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From the Private Secretary

22 September 1986

AIRBORNE EARLY WARNING AIRCRAFT

The Prime Minister has considered the Defence Secretary's minute of 18 September setting out the next steps in the selection of an airborne early warning aircraft. Mr. Younger discussed this with the Prime Minister on the way back from Germany on 17 September.

Subject to the views of colleagues, the Prime Minister is content that the shortlist should now be reduced to two, that is GAv and Boeing, and that both should be invited to make best and final offers and that a technical evaluation should be done of both of them by RAF personnel and MOD scientists, with a recommendation coming to OD in December.

I am copying this letter to the Private Secretaries to members of OD and to Sir Robert Armstrong.

(Charles Powell)

John Howe, Esq.,
Ministry of Defence.

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PRIME MINISTER

AIRBORNE EARLY WARNING

Mr. Younger discussed this with you on the way back from Germany. He has now minuted OD colleagues in the same sense, recommending that there should be a final run-off between Nimrod and the Boeing AWACs. A decision between these two would be taken in early December.

The Policy Unit have done a note (also attached). It sees some case, although not a strong one, for keeping the Lockheed in the competition. I don't myself see much to be gained by this. We should be the lead customer and exposed all over again to the same sort of risk that we took with Nimrod in 1977.

You might suggest that we should start to explore with the US Administration and with Boeing (who are adept at putting pressure on them) the scope for counter-purchases of UK military equipment - ideally involving GEC - if we were to opt for the Boeing AWACs.

Content with Mr. Younger's proposal, subject to the views of colleagues?

Yes

CDP

CHARLES POWELL
19 September 1986

EL3BJW

PRIME MINISTER 18 September 1986

UK AIRBORNE EARLY WARNING (AEW) DECISION

The primary role of the AEW is to detect Soviet bombers before they can launch their missiles, it will not detect Stealth and Cruise missiles until they are relatively close (perhaps too close). The AEW does not act as a flying command post but feeds data to the ground stations who perform that role. If the Soviets see the AEW as being a grave threat to their operations they will no doubt seek to create a fast long-range anti-AEW missile which would be difficult to deflect with current technology.

None of the proposals (even the Boeing AWAC) meet the full ASR 400 specification. At last week's MOD Equipment Policy Committee officials and the military whittled the four serious contenders down to just Nimrod and the Boeing AWAC. They plan a 'fly-off' between these and a recommendation to Ministers in early December. George Younger is expected to endorse this plan. The comparative cost of the four options are set out below:

	Grumman Hawrod	Lockheed P-3	Boeing AWAC	Nimrod	£m
Number of Aircraft	10	8	8	10	
Basic Price	480	760	960	610	
Cost inc. extras at 87 prices	750	850	1,250	700	
Whole life cost (over 20 years)	1,750	1,500	2,300	1,700	
UK jobs sustained (man years)	6,200	12,600	17,100	10,000	
Amount of direct offset	50%	75%	10%	N/A	

The price of the AWACs could be reduced by £150m if the US Government, as expected, waive their levy, and perhaps by a further £50m if the French were also to order Boeings. The Nimrod cost is just the additional expenditure required to complete the project.

COMPARISON OF ALTERNATIVES

All comparisons are fraught with difficulties over different aircraft, different radar systems and speculative running costs. Nevertheless, even with the waiver, Boeing is considerably more expensive than the other options. Whilst it offers the highest amount of offset, only 10% is directly related to the order, which leaves some doubts over its additionality and indeed achievability. If the number of AWACs were reduced from 8 to 6, prices would be more comparable albeit at the expense of defence capability.

Both the Grumman Hawkrod (the Nimrod airframe with American equipment) and the Lockheed P-3 look to be competitive on cost, but both use UHF rather than S-band radar. As yet there are no frequency allocations available for UHF radar and MOD had anticipated that it would cause significant interference with other users. MOD now believe they may have overstated these problems and think there is a reasonable chance that frequency allocations could be negotiated by the planned AEW in-service date, although there must remain a risk that it takes longer or agreement is not achieved at all. On the plus side, however, the lower frequency UHF is inherently more capable of detecting Cruise and Stealth missiles which are likely to become an increasing threat during the life of the AEW.

The MOD have decided to eliminate the Hawkrod and the Lockheed P-3 on the grounds of technical risk rather than UHF radar. To my mind the technical risk on the Hawkrod is at least as great as that on the Nimrod and because it is

constrained by the Nimrod airframe it seems to offer little advantage over the Nimrod. I therefore agree it should be discarded. On the other hand the Lockheed solution does not seem to have quite the same level of risk and could well offer a stretch capability that is not present in the Nimrod. The Lockheed offer is also arguably cheapest on whole life costs, promises mission reliability better than that for Nimrod and has the greatest amount of direct offset work. Against these virtues is the unpleasant fact that the Americans would be being paid in effect to develop a system where GEC have failed.

GEC have come a long way but they still have a long way to go. The bulk of their expenditure is still on development and is thus high risk; two-thirds of the expenditure is to meet the Phase B standard which is the first stage at which the RAF would have a useable system. Although the GEC system is working better it is not spotting all aircraft or holding on to them when it has spotted them. Moreover, there must be significant doubts that the Nimrod is capable of being stretched to meet the threats of the year 2000 even if GEC ultimately get Nimrod operational in the 1990s.

CONCLUSION

The problem of narrowing the field to just two contenders means that in December the Government will be faced with a stark choice of a Boeing low-risk high-cost option and a Nimrod high-risk low-cost (!) option (or more probably of buying fewer Boeings and thereby diminishing the AEW capability).

Surely not - Nimrod is more expensive if you count what we've spent already. CDP!

This is probably unavoidable, but if it were thought politically plausible that the UK could ultimately purchase the new Lockheed (which would be more difficult to justify than the existing AWAC) then would be a case for keeping them in the race to provide a compromise between the two

extreme choices. This would however cause the MOD major resource problems in running a 3-horse competition with very limited time.

R. Goodman

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PRIME MINISTER

AIRBORNE EARLY WARNING AIRCRAFT

When we met with OD colleagues on 12th February attached it was agreed that GEC Avionics (GAv) should be given six months to demonstrate a firm prospect that the specification for the Nimrod AEW system could satisfactorily be met within a reasonable time. Meanwhile, I was authorised to investigate alternative ways of meeting this requirement through approaches to US companies, and also to initiate discussions with the NATO authorities who operate the Alliance's AEW system, and with the French Government to explore the possibility of a joint Anglo-French purchase of any alternative to Nimrod. The then Minister of State for Defence Procurement so informed the House on 26th February.

2. The six months are now up, and my officials have completed their evaluation of the following eight proposals:-

Nimrod (British)

Boeing E-3A AWACS (US)

Grumman E-2C Hawkeye (US)

Hawkrod (US radar in Nimrod airframe)

Lockheed P3 AEW & C (US)

MEL radar (British)

Airship Industries airship (British)

Pilatus Britten-Norman aircraft with Thorn-EMI radar (British)

Their assessment of each option is summarised at Annex A. Comparative costs, as far as we can establish them, are summarised at Annex B; the figures for Nimrod exclude the £930M already spent or committed.

3. For the reasons given at paragraphs 6-8 of Annex A none of the last three proposals listed above comes anywhere near meeting the requirement, and I have accepted my officials' advice that they should not be considered further.

[incl. airship]

Nimrod

4. There is no doubt that over the past six months GAv have achieved significant technical progress, including progress in the key areas of shortcoming identified in my memorandum to OD

(OD(86)2), namely the radar capability when looking towards land from over the sea and the tracking capability of the system. The radar's detection range has been improved, and the earlier saturation of its receiver has been almost entirely eliminated. The overloading of the radar signal processing chain and the data handling system have been largely overcome. GAv claim that the first aircraft could enter service at the full required standard at the end of 1991. But the improvements have been demonstrated mainly on the ground and only to a limited extent in the air. There is moreover a fear that the steps taken to reduce the overloading of the system may be reducing the number of real targets detected. It is clear that the company still have a long way to go before they are in a position to put a fully effective and reliable system into the air, and we do not yet have technical confidence that they will eventually achieve this.

Alternatives to Nimrod

5. There has been some press publicity about the merits of the alternative technical approaches to the radar, namely S-band and UHF, and this issue requires explanation by way of background. Nimrod and the Boeing E-3A use S-band; the Grumman E-2C, Hawkrod and the Lockheed P3 use UHF. The arguments are summarised at Annex C. Briefly, both solutions have technical advantages and disadvantages, and either is acceptable in principle. The real

difficulty applies to UHF but not S-band, and concerns what is known as "frequency supportability", mainly though not entirely in peacetime. The powerful signal transmitted by the radar would interfere with the transmissions of civil and military ground communications systems and of radio amateurs, not only in Britain, but in a number of continental countries when the aircraft was operating over the North Sea; it could also interfere with the Ballistic Missile Early Warning System (BMEWS) at Fylingdales. Because other nations are involved we would need to negotiate with them an agreement to our using the relevant UHF waveband for this purpose. While this would certainly be difficult it is not necessarily impossible; but it would take time, and the issue could not be resolved within the timescale for our final decision on the AEW problem. While this difficulty does not require us to exclude all the UHF-based contenders in principle, it does mean that we would need to have very good reasons for selecting a UHF system in the face of the problem I have described.

6. Turning to the systems themselves, the Grumman E-2C Hawkeye, though a good system which has proved itself in service, is a small aircraft with no room for a relief crew; crew fatigue would therefore severely limit the time the aircraft could spend at its operational station. This is an overriding objection, and the E-2C must therefore be ruled out. Hawkrod - the E2C radar in an improved version installed in the Nimrod airframe - gets round this difficulty. It would however involve putting a large

mushroom-shaped rotodome on top of the airframe, and this could impair the aircraft's aerodynamic stability and fatigue life. Integrating the avionics into the airframe would be difficult; and the improved radar has not yet been fully developed, so there would be some timescale and perhaps performance risk here. I have considered this option carefully but concluded that, since the technical risk is assessed as being greater than for Nimrod itself, it too must be discarded. The Lockheed P3, incorporating the same radar as the E-2C and Hawkrod, is one of the cheaper options and on paper looks attractive; but it is an untried concept, and Lockheed's assessment that the first aircraft could be delivered well within four years is judged by my experts to be an under-estimate. The UK would be the lead customer for a project whose technical risk is of the same order as that remaining in the Nimrod programme, and I do not think we should get into this position.

7. In summary, the E-2C is discarded as inadequate for the requirement, and Hawkrod and the P3 on grounds of considerable development risk. I believe it would be wrong to drop Nimrod in favour of an equally risky alternative. The UHF frequency supportability problem is an additional objection but not a decisive one. I believe this conclusion is publicly defensible, and indeed that it would be wrong to keep any of these three options in the competition any longer in the face of these substantial technical doubts.

8. I have accordingly concluded that the only realistic alternative to Nimrod is the Boeing E-3A AWACS. This is performing well with the NATO and Saudi Arabian forces as well as the USAF, and it would fully meet our own requirements with the addition of a data link (Link 16) which, the USAF are planning for their own E-3A aircraft and which, as for all other options, is necessary to make it interoperable with other aircraft and ground installations within the UK air defence system. Boeing are offering a 100% offset through purchases in the UK, of which 80% would be in high technology. But the E-3A is expensive. The cost depends on whether or not the US Government would be prepared to waive the standard development levy; we believe they would be, subject to certain conditions which on first inspection seem reasonable. The capital cost would be £1100M with waiver (or £1250M without waiver) compared with £700M for the remaining expenditure on Nimrod. The cost could be reduced by buying fewer aircraft than the number needed to meet the full requirement. The operational penalty would be inability to mount the full number of simultaneous patrols needed to match the threat. Plainly this would be most unwelcome, but pressures on the budget compel me to look at this possibility.

9. It has been suggested that if we selected the E-3A we should adapt it to take the V2500 engine in which Rolls Royce have a stake. I would be opposed to this, since not only would it increase the cost of this option by up to £100M (of which a large

part would go on R & D) but it would import technical risk into an option whose principal attraction is that it provides a technically safe means of meeting the RAF's requirement.

The Way Ahead

10. In summary, I see this now as a two-horse race; but I believe we still lack some of the information we need before making a final choice. In particular I am not convinced that GAv's price of £700M is the best they can do, and Boeing too will almost certainly be prepared to reduce their price, quite apart from the waiver of levy point.

11. I therefore intend to seek best and final offers from GAv and Boeing for both full and reduced quantities of aircraft: 11, 10 and 8 in the case of Nimrod, 8 and 6 in the case of E-3A. I shall also seek proposals from Boeing for an annual payment profile for E-3A with a better match to defence budget constraints year by year. And the US Government's willingness to waive its levy needs to be formally established. Draft contracts with both firms will be negotiated so as to flush out any cost or other implications of either solution which may have escaped notice so far, and to enable us to sign up promptly when we have taken our final decision.

12. This work will take about two months, and we shall make use of the time to carry out a programme of trials of the Nimrod system to test it in flight against a more representative range of targets. If possible, this will include a "fly-off" between a Nimrod and an E-3A to compare their performance. I shall be arranging for a joint team of RAF personnel and MOD scientists to participate in this work to ensure that we have the best possible technical basis for a judgement of the remaining risks when we take our final decision; though I should warn colleagues that even at that stage it will still be very much a matter of judgement rather than demonstrated capability. At the same time my Department will be re-assessing in-house the likely evolution of the military threat which our future AEW system must match, and considering which of the two remaining contenders has the better potential for future development to respond to that changing threat. Finally we shall be carrying forward our discussions, already begun, with the French and with NATO to establish what cost savings could be made through joint procurement and support of the E-3A if chosen. My intention is to report to OD before Christmas with a final recommendation.

13. I intend to announce the next steps through an MOD press conference on Thursday 25th September. All the contenders will be informed shortly beforehand.

14. I am sending copies of this minute to OD colleagues and to Sir Robert Armstrong.

G.H.

Ministry of Defence

18th September 1986

ANNEX A

ASSESSMENT OF COMPETING SOLUTIONS

A. Serious contenders

1. Nimrod AEW

Airframe by British Aerospace (BAe), mission systems avionics (MSA) by GEC Avionics (GAv). Incorporates S-band radar. 10 aircraft are required for full capability, given air-to-air refuelling (AAR). Technical risk is discussed in the main minute. GAv offer the first aircraft to full standard by the end of 1991 and the last by September 1993.

2. Boeing E-3A

Boeing 707 airframe, radar (S-band) by Westinghouse. In service with the US Air Force, the NATO AEW Force and the Royal Saudi Air Force. A mature system which has been proven in service and which, with the inclusion of the Link 16 ECM-resistant data link for communicating with other aircraft and ground installations, together with an electronic support measures (ESM) system, would generally meet and in many respects exceed the required standard (ASR 400 1st Revise). The radar production line has been closed and would need to be reopened. 8 aircraft are required for full capability,

given AAR. Technical risk confined to integration of Link 16 and ESM into MSA. First aircraft offered by end 1990, eighth at the end of 1992.

3. Grumman E-2C Hawkeye

Grumman airframe, General Electric (US) UHF radar. A twin turbo-prop carrier-borne aircraft of the US Navy which has been sold to Israel and other nations. In theory 19 aircraft are required for full capability, given AAR; in practice the small size of the aircraft, and its inability to carry a relief crew, mean that crew fatigue would severely limit time on patrol and thus make it impossible to carry out missions at the required range and of the required duration. Some technical and cost risk because of need to develop improved version of radar and to integrate Link 16. First aircraft offered by October 1990, 19th at beginning of 1994.

4. Hawkrod

A proposal from Grumman to incorporate the E-2C's radar (in developed form) and data handling in the Nimrod airframe. UHF radar as for E-2C. 10 aircraft required for full capability, given AAR. Would give adequate range and endurance. Substantial technical, cost and timescale risk related mainly to the need to integrate the E-2C avionics

system into a different aircraft; to aerodynamic stability and fatigue life of tail structure (due to placing a large rotodome on top of the aircraft); and also to radar development and Link 16 integration as for E-2C. First aircraft offered at beginning of 1991, tenth by end 1992.

5. Lockheed P3 Airborne Early Warning and Control (AEW&C)

A Lockheed airframe, successfully in service since 1962, combined with the same UHF radar (ie in developed form) as in the Hawkeye and Hawkrod proposals. 8 aircraft required for full capability, given AAR. An aerodynamic prototype has flown, but without an AEW system. No orders placed so far. Would come close to meeting operational requirement, but major development work has still to be undertaken on airframe, avionics hardware and software and systems integration, including integration of Link 16. Although first aircraft is offered for mid-1990 and eighth for September 1991, this assumes that development could be completed in well under 4 years as Lockheed claim. MOD judge this as very optimistic and assess technical, cost and timescale risks as high.

B. Proposals that do not come close to meeting the military requirement

6. MEL (UK subsidiary of Philips)

They offer a radar but no aircraft.

7. Airship Industries (British)

They offer an airship but no radar or other avionics.

8. Pilatus Britten-Norman (British)

They offer a Thorn-EMI radar, based on the successful Searchwater, installed in a version of their own Islander aircraft. The proposal falls far short of the requirement in aircraft range and endurance, radar detection range, tracking capability, reliability and service life. The firm recognise this and justify their proposal as a stopgap solution in the short term with a useful non-AEW role when a more capable system can be obtained.

ANNEX B

COSTS OF COMPETING SOLUTIONS

All figures at 1986/87 outturn prices, VAT-exclusive, and assuming an exchange rate of £1=$1.50

	(a) Cost of acquisition	(b) Cost of acquisition plus 20 year operating costs
	£M	£M
Nimrod - 10 aircraft	700	1700
Boeing E-3A to enhanced standard (ie with JTIDS, Link 16 and ESM) - 8 aircraft:		
(i) if US Government levy not waived	1250	2300
(ii) if US Government levy waived	1100	2150
Grumman E-2C - 19 aircraft	1100	1900
Hawkrod - 10 aircraft	750	1750
Lockheed P3 - 8 aircraft	850	1500

Notes

1. Acquisition cost of Nimrod includes £150M for interest charges due to deferred payment. It excludes sunk costs of £930M.

2. Boeing E-3A figures make no allowance for potential savings through collaborative procurement with the French or sharing of support facilities with NATO.

3. E2-C, Hawkrod and Lockheed figures in column (a) include US Government levies of £40M, £20M and £10M respectively which might also be waived.

4. All figures in column (a) other than Nimrod include (i) Government furnished equipment purchased separately in the USA, (ii) cancellation charges of £50M for winding up Nimrod contract and (iii) expenditure in the range £60-140M to provide adequate support in the UK for the equipment once in service.

5. 20 year operating costs include aircrew, fuel, maintenance, and the marginal costs of tanker aircraft sorties. They are necessarily tentative at this stage.

ANNEX C

UHF VERSUS S-BAND

1. The radars of Nimrod and the Boeing E-3A operate in the S-band frequency; those of Hawkeye, Hawkrod and the Lockheed P3 operate or would operate on UHF frequencies. Grumman have claimed in full-page press advertisements (eg the Times of 5 September) that S-band systems are out of date and that the future lies with UHF systems. The facts are as follows.

2. Performance. Other things being equal UHF has a greater innate capability to detect small objects - of increasing importance as signatures get smaller through the deployment of cruise missiles and the use of "stealth" technology - and to minimise clutter, as claimed by Grumman. Against this, the angular resolution of detected objects is inferior to that of S-band, and the UHF is more susceptible to jamming. MOD judge the performance of S-band to be adequate to match the foreseeable threat, including cruise missiles.

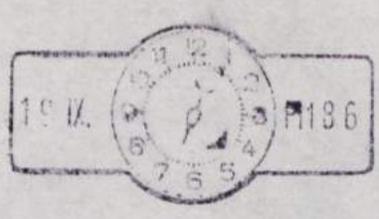
3. Jamming. It is forecast that a large-scale Soviet air attack on the UK - the threat against which the RAF's AEW

would be principally directed - would include a jamming offensive which would successfully attack the S-band (without however destroying AEW's operational value). The Soviets have developed a jamming capability against UHF radars but are not known to have deployed it in the NATO theatre.

4. Frequency supportability. This means the ability of a system to conform to the national and international network of frequency allocations. Whereas S-band presents no difficulty in this regard, UHF presents serious difficulties. The RAF's AEW force would operate in the North Sea and the very powerful signals from its radars would illuminate Norway, Denmark, West Germany, Belgium, Holland and France, as well as the UK. Under international rules the radars could transmit within only a relatively narrow waveband (between 430 and 440 Megahertz), which in Europe is allocated in peacetime to radar systems, low power radio systems and amateur radio enthusiasts on a basis of equal rights. In the UK the AEW system, when functioning, would interfere not only with the transmissions of the amateurs (who are numerous - of the order of 60,000) but also with the Ballistic Missile Early Warning System (BMEWS) at Fylingdales, which is about to be given a major technical

upgrade. Furthermore no nation may interfere with other nations' use of the spectrum; negotiation and agreement with European partners would therefore be necessary, and there are indications that the latter would not be readily forthcoming. This problem would take time to resolve and would certainly not be resolved by the end of 1986; there would also be costs. It follows that any decision within that timescale to procure a UHF-based system would be taken against a background of uncertainty over whether the AEW force could eventually be deployed for training in its intended area of operation.

5. MOD conclude that, while it would be wrong to exclude systems using UHF frequency on that ground alone, there would need to be very strong grounds for selecting such a system in face of the uncertainty over frequency supportability described in paragraph 4.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