missile JB's are

SECRET

U.K. EYES A

SECRET - UK EYES A

connectorised. Larger terminal boxes are fitted. MPRE 6 and 7 is replaced by new missile test equipment.

It is judged that the majority of the A3/C3 changes to the launcher subsystem are necessary for C4 since it is known that conversion from C3 to C4 involves only minor changes outside of the MCC fire control.

d. Alignment

The A3 trolley alignment system is removed and replaced by a fixed optical system in the conversion to C3. This system is apparently used for C4 also.

e. Missile Gas System

In converting from A3 to C3 valves MG183, MG181 and MG230 are replaced by new design valves. Valves MG106, MG97 and MG172 are removed MG107 is relocated. Changes are made to valve controls and there are some pipework modifications also. These changes will undoubtedly be essential for C4.

f. Missile Hydraulics

The hold down and lock out system is completely removed during the A3 to C3 conversion. No additional hydraulic supplies would appear necessary for C4.

g. Missile Heating and Cooling

Two larger capacity heat exchangers are fitted in AMR1 during the A3/C3 conversion. Four additional 3-way proportioning valves are fitted. Two extra areas of heating/cooling coils are fitted to each missile tube and the system is extended to the gas generators. Water flow is increased by change of pump impeller. Control air piping, switches and cabling is extensively modified.

h. TI

The M10 TI currently fitted in UK SSEN's will, with minor modifications probably be adequate for C4 (it is rumoured that in back fitted C4 SSEN's TI will remain permanently installed. If this is confirmed and UK follow this practice, we would need to purchase two additional sets of M10 TI and would consequently lose considerable patrol stowage space in the MC). The TI mast for C3, presumably also C4, is different from that for A3 and may prove difficult to fit in UK SSEN's.

i. Missile Compensation and Hovering Systems

The C4 missile is considerably heavier than A3 and this would require a reduction in the permanent ballast carried in the SSEN. Compensating for weight change on missile firing is likely to be easier - less compensation required. The present hover system will probably prove capable of dealing with a C4 launch but in that the impulsive launch loads are greater than in A3 this would require a detailed examination.

SECRET

U.K. EYES A

SECRET - UK EYES A

SECRET - UK EYES A

7. Support Facilities for C4a. IEPS

On the assumption that simultaneous A3T/A3TK and C4 training will be required for the duration of the change-over to C4, previous studies have all concluded that a purpose-built extension of the IEPS would be required to house the C4 weapons training equipment. Navigation equipment will have already been updated to C3 and would require only minor alteration. Based on 1971 estimates for C3 equipment to be delivered in 1974, the order of cost for the equipments considered necessary for C4 training, including programme co-ordination and design, and spares would be £13M at 1973 prices. A building extension of approximately 7,000 sq. ft. would also be required, the cost of this is estimated at £5M.

b. Armament Depot

C4 cannot be accommodated and processed in the present missile depot at Coulport, and the necessary extension of facilities on that site is not possible within explosive regulations. To meet such regulations a new missile depot would have to be provided in a "green field site" elsewhere. The construction programme is unlikely to complete in less than seven years or cost less than £300 M.

c. Module Repair and Calibration Facilities

No building extension is necessary but extensive re-equipping with new test sets would be required. The cost for this is estimated at £1M.

d. Mechanical Equipment Re-furbishment Facility.

It is unlikely that re-furbishment of C4 launch tubes will be required. Consequently, no extension of this facility is foreseen.

It is possible that there would be a cost saving in this area.

e. Bay 23 Rosyth

Minor equipment changes will be required here at minimal cost.

8. Procurement of US C4 Equipment

The majority of the US equipment necessary to convert to C4 is likely to be difficult to procure since the majority of changes necessary to support C4 were incorporated in US SSBN's during the A3/C3 conversion and hence the equipment is no longer in production. It is possible that some C4 equipment will be identical to that being fitted in the OHIO class currently under construction - this will not apply to launcher equipment however. Additionally, a few items of equipment may be purchasable by addition to current US orders involved in the C4 conversion programme now under way. This, however, would require a quick UK decision on C4 since the current US conversion programme completes in 1982.

SECRET - UK EYES A

SECRET

TOP SECRET

CSA/74/79

CN of copies

Page 2 of 3 pages

QUESTIONS

1. General

In the event of the system(s) (hardware, software, support etc) being made available:

- (1) Would the terms and conditions be similar to those of the PSA; would the 1958 Agreement be continued indefinitely?
- (2) What political conditions would be attached (eg support of NATO, national independence)?
- (3) What could the envisaged timescale be for negotiation, agreement, transfer of information, transfer of hardware and first operational system?
- (4) What would be the rate of availability of the latest 'buy time' and phasing of payment?
- (5) What would be the financial basis (eg contribution to R&D; cost of information; cost of hardware; cost of continuing support)?
- (6) What help for or restrictions on the design of the boats would be required, available, imposed?

2. Missile system

The main possibilities being C4 and A4:

- (1) What are the main missile characteristics - size, weight, range (max and min), accuracy, reliability?
- (2) What additional/different base facilities are required - buildings, ground handling, assembly, test, instrumentation?
- (3) What plans exist for successor(s) for C4/D5; the timescales and costs; the US balance of procurement over the target 10 years or so between C4/D5?

Front End

- (4) Would a MIRV system be available in event of C4 procurement and would the system be compatible with non-MIRVED REB's?
- (5) How many REBs and would they be made available?

TOP SECRET

TOP SECRET

Page 3 of 3 pages

3. Submarine System(s)

(1) If we wished to fit the new system into existing boats, what would be the scale of conversion from A3?

(2) If we decided to order a new build:

(a) What would be the optimum size, capability of new boats (how many missiles etc)?

(b) What design assistance, at least for the missile compartment and missile support system, would be available?

TOP SECRET

U.K. EYES A

9. Re-Entry System (RES)

The time to first deployment of C4 in UK SSBN's would be heavily dependent on whether the US re-entry system is included in the sales agreement. The time required to develop a UK RES to fit C4, from commencement of feasibility studies to the early production stage, is unlikely to be less than 8 years.

10. Conversion Programme Timescale

From the time the UK decides to pursue a C4 conversion programme and US agreement is given, it would probably take a minimum of six months to establish "Shopping Lists" and, in view of the procurement difficulties noted above, a further 3/4 years to take delivery of the first boat set of equipment. Hence, if equipment procurement were the only limiting factor, the earliest time to start conversion is about 4 years from a decision to proceed.

Assuming this decision is taken in 1980 then the earliest possible conversion would be RENOWN at 3rd refit 1985/86.

If a new armament depot is necessary to assemble and store the C4 missiles and the construction time is of order 7 years, the earliest possible conversion would be REVENGE at 3rd refit 1986/88, assuming again, the decision to proceed with C4 is taken in 1980.

If a UK RES is developed, starting in 1980, the earliest possible conversion would again be REVENGE at 3rd refit.

11. Refit

The work content involved in the conversion from A3 to C4 is, having considered references A, B and C, judged to be about the same order as that from A3 to C3. In the latter case the US conversion timescales, as previously stated, varied from 14 - 29 months - presumably this variation was caused primarily by conflicting pressures within the shipyards involved. The additional work accomplished during the C3 conversion overhauls is not known, so the US timescale for these overhauls cannot be used sensibly for UK planning. A planning figure of 60,000 man days of effort has, however, been quoted by the US for the A3/C3 conversion. If significant additional resources are not available at Rosyth in the medium term, the presently planned 3rd refit time of 20 months will need to be extended pro rata - this gives a conversion refit time minimum of 24 months. Annex A indicates the present refit and proposed conversion refit programmes based on single stream refitting at Rosyth commencing conversion with either RENOWN or REVENGE 3rd refits. The use of a single stream at Rosyth dockyard is not attractive since the overall timescale of the conversion programme would be about 8 years.

The only way of reducing the overall programme timescale would appear to be part double streaming (large overlaps) at Rosyth and this would inevitably mean taking other work out of the Yard's programme, reinforcement from Southern Yards and a reduction of SSBN availability.

SECRET

SECRET - UK EYES A

12. Cost of Conversion of UK SSBN's to C4

In September 1971 the cost of US equipment to convert the 4 UK SSBN's from A3 to C4 was assessed (Reference B) at £46.5M. Assuming the C4 fire control equipment, would, by virtue of more advanced technology, cost more than the C3 equipment, this figure will be increased by 30 per cent. Additionally, allowing for the US cost escalation from September 1971 to September 1978 of 65 per cent., this gives a current figure of £100M.

The current dockyard costs additional to a normal refit, based on 12,000 man weeks at £600 per week gives £7.2M per submarine; for all 4 boats plus a small margin for HQ costs, the figure is, say, £30M.

A total of 100 missiles will be required comprising tactical, DASO and AIM configurations. The cost of a C4 missile, less the re-entry system is of order £5M. Hence the total cost for missiles, excluding RES's and any necessary flight proving trials needed if a UK RES is developed, is of order £500M.

Hence the total cost of conversion of the 4 submarines, the supply of missiles and support facility costs is of order £950M. (Note: this cost does not include REB's).

930

13. Technical Support and Planning of Conversion

A mixed discipline, dedicated, DPT Lead Project Team, total about 40, would be required to establish and obtain all relevant US technical documentation and drawings and to plan and monitor equipment procurement. There would undoubtedly be a need to undertake a significant amount of new drawing work and generally to re-draft and interpret US information to make it suitable for Rosyth Dockyard.

A small team, total about 5, would also be required in the US, possibly resident at Electric Boat Groton, to act as a direct link between the US authorities and the DPT Project Team. Design Staff in DPT are all fully committed now and in the medium term hence if additional staff were unavailable for the above tasks they would have to be diverted from other work.

A planning and scheduling team would be required at Rosyth Dockyard. The majority of new drawing work, should, ideally, be undertaken by the Design Division Rosyth but the Division is presently heavily committed and if additional staff are unavailable it might be necessary to sub-contract drawing work.

A dedicated Weapon Group team of approximately 15 would be needed during the initial 6 month "shopping list" period. Subsequently the in-house MOD effort would need to

be built up to 50 engineers/PTO grades during the period of commissioning the RNPS, RNAD and first SSBN of which some 15 could probably be released from the A3T and A3TK programmes. UK contractual support during this phase would need to be enhanced by about 40. These numbers might need to be doubled if US support is limited and a conflict of manpower resources is likely over the period 1981 - 84.

There would also need to be increased representation in the US at SPRN and LMSC. US Weapon equipment contractors representatives would be required at the RNPS, RNAD and Rosyth.

14. Summary

- a. Conversion of the UKSSBNs to carry C4 is technically feasible.
- b. Conversion must be undertaken concurrent with a refit, the currently planned 20 month refit would be extended to a minimum of 24 months.
- c. Conversion time for the SSBN force could be shortened either by accepting overlap between refits or by reducing the refit time. Both these proposals would demand significant increase to SSBN refit resources which could only be provided at the expense of other programmes.
- d. Additional staff will be required to man the DPT Project Team and in the Design Division Rosyth if current tasks are not reduced.
- e. US equipment necessary to undertake C4 conversion is not likely to be readily available. Additional costs and delay may be involved over those assumed in this paper since the US programme completed in 1977.
- f. The time required to construct a new armament depot and/or the time required to develop a UK RES would appear to determine the start date for the conversion programme.
- g. The most likely conversion start would be REVENGE at 3rd refit. If the conversion programme is based on a single stream at Rosyth it would not complete until 1994, which is the current planned date for the SSBN force to phase out. Even if additional resources were made available at Rosyth and part double streaming adopted, the reduction in overall conversion programme time is unlikely to leave the SSBN force with a significantly useful life when completed. (The practicality and degree of overlap possible in part double streaming would need to be carefully examined with the Naval Staff to ensure adequate deployment

SECRET - UK EYES A

U.K. EYES A

of the deterrent was maintained).

- h. The all up cost, excluding REBs is of the order of £950M.
930

15. Conclusions

Even if a decision was taken to convert the UK SSBNs to C4 as early as 1980 the most realistic start date for the conversion programme would be 1986, with the first submarine operational in 1989.

The effective deployment time of the 4 submarine converted force would only be 2 or 3 years based on the currently planned phase out date of 1994 even if some compression of the overall conversion time scale is possible. This in DPT's judgment is an overriding reason for not pursuing a C4 conversion programme, at a cost of £950M excluding REBs.

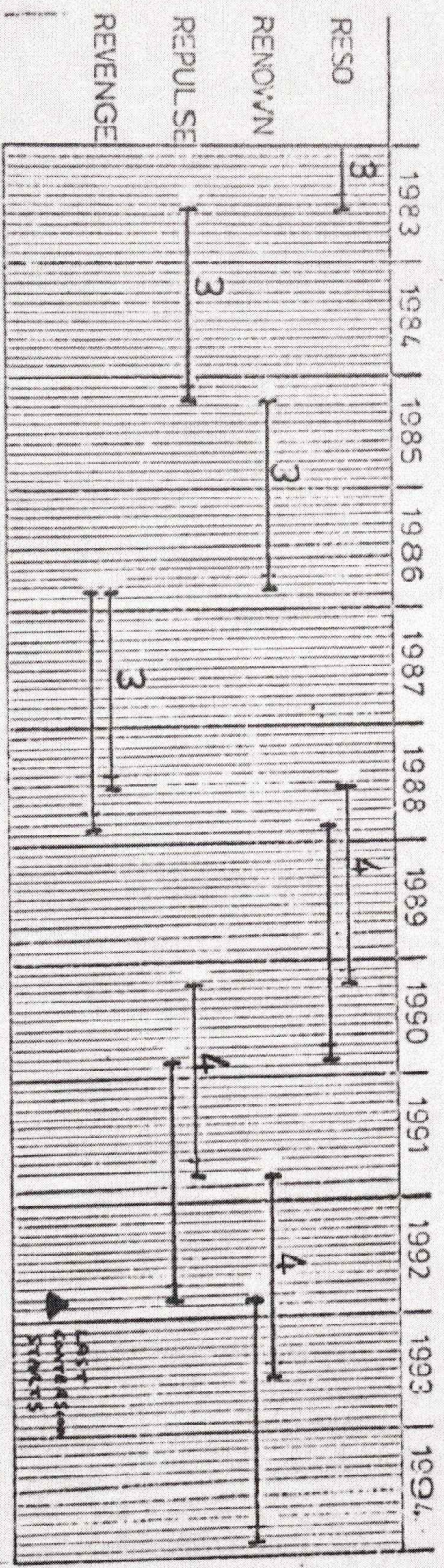
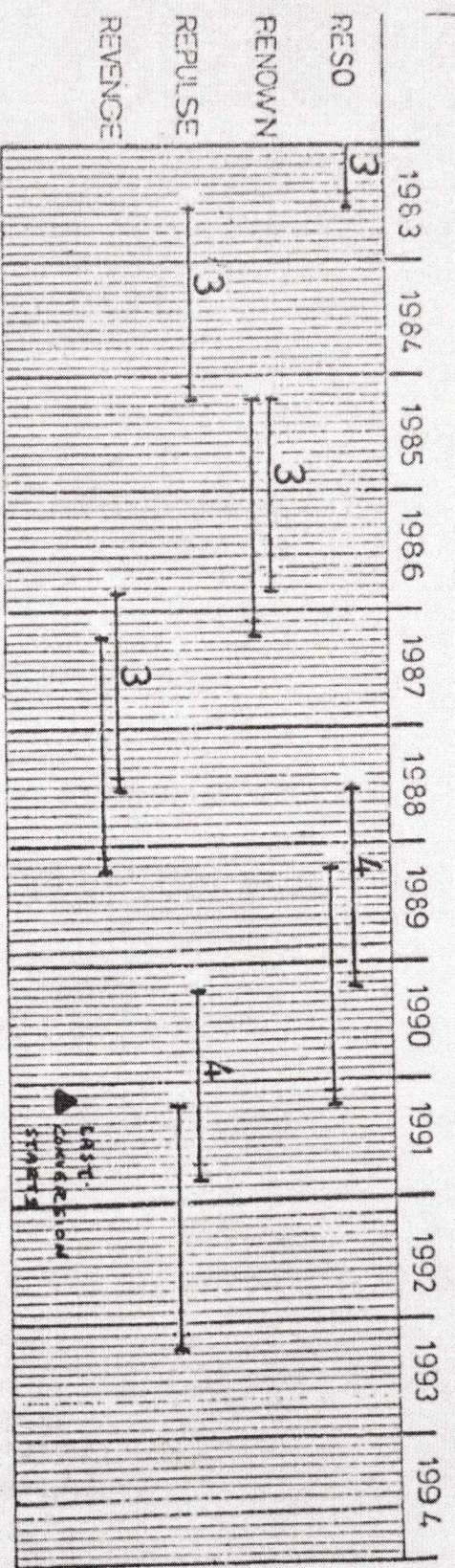
4 Apr 79

8

U.K. EYES A

SECRET - UK EYES A

CONFIDENTIAL
 S.SBN REFIT SCHEDULE. CONFIDENTIAL ANNEX A



CONFIDENTIAL

Covering TOP SECRET AND PERSONAL

E11.

D/S:12/5/6/6/4/D



OFC

DFA (P)

Future of the Deterat: Brief for a new Government

1. I have been asked to consult you about the factual accuracy of Sir Clive Rose's attached brief and a draft reply for Dus(P) to send to Sir Clive Rose. My apologies that this is in manuscript.

2. Particular points which might concern you are:

a. The accuracy of para 4, on Chevaline costs, including Dus(P)'s amendments;

b. The substitution of "submerged advance" for "survivability" in para 6;

c. Hansford's letter - para 3(b) on Chevaline funding

d. Para 3 of the draft reply on the likely resource implications of a new system (see also para 3(d) of Hansford's letter).

3. I would be most grateful if you could look at this as soon as possible, and not later than 11-00 a.m. tomorrow.
Many thanks.

12.4.79

Colin Jennings DS12
Room 7353 x 7672

SECRET PERSONAL

E12

DFA(P) 46/79

oFC
15/6/6/4/1
✓

DS12 (Mr Jennings)

BRIEF FOR NEW GOVERNMENT

Thank you.

2. I suggest amending para 4 to read as follows:

"Chevaline is a project unique to the UK (though using US firms as well as British) and involves new and advanced technology. The cost escalated considerably during the earlier stages of Development but seems now relatively stable barring major programme setbacks. The total cost is estimated to be £935 million, of which some 75% has already been spent or committed. The Labour Government in January 1979 approved funding to completion, subject to a progress report in January 1980, or earlier if further significant cost increases were to occur."

3. Delete penultimate sentence of para 6 and substitute:

"The general conclusion is therefore that it should be possible to maintain the present force in operation into the 1990s, albeit at increasing cost, but that it will be impracticable, for a number of reasons, to run on the force beyond the mid 1990s; these reasons include the increasing unreliability of an ageing force, an accumulation of major technical problems, and the unlikelihood that a force built to 1960s technology will prove operationally viable in the environment of the late 1990s."

4. In Annex, para 5, line 4, delete:

"much nearer".

J. F. Howe

J F HOWE
DFA(P)
20 April 1979

SECRET PERSONAL

major redrafting could lead to a demand for a re-examination of the whole Report. In principle I would suggest that amendments should be limited to updating any of the technical information quoted. This is primarily a matter for CSA, but I understand that the sections on cruise missiles were based largely on some very preliminary work at DOAE (see para 10). My reading of the HLG papers suggests that this work is now at a much more advanced stage, and consideration should perhaps be given at least to updating the discussion on CM penetrativity (see paras 9-10, 20 and 28). Finally one minor editorial point: I suggest that a slight redraft of the last part of paragraph 1 of Part III (particularly the sentence beginning "The Terms of Reference") would be appropriate.

2. If we decide to make any changes should we consult the FCO in case they intend to show the papers to their new Ministers?

J M Legge

25 April 1979

J M LEGGE
DS12
MB 8326 3041 MB

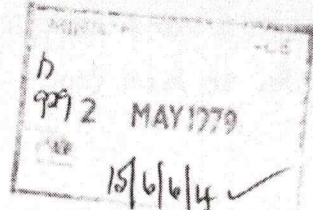
TOP SECRET

TOP SECRET

PERSONAL AND SECRET



DUS(P)



DUS(P) 255/79

OFC

DS 12 (Mr Legge)

Copy to:
AUS(D Staff)

FUTURE OF THE BRITISH DETERRENT

Many thanks for your minute D/DS 12/15/6/6/4 of 25 April. I think that on balance the points you identify are few enough and minor enough to be lived with even if there is a change of Government - we should have to make it clear to Conservative Ministers (e.g. because of the developments in CM information) that the reports were now slightly dated, and given this the presence of a couple of passages which plainly reflect that they were written under a Labour Government does not seem objectionable.

1 May 1979

W. J.
M E QUINLAN
DUS(P)

PERSONAL AND SECRET

D/DS12/15/6/6/4

DUS(P) (through AUS(D Staff))

FUTURE OF THE BRITISH DETERRENT

1. As requested, I have examined the Duff-Mason Reports giving particular attention to the possibility of needing to make "cosmetic" amendments before they are seen by new Ministers. On the basis of a first reading, I would offer the following comments:

a. Part I. Although there are few places where the text gives a slight flavour (perhaps deliberately) of being written with Labour Ministers in mind, there are only two major points which I suggest you might like to look at again;

i. Paragraphs 28-9 on the case for a strategic deterrent for the independent defence of national interests. Although these paragraphs set out the case for and against an independent deterrent for purely national defence, the balance of argument (particularly in the context of the paper as a whole) appears to me to come down in favour of attaching relatively little weight to this criterion. This runs counter to the view taken by the 1970-74 Conservative Government in justifying the role of Polaris, as opposed to the present Labour Government who have stressed the commitment of our strategic force to NATO. However, the relevant arguments are objectively set out, and I do not think there is any case for altering them because they might be unpalatable to new Ministers.

ii. Paragraphs 34-35 on the non-proliferation and disarmament consequences of opting for a new generation strategic deterrent. These paragraphs raise a more difficult point in that they are clearly written against the background of the present Government's commitment to the reduction and eventual elimination of nuclear weapons through disarmament negotiations; the first sentence of paragraph 34 makes this abundantly clear. If the paper is to be presented to new Conservative Ministers, I suggest that paragraph 34 in particular needs a little editing to present the same points in a more neutral framework.

b. Part II. This section of the Report sets out the factors to be considered in an objective and factual way, and I see no need for any changes;

c. Part III. I understand that this part of the Report was rushed through the Chiefs of Staff at great speed, and they continue to feel that they were inadequately consulted. This itself argues against any substantive changes, since

SW Covering TOP SECRET AND PERSONAL

EB

LOOSE MINUTE

File copy

D/DS12/15/6/6/4/D

AUS(D Staff)

FUTURE OF THE DETERRENT: BRIEF FOR A NEW GOVERNMENT

I attach a draft reply which DUS(P) might like to send in response to Sir Clive Rose's letter, having agreed its contents with DFA(P) as you requested. It largely reflects DUS(P)'s manuscript comments, but also includes some new wording from DFA(P) for paras 4 and 6 of the brief. In addition, I have provided some language to counter Mansford's misleading illustration of the order of costs for a successor system (his para 3(d)).

C.B. Jennings

20 April 1979

C B JENNINGS
DS12
MB 7353 7672 MB

Covering TOP SECRET AND PERSONAL