



EUROFIGHTER TYPHOON PART 1

COLD WAR ORIGINS

1983-1990

AIR HISTORICAL BRANCH (RAF)

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Photographs

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(unless otherwise stated)

Cover photograph shows an artist's impression of the European Fighter Aircraft, which ultimately became the Eurofighter Typhoon.

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Introduction

The aircraft now known to the Royal Air force as *Typhoon* was the product of the European Fighter Aircraft (EFA) programme launched in the 1980s. From a UK perspective, the origins of the EFA programme lay in the retirement of the English Electric Lightning fighter from operational service in the later 1970s and 1980s, which left the RAF without an agile air superiority fighter of UK design and manufacture. American-built Phantoms fulfilled the air-to-air combat role in the RAF in this period, but the UK effectively conceded the lucrative global market for fighters to the United States and France. The French firm, Dassault, became by far the most prominent European fighter manufacturer, securing significant export sales for their Mirage range.

Fighter development in the UK in the 1970s occurred at the industrial level and took the form of conceptual and experimental work, but combat aircraft production became focused on the Panavia Tornado. The Tornado Air Defence Variant (ADV) ultimately provided the RAF with a long-range bomber interceptor in the form of the F3 but not an agile air superiority fighter. By the early 1980s, it was possible to foresee a situation in which the Phantom would be nearing the end its service life. The Soviet Union was known to be developing a new generation of advanced fighters, but the RAF would have no aircraft that could challenge them unless it once again bought from abroad or initiated an entirely new project. Other European air forces, including those of France, West Germany and Italy, had also identified an increasingly urgent need to develop new fighters to counter the Soviet threat. At the same time, the Panavia consortium was passing the peak of Tornado production, and it was clear that industrial capacity would contract unless another major project was initiated.

In 1972, the RAF issued Air Staff Target (AST) 403, which provided a basis for conceptual and experimental development work on combat aircraft in the mid-1970s, particularly the P96 project – a conventional swept wing, twin-engine design. After the P96 was cancelled, British Aerospace submitted proposals to the RAF for both single-engine and twin-engine fighters, and it was the twin-engine design that subsequently progressed as the P110. Meanwhile, British Aerospace and the German company MBB proposed to their governments a collaborative fighter programme, which became known as the European Combat Aircraft or ECA. Dassault subsequently joined the ECA programme, and the three companies reached

broad agreement on a twin-engine delta canard configuration for the aircraft, but they also continued to work on their own designs.

ECA collapsed in 1981. While there were predictable issues of funding and of aligning the operational requirements of the four nations, there were also differences with France over project leadership and engine selection. However, the three Panavia partners – the UK, Germany and Italy – launched the Agile Combat Aircraft (ACA) programme in the following April. After the German and Italian governments withdrew from ACA, the project continued with British government (Ministry of Defence (MOD)) funding and industrial investment from British Aerospace, MBB and Aeritalia. The ACA project was briefed to the Secretary of State for Defence, John Nott, in the summer of 1982. Meanwhile, Dassault continued with their own project – the Avion de Combat eXperimental (ACX). Both programmes led to the development of technology demonstrators over the following years, the ACA evolving into the EAP (standing for Experimental Aircraft Programme), which first flew in August 1986.¹

It is unclear whether there was ever a realistic prospect of the ACA being procured on a purely national basis, but public statements by ministers in 1982 sought to discourage any suggestion that the RAF might buy an all-British aircraft.² In October, the Minister for Defence Procurement (DP) told Parliament that Nott hoped to secure collaborative arrangements with European partners to work on the ACA as an experimental project.³

Then, in January 1983, Nott was replaced at the MOD by Michael (later Lord) Heseltine. Mr Heseltine had held the aerospace portfolio at ministerial level in the Department for Trade and Industry (DTI) from 1972 to 1974 and had thus been involved in three collaborative ventures – Jaguar (entry into RAF service) and Concorde (sales) with France, and Tornado (development) with Germany and Italy. He had also helped to set up the European Space Agency. And it was in January 1983 that the Air Staff's Operational Requirements staff learnt that the RAF was unlikely to acquire a new fighter unless it could be designed, developed and produced on a multinational collaborative basis.⁴

Heseltine fully accepted that there was a genuine RAF requirement for a fighter, an aircraft, as he put it, 'with sufficient speed, acceleration and agility not only to defeat in air combat the fighters which the Soviets will be able to deploy after 1995 ... but also to remain effective against increasingly powerful opposition throughout the first two decades of the new century.'⁵ But he saw collaboration as the key. As he told the Prime Minister, Margaret Thatcher,

If we could avoid the duplication of design and development effort which has up till now characterised the military aircraft scene in Europe, the prizes would be enormous. The participating nations would start with their own requirements amounting in total up to 800-1,000 aircraft, and might readily expect to approach that number in the export market ... Only Dassault with their Mirage series of designs (of which some 1,500 have been sold abroad) have come close to providing a challenge to the dominance of the United States. Collaboration ... if attainable, would thus open up new export opportunities for British industry; equally important, the financial burden of developing a major new aircraft would be shared among five partners, to that extent easing the pressure on the defence budget.⁶

Heseltine argued on more than one occasion that a national development would be 15-20 per cent more expensive than a collaborative one.⁷

Heseltine's focus on the numerous savings to be made at the industrial level from the collaborative approach reflected his great enthusiasm for the EFA programme, which was unquestionably a pivotal factor in the launch of the feasibility and project definition phases in the mid-1980s. However, it is perhaps equally understandable that he chose not to highlight the additional costs of collaboration in terms of project management, which were considerable.

Managing purely national military procurement projects is a formidable task, but that task is invariably enlarged and complicated many times over in multinational ventures. In EFA's case, it required protracted inter-governmental arguments over participation, and (ultimately) four national approval processes rather than one – for what was one of the largest European defence equipment programmes ever launched. The range of political pressures and military and technical perspectives was likewise multiplied, generating numerous tensions and an almost incessant demand for time-consuming negotiation and compromise. Within this process, there was always scope for a four-nation agreement on the aircraft specification to shift some distance away from the concept originally envisaged by individual air forces. The number of industrial 'moving parts' – interlinked and interdependent arrangements and processes – also extended the complexity of programme management far beyond the parameters that we might associate with purely national undertakings.

The volume of paperwork created by the collaborative EFA programme was truly staggering. At every stage, there were official targets, requirements, and Memoranda of Understanding (MOUs) to complete, and there were no less frequent demands for industrial and official reports on innumerable technical issues. This was quite apart from the contractual process, which was barely less laborious and complex. On several occasions over the following years, the EFA project was confronted by tangible political and industrial obstacles that challenged the participating governments and their most senior procurement staffs, but their impact was magnified by the bureaucratic procedures and contractual deliberations that underpinned the multinational programme. Even when the more obvious problems had been dealt with, progress was often held up by the absence of essential documentation or contractual agreements.

In short, there is no doubt that collaboration generated significant time and cost penalties. The precise scale of these penalties is more difficult to establish, nor can we easily calculate how far they consumed the savings so confidently predicted by Mr Heseltine.

Planning for European collaboration effectively blended the UK, German and Italian Panavia Tornado partnership with the Anglo-French Jaguar enterprise. This was logical enough. Germany also strongly favoured a collaborative venture that involved France, and France's inclusion might also have provided openings to her existing fighter export markets. For France, there was the political attraction of a genuinely European venture, reduced costs relative to a purely national programme, and access to the most advanced aerospace technologies of the other partner nations – notably Rolls-Royce aero-engines. However, as Heseltine's new initiative came only two years after the failure of ECA, there was always a likelihood that history would repeat itself and, perhaps, a case for devising a strategy to reduce the scope for it to do so. The events of the next two and a half years were to that extent shaped by a degree of corporate amnesia that could hardly do more to underline the importance of integrating past experience and lessons into the development of policy.

1. The Outline Staff Target

Talks between the Air Staffs of the four nations began at the UK's instigation in January and February 1983. The basic chain of command extended from the Air Staff and equivalent official levels (such as Controller Aircraft) up to the so-called National Armament Directors (NADs). The UK NAD was the Chief of Defence Procurement (CDP), a post that could be filled by serving military officers or Civil Servants. In 1982, the former Controller Aircraft, Air Chief Marshal Sir Douglas Lowe, was appointed CDP, but he retired in the following year. He was succeeded by a civilian, Sir David Perry, who had an engineering background and had worked for many years at the Royal Aircraft Establishment before moving to the MOD in 1978.

In 1985, Perry assumed the role of Chief of Defence Equipment Collaboration (CDEC). He was replaced as CDP by Sir Peter (now Lord) Levene, a businessman who Heseltine had invited into the MOD, initially as his personal adviser. Above the NADs was the ministerial level, Minister DP having direct responsibility for procurement under the Secretary of State for Defence. Consecutive Minister DPs were closely involved in the EFA programme over the following years, but the extreme difficulties of managing such a high-profile and costly multinational venture were enough to ensure that the Secretary of State's intervention was frequently required.

Some of the MOD's formal procurement mechanisms were marginalised during the early EFA discussions. The highest procurement committee, known as the Equipment Policy Committee (EPC), did not consider the fighter until April 1985, and it was not formally discussed by the Chiefs of Staff Committee (COS) until May 1985. This two-year delay drew comment from the Chief of the General Staff (CGS) and the Chief of the Naval Staff (CNS). They both felt that the established procedures for initiating such major projects had been bypassed partly because of the political impetus for European defence collaboration and partly because of pressure from 'the industrial lobby' – as they described it.⁸

The early Air Staff contacts revealed strong German and Italian interest in the development of a new fighter, but the German government insisted that a collaborative programme should include France. By contrast, the French were more cautious following the failure of the ECA initiative, and their stance also reflected the fact that they already anticipated a purely national development path for the ACX that extended from the technology demonstrator through to the procurement of an operational aircraft.

Nevertheless, all four nations eventually agreed to a meeting in Paris on 29 April 1983 to discuss their requirements. Shortly beforehand, the Spanish Air Force became aware of the meeting, and their request for permission to attend – less than a year after Spain joined NATO – was promptly accepted.

The general atmosphere at the meeting was clearly positive, and the assembled staffs agreed on the following:

- There was a requirement for a new fighter in the mid-1990s.
- It would be important to limit costs of development, production and through-life costs.
- There were benefits in collaboration.
- There was a need to retain a flexible approach at this stage to the operational requirement.
- There should be good performance in more than one role.
- The aircraft should be STOL.^a
- Two engines were generally preferred.

The Air Staffs agreed to establish a Working Group with national technical support to investigate common requirements for a new fighter and the extent to which requirements differed. Periodic ‘Generals’ meetings would determine policy, while the ‘Colonels’ meetings addressed the key issues in more detail. The UK General was the Assistant Chief of the Air Staff (Operational Requirements)(ACAS (OR)).⁹ For the time being, the proposed fighter was to be known as the Future Combat Aircraft (FCA).

Yet the positive stance of the five Air Staffs in April was not in evidence at the industrial level. Early in May, CDP discussed the FCA with his French opposite number and with representatives of Dassault and SNECMA – the French aero-engine company. He subsequently noted that they appeared ambivalent on collaboration and seemed to have no sense of urgency. CDP believed that to meet the procurement timescales envisaged by the UK, which

a. STOL – Short Take-Off and Landing.

were based on the new fighter entering service in the mid-1990s, broad agreement on the way forward was required between the participating nations by the end of the year. He also feared that if the national programmes advanced too far before an agreement was reached, collaboration would be more difficult. 'If we waited too long, we would all be locked into national solutions.'¹⁰ Worryingly, he described Dassault as 'unforthcoming to the point of being negative'. SNECMA had been more enthusiastic but unprepared to move far without clear backing from the French government.¹¹

Some British officials were even more pessimistic. In July, the Head of Defence Sales (HDS) cast doubt on the proposed five-nation project, suggesting that additional management complexity would delay the aircraft's entry into service and reduce the scope for saving money by spreading development costs. Prophetically, he also warned that the French would seek to manipulate the project in their own interests. They would probably seek airframe design leadership and an engine based on the SNECMA M88; collaboration on the Jaguar project had only proved possible under French design leadership, whereas France had withdrawn from the British-led Tornado programme. HDS's favoured solution was a combined UK, German and Italian project, building on the existing Tornado partnership and drawing on experience with the Tornado. This would help to reduce the costs and delays involved in constructing an entirely new industrial organisation.¹² Logical as this might sound, HDS's argument overlooked the German government's desire for collaboration with France. Another link-up with the UK and Italy would have been rejected by Germany in the absence of concerted efforts to secure French participation in the FCA programme.

It was certain that high-level political direction would be needed if requirements for the aircraft were to be harmonised across the five nations by the end of 1983,¹³ and this duly materialised in September at a meeting of the British, French and German defence ministers. Subsequently, ACAS (OR) signalled the other 'Generals' in Paris, Bonn, Rome and Madrid and proposed an amended agenda for the next planned meeting of the Working Group, which was to be held in London from 6 to 8 October. They should draft an Outline Staff Target (OST) for the FCA. The German, Italian and Spanish Generals all agreed. However, there was no response from the French before the meeting convened. Their representative then declared that he could neither draft nor sign an agreement.

From this as well as further input from the other three nations, it became clear that full harmonisation would not be achieved and that it would only be possible to produce a *draft* OST that stated requirements individually or

collectively. However, it was possible to agree what were referred to as 'common baseline points' and to reach a provisional agreement to exchange technical information by the 21st. The UK, Germany, Italy and Spain then confirmed their preparedness to meet between 2 and 4 November to discuss harmonisation in detail before the next Generals meeting on the 8th. By contrast, the French were unsure whether they could obtain the necessary authority for the proposed information exchange by the 21st, and they also argued that 2-4 November was too early for another Working Group meeting.¹⁴ They subsequently secured the postponement of the next Generals meeting until 15 November.¹⁵

ACAS (OR) afterwards took steps to establish that the French accepted the proposed British timetable for harmonisation and that the necessary political instructions had been issued to the French Air Staff.¹⁶ As the draft OST was, in his words, 'an imprecise document' in which 'many of the performance points had been calculated to different baseline parameters', performance targets were recalculated to a common baseline in communications between the five nations, which were concluded by the 21 October target date. However, when the Working Group met in Madrid on 3-4 November, the French arrived without the necessary delegated authorities. Moreover, there were some fundamental areas of disagreement, such as the role of the FCA. The four nations prioritised air-to-air combat and air defence, whereas the French laid more emphasis on an air-to-ground role and possibly a capacity to operate from aircraft carriers. The four nations also believed that a minimum total engine thrust of 14 tons (i.e. 7 tons per engine) would be required – perhaps from a derivative of an existing engine – while the French viewed this as a maximum and favoured the development of an entirely new design. The use of an existing engine would have left SNECMA with a marginal role in the project, at best, whereas the French were already considering the development of a new SNECMA design for the ACX. The thrust envisaged as a minimum by the other nations for the FCA represented the upper limit for the engine that the French had in mind.¹⁷

Harmonisation was therefore restricted to the other four nations, and a revised document retitled the Outline European Staff Target (OEST) merely stated the French target figures. Nevertheless, the meeting left ACAS (OR) hopeful of a breakthrough when the Working Group reconvened in London on 15-16 November. He advised the Vice-Chief of the Air Staff (VCAS) on the 8th:

I believe the prospects for this potentially large European programme are promising. Even the French have indicated their willingness to try and reach military agreement by the end of the year, thus enabling the NADS to report to Ministers during May 84, as agreed by the defence ministers of France, Germany and the UK at their meeting in Paris on 21 Sep 83.¹⁸

On the following day he told the Chief of the Air Staff (CAS), Air Chief Marshal Sir Keith Williamson:

In many cases the French figures coincided with the harmonised ones or fell close to them ... I understand that this week the French will obtain authority to negotiate, and I anticipate that they will be in a position to agree performance targets at next week's meeting.¹⁹

During the first day of the Generals meeting, the atmosphere was very tense, and the French repeatedly isolated themselves from the other four nations. Once again, they appeared to lack the authority necessary to negotiate harmonisation, and their requirement for an air-to-ground capability proved to be another significant obstacle. However, after four lengthy phone calls to the French CAS and VCAS in Paris, their delegation sat up into the early hours discussing the situation. The following day's events were recorded afterwards by ACAS (OR):

General Gueguen came to the second day of the meeting with the authority, and the will, to harmonise and compromise ... The OEST which emerged is, I believe, an entirely satisfactory document. Nevertheless, the point was made by both my German and Italian colleagues that the task could easily have been completed by four nations in less than half the time, and with relatively little debate.²⁰

Eurofighter Typhoon: Cold War Origins



*Michael Heseltine, Secretary of State for Defence
from 1983 to 1986.*

2. The European Staff Target

The OEST acknowledged but did not resolve the key differences between France and the other four nations regarding both the FCA's role and its engine thrust. Moreover, in recording France's desire for an engine in the 7 tons thrust class, it suggested a potential link with the weight and size of the aircraft – issues that combined to form the major barrier to five-nation agreement in the following year.²¹ Nevertheless, for the more immediate future, the position appeared promising. The FCA was renamed the Future European Fighter Aircraft (soon shortened to European Fighter Aircraft – EFA), and the Chiefs of Air Staff of the participating nations met in Germany on 16 December to ratify the OEST.²² On the 20th, CAS advised the Minister DP that the next step would be for CDP to initiate follow-on work to permit the NADs to report to ministers by the following May. This would involve the creation of a new five-nation Working Group of officials and industrial representatives.²³

Less than a month later, on 18 January 1984, the MOD dispatched letters to the chairmen of British Aerospace and Rolls-Royce to initiate industrial studies for the EFA project, and a meeting in Paris meanwhile agreed on work to be undertaken in parallel by procurement and other official and air force staffs. The aim was to produce a report for the consideration of the five NADs in April; ministers from all five countries would then meet in May to discuss the launch of a feasibility study.²⁴ In the event, Heseltine met his French, German, Italian and Spanish counterparts in Madrid in July, when the five ministers agreed to launch a technical and industrial feasibility study into EFA. The study was to consider an aircraft of 9.5 tonnes maximum Basic Mass Empty (BME) and a performance within the parameters outlined in the OEST.²⁵ It was not easy to achieve a consensus on the BME figure. As Heseltine later informed the Prime Minister,

The 9½ tonne specification for EFA is a compromise, agreed by my French counterpart M. Hernu and myself, between 10½ tonnes or so which my military advisers judged to be necessary and the lighter design of 8½ tonnes initially favoured by the French.²⁶

It was actually closest to the BME favoured by Germany and was closely tied to predictions of cost. As a later UK brief put it:

The significance of these differences lies not in the mass of the aircraft, per se, but in the degree of sophistication, and thus cost, which it represents. In the absence of a better yardstick, Ministers were forced to draw the balance between capability and costs in terms of this single, and in some ways unsatisfactory, characteristic.²⁷

The compromise was further complicated by the fact that the UK, Germany, Italy and Spain anticipated a quarter tonne increase in the BME during development, whereas the French saw 9.5 tonnes as a rigid limit.²⁸

Meanwhile, the Air Staffs of the five nations worked to raise the provisional OEST to an agreed European Staff Target (EST) status. They completed their task in Rome on 11 October 1984, when the five Chiefs of Air Staff signed the EST.²⁹ This required a further compromise on the manoeuvrability of the aircraft. While the UK Air Staff had originally favoured a level of agility close to the maximum defined by the OEST, they ultimately accepted 'min OEST' levels 'in the interests of European collaboration' – in other words, to secure the agreement of France.³⁰

Nevertheless, on the 31st, ACAS (OR) advised CAS of a request received from the NADs for the Air Staff to examine what reductions in EST targets might be acceptable to meet the BME limit of 9.5 tonnes. This was because industry had already completed an interim feasibility study, which stated that the operational capability and aerodynamic performance stipulated by the EST could not be achieved within the agreed BME limit. Until this issue was resolved, it would be impossible for the EFA programme to move into the project definition phase. Clearly, further reductions in manoeuvre performance would be undesirable; equally, it appeared unwise to accept cuts in mission performance, which were in any case unlikely to bring the BME within 9.5 tonnes. According to ACAS (OR), the MOD Procurement Executive (PE) considered that strict adherence to a BME of 9.5 tonnes was unlikely to produce an aircraft better than the American F-18, which was already in service, and the Deputy Controller Aircraft (DCA) was no more enthusiastic. As he reportedly argued, 'It makes little military sense to consider collaborating on an aircraft which, by the mid-90s, will reflect such a relatively low capability.' ACAS (OR) expected clear battle lines to be drawn up at the next NADs meeting on 12 November, where the French would insist on low weight while the other four nations stressed the importance of fulfilling the EST.³¹

In the light of this situation and before the NADs gathered, Minister DP held a meeting to discuss EFA, which was attended by CAS, the MOD's Permanent Under-Secretary (PUS), Controller Aircraft, ACAS (OR), CDP and senior British Aerospace and Rolls-Royce executives. They unanimously agreed that an aircraft with a BME of less than 9.5 tonnes would be incapable of meeting the EST and that EFA's weight should if necessary be increased to preserve the integrity of the EST. They also highlighted the fact that the UK, Germany, Italy and Spain were now considering the development of a new and more powerful engine for EFA with a potential rating of 91.5 KN, whereas the French vision of a 9.25 to 9.5 tonne aircraft was based on an engine with a rating of 82-85 KN.

However, concerns about the French position extended beyond the characteristics of the aircraft. They were suspected of seeking to delay the EFA project or reduce the capability of the aircraft for commercial reasons, and the British Aerospace representative reported that Dassault were refusing to cooperate in the technical and feasibility studies. In this context, it is not surprising that the meeting agreed on a strong line. There should be no compromise over the EST to satisfy an arbitrary weight ceiling; feasibility studies should not be limited to an aircraft of 9.5 tonnes BME; the aircraft should be designed with a common engine bay capable of housing the Rolls-Royce RB199, the General Electric GE404 or a new power unit; industry should continue working on EFA with or without Dassault.³²

Despite the seemingly robust line taken by the UK, the report drawn up at the NADs meeting held in Bonn on 12 November was somewhat ambiguous, and, in CDP's words, suggested 'that Ministers should ask their Air Staffs to reconsider the EST which they recently signed, because full compliance with its performance, mission and capability targets would imply an aircraft mass substantially larger than the 9½ tonne compromise weight reached in Madrid.' At the same time, it suggested 'continuation of the industrial studies into an aircraft having an in-service mass limit of 9½ tonnes, since work done since Madrid has cast considerable doubt ... about whether such an aircraft could achieve the performance and capability expected when the Madrid agreement was reached.'³³

Whilst it would be possible to design an aircraft which would not exceed 9.5 tonnes in service BME and which would meet all except one of the bottom levels of OEST performance, four aircraft companies out of five have reservations about the practicability of

achieving the proper integration of all equipments and weapons into such a size of aircraft.³⁴

The report also stated that the aircraft would fail to meet nearly all the performance requirements set out in the EST signed in Rome.³⁵ Key differences between France and the other four nations included:

	France	Four nations
Thrust (KN)	80/82	90
Wing area (Msq)	47.5	50
Standard engine bay	No	Yes
Mass growth allowance (kg)	250	250-600

Not surprisingly, CAS was unhappy with the sections of the report that appeared to support the French position and imply that the other nations – and particularly their Air Staffs – were out of line. He was determined that the EST should not be ‘downgraded’ to achieve compatibility with the 9.5 tonne BME limit.³⁶ Yet the issues at stake extended beyond the RAF’s aspirations for EFA. As the Defence Sales Organisation (DSO) put it, ‘In terms of value, fighter aircraft are by far and away the single most important sector of the world defence market.’ The UK’s failure to develop an air superiority fighter to succeed the Lightning had allowed France to emerge as Europe’s leading fighter producer and exporter, but EFA had the potential to re-establish the British aerospace industry’s position in the global fighter market. An extended impasse on the fundamental characteristics of the aircraft would only be to France’s benefit, for it would delay any potential competition for sales between EFA, upon its entry into service, and French fighters such as the Mirage 2000. Concessions to France on the aircraft’s size would have a direct impact on its export potential as well as its capacity to meet the RAF’s requirements.

However, in the absence of an agreement, only France could realistically consider a national alternative to the proposed five-nation project, and the French possessed a further bargaining counter in terms of their access to export markets. The DSO went so far as to suggest that the development of an entirely British fighter would be preferable to any further compromise on

EFA's specifications; the DTI took a similar view. Yet the feasibility of such an approach would probably have been ruled out on grounds of cost alone.³⁷

Input from other key stakeholders in the EFA project was barely less compromising. Minister DP was insistent that EFA 'should meet the agreed requirement' and told Heseltine: 'I believe that we have no alternative but to insist upon our vital interests.'³⁸ The Minister for Industry and Information Technology at the DTI expressed equally forthright views to the MOD on 20 November.³⁹ From industry, Rolls-Royce argued that EFA's engine should aim at a nominal 93 KN thrust with growth potential to 100 KN in order to compete with the GE404 – figures far higher than the 80/82 KN envisaged by France.⁴⁰ Meanwhile, British Aerospace argued that unless the French accepted 'the clear-cut and agreed conclusions of the other four nations' it would be extremely difficult to continue working on a five-nation basis.⁴¹ Yet Heseltine strongly supported the multinational concept, particularly in the context of European collaboration, and believed that French participation in the project would be very valuable. He evidently felt that he could work productively with Hernu but perhaps underestimated the extent to which French policy was constrained by a powerful domestic lobby that favoured a more nationalistic approach to military aircraft procurement. This included industry, trade unions and other government departments.⁴²

When the defence ministers of the five nations met at The Hague on 22 November, no single approach on the parameters of future industrial studies could be agreed. Instead, they decided to launch investigations of the 9.5 tonne aircraft that incorporated limited weight variations and highlighted any shortfalls from the EST.⁴³ As refined by the NADs at Bonn shortly afterwards, and as the French would not agree to a weight gain in excess of 250 kg, the requirement was that three studies should focus on aircraft of 9.25 tonnes BME, 9.5 tonnes BME and 9.75 tonnes BME.⁴⁴

Difficulties almost immediately arose between the main aerospace companies. A MOD brief on EFA prepared as early as 14 December reported British Aerospace's insistence that collaboration should be between industrial partners of equal status and not leadership by one company – in other words, Dassault. Equally, workshare should reflect national purchase commitments and not notional export sales facilitated by one partner (another clear reference to France) and the aircraft should address the established military requirement. It should not be defined by cost or arbitrary weight limitations.⁴⁵

Over the following weeks, there was limited progress at the official level: the EFA Working Group addressed itself to such issues as programme

timescales, third-party sales, work-sharing, cost-sharing and the structure and location of an International Programme Office (IPO).⁴⁶ But there were few grounds for optimism where industry was concerned. On 12 February 1985, CDP advised Heseltine that the report of the 'collaborative' industrial feasibility study would be available within days but that Dassault was expected to submit a separate report from that of the other four aerospace companies, 'at least in some areas'. Moreover, it seemed likely that the industrial studies would show that an aircraft meeting all the performance and capability requirements set out in the EST would be heavier and more expensive than most governments were prepared to consider. CDP suggested that the Air Staffs might have to agree to some relaxation of their requirements.⁴⁷

Aside from operational requirements and budgetary matters, the industrial position remains the most contentious issue in launching a collaborative programme. There is some consensus that two industrial consortia will be needed, one for the engine and one for the airframe. Progress has also been made between the industries in identifying 'work packages' comprising tasks which it would not be sensible to divide and which have manageable interfaces. There is however currently no agreement about who should undertake the various packages nor about the industrial management structure needed to meld them together.⁴⁸

This gloomy assessment was validated within days at the next meeting of the EFA Working Group in Munich. There, it emerged that Dassault had refused to engage in technical discussions with British Aerospace and the other three manufacturers. Consequently, it had proved impossible to produce a single design supported by all five nations, and the Working Group had been presented with two options for the basic 9.5 tonne aircraft, one sponsored by Dassault and the other by the remaining four companies. Two engine proposals had also been drawn up: SNECMA's concept was based on a thrust of 81 KN, while Rolls-Royce, Fiat and MTU favoured a 90 KN design. While SNECMA nevertheless appeared ready to work with the other companies, Dassault had refused to confirm a willingness to collaborate, and their representatives had lacked the authority to enter into technical discussions at the Working Group meeting.⁴⁹ Beyond this, the industrial studies had suggested that even the heaviest 9.75 tonne version of EFA would fall short of UK equipment fit requirements, and the French study had generated

further uncertainty by referring once again to naval requirements, despite previous agreements that these would not be considered in the feasibility studies.⁵⁰



*Air Chief Marshal Sir Keith Williamson, Chief of the Air Staff
from 1982 to 1985*

3. The Search for a Compromise

On 19 February, Mr Heseltine met with the senior MOD staff most directly involved in the EFA programme and again voiced his support for a collaborative solution. This was in his view ‘in the overall defence interest of Europe’, and both the RAF and industry should be prepared to compromise on this basis. However, the Vice Chief of Defence Staff (VCDS), Air Chief Marshal Sir Peter Harding, told the meeting that, while an aircraft within the 9.5 to 9.75 tonne range could not give the RAF all it wanted, ‘it looked at the moment as if the RAF could live with an aircraft in that range.’⁵¹

By this time, Heseltine’s reorganisation of the MOD and the Service staffs had resulted (among other things) in the reduction of the Assistant Chiefs of Staff to just one per Service. Responsibility for Operational Requirements had passed to the newly created Assistant Chief of Defence Staff OR (Air) (ACDS OR (Air)), and he it was who elaborated on VCDS’s point on 4 March, referring again to the different interpretations of BME. As he put it, ‘The French solution includes an allowance of 250kg for growth. However, the other four companies make no such allowance.’⁵² British Aerospace expected EFA at 9.5 tonnes to enter service at 10.075 tonnes, while EFA at 9.75 tonnes would enter service at 10.325 tonnes. This would reduce the aircraft’s aerodynamic performance, but the loss might be acceptable if there was enough space to accommodate equipment deemed by the RAF to be essential. This was not the case where the 9.5 tonne EFA was concerned.

However, the 9.75 tonne, four-company proposal has space for additional equipment ... The fundamental elements of this 9.75 tonne proposal are a 51m sq wing, a 92 KN engine and the 10cm fuselage plug ... Although the aircraft described ... would weigh some 10.65 tonnes ... this figure need not be agreed internationally. The EFA partners need only agree the 9.75 tonne 4-company proposal. This datum aircraft could then provide the baseline aircraft for nations who then wished to add their own additional equipments.⁵³

Here was the basis for a multi-national collaborative solution, provided the endorsement of all five nations could be secured. In this regard, there was some reason to be optimistic about the German position, for their Defence

Minister, Dr Manfred Woerner, generally saw eye-to-eye with the British and remained firmly in favour of a multi-national venture. That very day, he told Heseltine that he would resist any attempt by the French to construct a Franco/German alternative to the five-nation plan. Yet Woerner at this stage favoured the 9.5 tonne BME configuration over the 9.75 tonne option, and he was ultimately answerable to the Francophile West German chancellor, Helmut Kohl.⁵⁴

The difficulties involved at the industrial level were meanwhile highlighted by Sir Raymond Lygo of British Aerospace following discussions with GEC, Dowty, Ferranti, Lucas, Rolls-Royce and Smiths Industries. Lygo was deeply concerned about the outcome of the feasibility studies due to Dassault's refusal to work with the other companies, their apparent determination to lead the EFA programme and base the aircraft on their ACX design, the fact that this design would not fulfil the requirements of the EST, and their anticipated insistence on a disproportionately large workshare. This would have particularly serious consequences for British Aerospace as Tornado production declined. He argued that French involvement in the programme might seriously delay EFA's entry into service and echoed the sentiments of those in the MOD who suspected that this was Dassault's real objective.

Lygo insisted that EFA should meet the minimum operational requirements of the RAF, that there should be equal workshare arrangements between the UK and France, and that there should be a joint management organisation that distributed equitable authority and responsibility between the participating five nations with no overt leadership on airframe, equipment or engine. He also contended that a central NATO agency was required with authority to contract the industries on behalf of governments. If it was not possible to found the programme on these guiding principles, he suggested proceeding without France or initiating a UK-only project.⁵⁵

Lygo reiterated his views at a meeting with Heseltine and his staff (along with Ralph – later Sir Ralph – Robins of Rolls-Royce and representatives from the DTI) on the 12th. The French had been unwilling to participate in the joint industrial studies, had shown little willingness to compromise, and seemed uninterested in collaboration. 'The view of British industry was that the [9.75 tonne] solution ... was the best way forward on EFA.' Moreover, unless there was a change in the French position, 'the other four nations should go ahead with the project but say to the French that there was still available to them 25 per cent of the workshare if they eventually decided to join.'⁵⁶

Heseltine's vision of an international programme that included France was hanging in the balance. While he still favoured collaboration, he now expressed disappointment that the French 'seemed as yet to have not made any positive response to overtures from British Aerospace'.⁵⁷ Nevertheless, retaining his hopes that a five-nation programme acceptable to the UK might still be salvaged, he sought the support of the Foreign Secretary, Sir Geoffrey Howe – another pro-European – and Howe promptly agreed that the Foreign Office should be fully associated with the MOD's work on the EFA project.⁵⁸

Understandably but more controversially, Heseltine also raised the possibility that the UK Air Staff might consider a further compromise to secure French collaboration. At the beginning of April, a draft paper on EFA entered circulation. In its final form, this document was intended for submission by Heseltine to the Prime Minister to facilitate Cabinet discussion of the project. The paper drew attention to the deadlock over the aircraft's specifications, to continuing problems over industrial leadership between British Aerospace and Dassault, and to arguments about arrangements for programme management. At the same time, it stated that the new fighter was not essential but 'highly desirable' and continued:

The need for nations to compromise on military requirements is a recognised penalty of collaboration. Against this must be set the potential benefits in terms of defence and wider political cooperation, which for a project of this size would be enormous ... I am in no doubt that the cost and wider advantages of pulling off a successful collaboration in this case would justify some sacrifice of operational capability in the aircraft itself.⁵⁹

On EFA's weight, the draft paper contained the following expression of Heseltine's views at this time: 'I find it hard to believe that a 0.25 tonne difference should be make-or-break.'⁶⁰

Predictably enough, the draft was not well received at senior levels of the RAF. The Deputy Chief of Defence Staff (Systems) (DCDS(S)), Air Marshal Sir Donald Hall, complained that the UK's national position on EFA was 'equivocal to say the least' and argued that the Prime Minister needed more positive advice. In his view, the paper lacked balance and was too charitable to the French, who were determined to promote their ACX design. On aircraft weight, the difference in service was likely to be 0.75 tonnes rather than 0.25 tonnes and was of fundamental importance. As he put it, 'The weight difference is the difference between operational viability or not and the

higher weight needs to be fought for.’⁶¹ The Air Staff were equally perturbed. ACAS, commenting in CAS’s absence, argued that the draft did not lay sufficient emphasis on the military requirement and was too heavily focused on the issue of collaboration. ‘The introduction of an agile fighter, optimised for the air-to-air role, but with an attack capability, is essential to the RAF to prevent the development of a serious gap in our capabilities following the demise of the Phantom and increasing inadequacy of the Jaguar.’⁶²

The final version of the paper accepted that a replacement aircraft was necessary to maintain the RAF’s front-line capability, and its coverage of the weight issue was amended to suggest that a 0.25 tonne difference might not be a make-or-break issue *for the French*. It nevertheless retained the highly questionable argument that an agreement on collaboration would justify a reduction of operational capability.⁶³

The next meeting of the NADs, also on 12 March, merely worsened the impasse. CDP described it as ‘a most unsatisfactory occasion which only served to accentuate the difference between France and the other nations.’ After expressing UK concern that industry had not collaborated to produce a single design, as instructed by ministers, he had suggested that the aerospace companies should be told by their governments to do so. This line had been strongly supported by Germany, but the French NAD had refused to instruct Dassault in this way. Instead, he had proposed that officials should deal with Dassault and the other four companies separately. The NADs could only agree that officials and Air Staffs should discuss the two designs further with industry pending their next meeting in Madrid on 19 April. CDP advised Heseltine that he would hold bilateral meetings with his French and German counterparts in the meantime to pursue possible compromises, but he was not anticipating a breakthrough and he concluded: ‘We are as far apart as we have ever been, with the French seemingly very firmly behind the Dassault ACX design.’⁶⁴

This latter point was confirmed in far greater detail by the British ambassador in Paris on the 29th, who warned that the French were ‘mounting a serious campaign to win acceptance of Dassault’s ACX as the basis for the EFA project’.

The French are not subject to the same time constraints as other partners: the longer EFA is delayed, the more Mirage 2000s Dassault can hope to sell ... But they are using the period of international negotiation about the new aircraft to develop the ACX

to the point where it can be presented as a viable aircraft programme in which other partners could have confidence.⁶⁵

The ambassador maintained that the French were hoping to impose the ACX on the Germans; if they succeeded, Italy and Spain might well be drawn into the ACX programme too. If this remained unacceptable to the UK, it would be essential to mount a sustained lobbying campaign in support of an alternative project, 'with suitable tempting offers to bring the Germans and others on board'.⁶⁶

The British ambassador in Bonn offered a more upbeat assessment. The Germans favoured a five-nation collaborative project; however, if French intransigence made that impossible, they would favour a four-nation venture with the UK. German experts were also said to be 'dismissive of French ACX aircraft'. He saw the problem as Kohl, who attached an 'extremely high priority to relations with France' and viewed the French president, Francois Mitterrand, as his most important partner in the development of the EU,⁶⁷ yet this was an oversimplification. At this stage, the British and German positions on EFA's BME were still not fully aligned, at least at the political level.⁶⁸

The EFA Working Group reconvened between 26 and 28 March. As described by the Director General Aircraft 1 (DGA1), 'It was a complete waste of time.' Their deliberations very soon became bogged down in familiar but irreconcilable arguments over aircraft weight and engine thrust. Further Working Group activity was planned, including visits to British Aerospace at Warton and Rolls-Royce at Bristol, before another paper was prepared for the NADs, but significant progress appeared unlikely.⁶⁹

The situation deteriorated further at the next meeting, which DGA1 described as 'a bad-tempered affair' where 'it proved impossible to get agreement on a single form of words.' Continuing French obstruction had this time 'provoked angry comment from all the other delegations'. Among other things, the French had resurrected their demand for EFA to be suitable for carrier operations. On this basis, they maintained that limitations imposed by the arrestor gear, catapult, deck strength and aircraft lift of the Foch carrier meant that the aircraft's actual in-service BME would have to be less than 9.75 tonnes, its wing area 49 square metres and its engine thrust 82 KN. However, the NADs of the other four nations pointed out that the French Navy had not been a signatory to the EST and that industry had therefore been instructed to ignore any naval requirement.⁷⁰

4. The French Disconnection

Matters were now coming to a head as the four nations ran out of patience. It was also at this point that Perry moved sideways into the role of CDEC while Levene took over as CDP. In mid-April, Woerner met with representatives of British Aerospace, Dassault and MBB in a further attempt to break the deadlock. He subsequently told Heseltine that British Aerospace's attitude towards EFA was very co-operative. 'They approached the project in a spirit of compromise.' The same could not be said of Dassault, who had claimed that they were unable because of French state regulations to share technical information with the industries of other nations until MOUs had been exchanged between the respective governments firmly committing them to the project, which they, Dassault, should lead. Neither Woerner nor Heseltine believed that this was true, and it was hardly realistic to expect the various governments to enter into binding agreements that gave a leading project role to an aerospace company that refused to engage in meaningful technical dialogue.⁷¹

Not long afterwards, the French began arguing that the EFA requirement had been prepared without adequate definition or analysis of the threat it was supposed to counter.⁷² In fact, while the UK had withheld a limited amount of threat intelligence to protect sensitive sources, there had been detailed consideration of the threat and of the need for an agile fighter aircraft to defeat it.⁷³ The French Air Staff also suggested changing the EST if it could not be fulfilled by an aircraft with a BME of 9.5 tonnes, yet the inadequacy of EFA at 9.5 tonnes relative to the EST had been firmly established since the previous November.⁷⁴

In response, Woerner proposed yet another meeting of the five nations' Chiefs of Air Staff, NADs and industries 'to attempt to resolve remaining ambiguities and to provide a basis upon which ministers could be presented with the options they had asked for'.⁷⁵ In the UK, the Air Staff were far from enthusiastic. Even after the British Air Attaché in Bonn reported that the French had appeared to show more flexibility at the NADs meeting on 19 April, CAS declared that he could 'see more dangers than benefits in getting the Air Staffs together again' at such a late stage in the negotiations. He did not expect any compromise from the French, and it seemed unlikely that progress would be possible unless the other four nations made concessions.⁷⁶ In his view, the continuing disagreements over EFAs specifications and programme management arrangements could only be resolved at the highest political level.⁷⁷

Ultimately, the arguments dragged on into May, when a further round of meetings was due to culminate in a ministerial session in Rome that had the potential to initiate EFA's project definition phase – if an agreement could be reached. In the interim, interventions at the uppermost UK official, political and military levels sought to impose a degree of order on a process that seemed to be developing a momentum of its own. At the official level, EFA was considered by the EPC, which concluded that, 'on the evidence so far available, it was likely that the RAF's need could be met by EFA as outlined in the 4-nation 9.75 tonne proposal' and agreed that the UK should participate in the next phase of the collaborative EFA programme. The committee nevertheless invited Controller Aircraft to evaluate practicable alternative options and suggested that 'further study was needed to determine the value for money of such an aircraft and its priority in the overall defence programme.'⁷⁸

The political intervention came from the Cabinet's Defence and Overseas Policy Committee (abbreviated to OD), which discussed EFA on 7 May and established the following conditions deemed necessary before the UK could enter the EFA project definition phase:

- a) Aircraft specification to meet the RAF's requirements on performance and capability.
- b) Engine of not less than 92 KN nominal thrust, with the EFA design being capable of taking an engine of RB199 size.
- c) Equal work shares of about 25 per cent for development in the UK, France and West Germany with every effort being made to secure the front fuselage and high-pressure turbine for the UK's share.
- d) UK design leadership for engine and airframe was not a condition of entering the project definition phase, but every effort was needed to secure leadership for Rolls-Royce on the engine and to block France on the airframe.
- e) Press for project management headquarters to be in the UK but, if a location in West Germany was the only way forward, compensating concessions were needed from West Germany.

f) All relevant UK firms should be able to compete for equipment work while maintaining overall work share.

g) A common marketing organisation should be fully addressed before any project definition commitments were agreed.⁷⁹

Concern was clearly mounting in Whitehall that Heseltine might concede too much to the French in his quest for their participation in a five-nation programme.⁸⁰

Finally, at the military level, the COS discussed a lengthy paper on EFA that provided full details of the RAF's requirement, of the proposed configuration of the aircraft, of the collaborative process to date, and of the UK's proposed negotiating position for entering the project definition phase. Apart from CAS, the Chief of the Defence Staff (CDS), General Sir Edwin (later Lord) Bramall, was broadly supportive of the project, while CNS and CGS were more sceptical, partly on procedural grounds. It is not clear that the rules were set in stone, but there was evidently a convention to the effect that the COS should have an opportunity to discuss major procurement initiatives before they went to Cabinet. CGS 'observed with regret that this project had been debated in Cabinet prior to their discussion and that the Secretary of State had therefore already received political guidance concerning the negotiating strategy for the forthcoming five-nation ministerial meeting.' The COS nevertheless accepted that 'that BME, aircraft size, wing area and engine thrust could not be compromised beyond the limits discussed ... if adequate capability was to be provided.' They also agreed to support the UK's negotiating strategy as approved by the Cabinet on the basis that it applied to the project definition phase; a more definitive COS stance on EFA would have to await the completion of project definition and the studies initiated by the EPC.⁸¹

At the Rome meeting on the 16th, Woerner's steadfast refusal to accept an EFA BME above 9.5 tonnes led to wavering by the Italians and the Spanish and left Heseltine isolated as he clung to the 9.75 tonne upper limit. The five nations could only agree to hold still further NADs and ministerial meetings in London on 17 and 18 June. However, during the intervening period, there was an important shift in the German position. According to the British record, in the light of technical evidence, Woerner was persuaded by his Air Staff and technical experts that the 9.5 tonne BME limitation would impose severe constraints on EFA's capability, and he reluctantly agreed to a weight limit of 9.75 tonnes.⁸² This proved enough to win over any Italian

doubts and, with the three nations aligned behind the higher figure, greatly increased the likelihood that Spain would fall in behind them.

Meanwhile, the key industrial enterprises of the UK, Germany, Italy and Spain had all but abandoned any expectation of a five-nation solution. On 8 June, the aerospace companies addressed a joint letter to their four defence ministers confirming their broad agreement on aircraft specifications and industrial management arrangements and highlighting the continuing difficulties with France – now further complicated by the naval requirement. The letter finished: ‘We have, very reluctantly, come to the conclusion that the most profitable way forward for this very important European initiative is to build upon the high level of agreement already achieved by our four industries.’⁸³ Other key industrialists, such as Robins and Dr Greve, head of the Association of German Aerospace Companies, delivered similar communications at about this time.⁸⁴

The Secretary of State for Trade and Industry, Norman (later Lord) Tebbit, also became involved, urging Heseltine to ‘press the French very hard’ at the meetings of 17 and 18 June to harmonise their position with the other four nations and, ‘if they decline to do so, to warn them that the four nations intend to continue their co-operation without French involvement.’ He expected the Germans and the Italians to support this position. If the French were given another chance, there would be no further progress until the autumn, and the EFA project would have been in a position of virtual stalemate for nearly a year.⁸⁵

On the 18th, after the meetings, Heseltine wrote to the Prime Minister. There had been no agreement on EFA’s size, weight and thrust, and whereas the four nations had sought an equal partnership in the programme’s organisation, France wanted a design office in Paris and a French technical director. In Heseltine’s view, this amounted to French domination of the project and was unacceptable. Nevertheless, both the Germans and the Italians were reluctant to force a decisive break with France. Therefore, he had convened a final ministerial session, which produced an agreement that one last attempt should be made to find a five-nation solution. A deadline had been set for 15 July. By that date, industry was to finalise a feasibility study for one aircraft with a BME of 9.5 tonnes, plus an allowance for 140 kg of equipment, plus a contingency of 110 kg. This compromise on weight had been devised by the Germans but was acceptable to the UK. The three engine thrusts to be considered were 91.7 KN (preferred by the UK), 90 KN (Germany and Italy) and 84 KN (France). Heseltine concluded: ‘A form of

words has been agreed which implies that, if there is no common solution by 15th July, those nations able to agree on a common project will go ahead.’⁸⁶

The 17 and 18 June meetings left Heseltine with little expectation that the French would agree to an aircraft of sufficient size and thrust to satisfy the military requirement. As he admitted to Mrs Thatcher, ‘a five-nation solution acceptable to both Britain and France therefore is difficult to see.’⁸⁷ But the final compromise was essential to maintain German support for a four-nation alternative that would not be bound by arbitrary weight limitations, and it anticipated French political and diplomatic efforts at the highest levels to convert at least one of the other EFA nations – probably Germany – to their point of view. One air procurement official summarised the situation perfectly in a minute to DCA on the 19th when he wrote, ‘We need to ensure that our own views are put over clearly and positively in the right quarters, both to counter the likely French pressure and to strengthen the four-nation position in its own right.’ He saw Germany as the key and believed the Foreign Office had an important role to play through the ambassador in Bonn. He also recommended keeping other channels open, such as the Air Staffs and the procurement staffs.⁸⁸ On the 24th, the UK’s ambassadors in Paris, Rome, Madrid and Bonn all received a detailed account of the ministerial meetings and their outcome.⁸⁹

One part of the subsequent process involved inviting the Air Staffs of the five nations to participate at two-star level in UK simulations that had been used to study the performance of fighter aircraft with different characteristics. As Heseltine wrote to the other defence ministers, ‘I should be happy to make available these assessments to your representatives and offer the opportunity for your pilots to participate in further simulations.’ He also invited them to reciprocate, using their own studies. ‘Ministers would then have an agreed data base on which to draw in assessing the final feasibility study from industry.’ He directed CAS to make the necessary arrangements.⁹⁰ Meanwhile, all five aerospace companies resumed their joint work, based in Turin, examining a Dassault proposal for a single common design based partly on their configuration and partly on that of the other four nations.⁹¹

The French reply to Heseltine’s letter probably hammered the final nail into the coffin of the five-nation programme. Understandably, they insisted that the simulations should be objective. The fact that the RAF had been using simulators belonging to British Aerospace at their Warton plant therefore required some explanation. However, French demands extended much further. Effectively, they proposed returning the EFA project to Square

1 by initiating far more extensive technical investigations than any of the other nations had considered at the 18 June meeting and by changing the EST. In the words of General Capillon, their Chief of Air Staff, the Warton gathering 'should deal on one hand with the very technical definition of the parameters to be considered to settle the simulation models, and on the other hand with the adjustments that could be made in the EST'.⁹²

In response to this transparently disingenuous declaration and a similarly unconvincing communication from Hernu,⁹³ CAS advised Heseltine that the French were attempting to widen considerably the intention behind the further technical investigations. The UK had never agreed to any modification of the EST, and it remained the basis of the agreed Air Staff requirement against which any evaluation of the proposals put forward by industry could be made. Anything less than the EST appeared unlikely to satisfy the military requirement. Hernu had argued 'that simulations must be addressed to the whole package formed by the aircraft and its weapon system' but this seemed to be a further attempt to cause delay.⁹⁴

The same basic message emerged from the industrial discussions in Turin, where Dassault now declared that the five-nation EFA programme required a further feasibility study period lasting nine months followed by a nine-month project definition phase!⁹⁵ British Aerospace reported that Dassault had been 'prepared to work in a limited way with the other companies but had reservations which would prevent them from making a meaningful joint report to the NADs'. Moreover, their aim was still to dominate the project, and the French vision of governmental and industrial programme management based in Paris would potentially 'misdirect the international effort towards French national advantage'.⁹⁶

To Capillon, CAS sent a robust response, assuring him that the simulations would not involve British Aerospace but otherwise insisting that they should be restricted to an examination of varying thrust and wing area combinations, as agreed at the ministerial meeting on 18 June. To meet the ministers' deadline of 15 July, there was not enough time to complete wide-ranging five-nation studies into systems and armament variations. Most of all, there was no intention to review the EST.⁹⁷

On 3 July, the British ambassador in Paris advised Heseltine that political intervention was unlikely to help and that the UK could best direct its efforts towards countering the arguments that the French would probably employ with the Germans and others.⁹⁸ Where Germany was concerned, everything depended on Kohl's position, but on this point the reporting now became more optimistic. That same day, the British ambassador in Bonn revealed

that Kohl had endorsed Woerner's stance on EFA but had asked him to go to Paris and attempt to gain Mitterand's support for a five-nation programme that could be agreed by the 15th.⁹⁹ Against this background, the Foreign Secretary advised Heseltine to maintain regular contact not only with Woerner but also with the German foreign ministry and chancellery. 'The French will be pressing their case to the Germans at all levels.'¹⁰⁰

The meeting at Warton took place on 8-9 July. The French sent one-star rather than two-star representation. Although all delegations were given the opportunity to use the simulator, only Italy and Germany accepted the offer, and the outcome was eminently predictable. The UK, Germany and Italy agreed that the original threat assessment remained valid and were convinced that EFA needed a wingspan of 50 square metres and an engine thrust of 91.7 KN; Spain took the view that 87 KN was adequate, and France continued to press the need for further lengthy studies of six months to one year in duration.¹⁰¹ Throughout, they also argued that the EST should be revised.¹⁰² A meeting of the five Chiefs of Air Staff was scheduled at RAF Benson to consider the outcome of the Warton session and of the further industrial studies under way in Turin.¹⁰³

Over the next few days, it became clear that the five aerospace companies would not produce a single report on an agreed aircraft design by 15 July.¹⁰⁴ In Turin, Dassault had confirmed their reservations about the data of the other companies, stating that they would need to verify it before they could agree to start project definition; this would take 6-9 months. However, they were 'ready to start project definition at once on the basis of their own design'.¹⁰⁵ This was hardly unexpected. A greater cause for UK concern was an apparent shift in the German position, which left the Minister DP convinced that a four-nation EFA solution without France would be unacceptable to Chancellor Kohl.¹⁰⁶

Briefs for CAS and Heseltine over the next two days nevertheless confirmed that EFA was only likely to progress on a four-nation basis.¹⁰⁷ The British, German, Italian and Spanish companies duly reported together following the deliberations in Turin, but Dassault, true to form, reported separately. The four concluded that an aircraft sized to 91.7 KN and 51 square metres wingspan would respect the 9.75 tonne BME limit stipulated, and recommended adopting these parameters for the project definition phase. On management of the project, they were content to distribute key appointments between the participating nations and accepted that contracts should be placed by an international government agency, whereas Dassault argued against such provisions on grounds of efficiency. The briefing

documents were accompanied by data that illustrated the depths of the divide. The four-company proposals based on a thrust of 91 KN envisaged a wingspan of 51 square meters, while Dassault's figure was 46.3 square metres. Comparable figures for an engine thrust of 90 KN were 52.1 square meters for the four companies but 47.1 for Dassault. As CDEC advised Heseltine, 'For a given engine size, the Dassault designs have several square meters less wing area, and consequently inferior turning performance.'¹⁰⁸

After the 15 July deadline expired, Heseltine visited Woerner in Bonn, while the Minister DP journeyed to Rome to discuss the situation with his Italian opposite number. Their talks confirmed that there was close alignment between the defence ministries of the three capitals, but the key question remained: would Chancellor Kohl agree to proceed with EFA without France? The British ambassador met Kohl on the 18th and was extensively briefed on the EFA situation beforehand.¹⁰⁹ That day, Woerner telephoned Heseltine and, presumably at Kohl's request, proposed 'one last effort at a compromise' – a term that had also been used to describe the previous compromise.¹¹⁰ As described by the German delegation at the Chiefs of Air Staff meeting at Benson, this was still based on 89-90 KN thrust, 49-50 square metres wingspan and a BME of 9.75 tonnes.¹¹¹

The Germans formally tabled Woerner's compromise EFA configuration at the next NADs meeting on 23 July. Predictably, the French rejected it and submitted their own alternative, which envisaged an increase in engine thrust to 86 or 87 KN but otherwise barely differed from their earlier proposals. Moreover, workshare arrangements that Hernu had previously appeared to accept in which the UK, Germany and France all received a 24.5 per cent portion, were now called into question by the French representative. When the meeting ended – at 10pm – the German delegates appeared to abandon all hope of a five-nation EFA programme that included France.¹¹²

The following day saw Woerner back in Paris to explain the German position to Mitterrand and Hernu. He then proposed yet another ministerial meeting in an attempt to forge a five-nation consensus that would allow EFA to progress to the project definition phase. The meeting would again consider the German compromise configuration. However, as it was certain that the French would demand lower figures, Woerner agreed a 'bottom line' negotiating position with Heseltine of 89 KN thrust and 49.5 square metres wingspan.¹¹³ CAS saw 'substantial risk in this design' and urged Heseltine to press for 90 KN and 50 square metres, but he ultimately accepted the 89/49.5 parameters as the absolute minima and for project definition only.¹¹⁴ The Prime Minister's Private Secretary was even more sceptical, as was

Tebbit at the DTI.¹¹⁵ Nevertheless, before the meeting, Heseltine obtained the Prime Minister's authority to negotiate on this basis. Workshare was to be 25 per cent for the UK, for Germany and for France, and Munich was identified as a suitable location for the programme headquarters. Heseltine told Mrs Thatcher:

In the event that agreement is not possible between the five Nations on the above basis, Dr Woerner will almost certainly wish to go ahead without France. I would support this, although in these circumstances I would intend that the project definition study should be based on the design proposed by the industries of the four nations.¹¹⁶

In other words, if there was no further need to compromise, the constraints on EFA's configuration could be relaxed with the aim of improving its ultimate performance and capability in service. Heseltine was hoping for an audience with Mitterrand before the ministerial meeting on EFA. As he wrote in his memoirs, 'I rang the Prime Minister to ask her to use her influence to get me in to see the President of France ... She tried, but he refused to see me.'¹¹⁷

The precise course of subsequent events is not entirely clear from the official records, but such actions as occurred at ministerial level were of an informal or bilateral character. Heseltine referred to 'intensive discussions this week between me and my German opposite number Dr Woerner, and our experts, to establish a basis upon which a decision to proceed could be reached before the holiday period.'

The danger of further delay was that France would bring to bear pressure at the highest political level to secure a Franco-German solution rather than the four-nation proposal favoured by the German Air Force and German industry. To head this off, I agreed with Dr Woerner and with the Italians a package of proposals ... to which we would all subscribe and proceed with in the event that wider agreement on a five-nation basis could not be secured.¹¹⁸

Woerner's proposed ministerial meeting never took place. Instead, the decisive gathering occurred under the auspices of the NADs in Turin on 1 August. Beforehand, Woerner assured Heseltine that, irrespective of the French position, the German NAD would have the authority to sign an agreement for a 9.75 tonne aircraft with a 90 KN engine thrust and a 50 square metre wingspan, and Heseltine confirmed that, in these

circumstances, the UK would also sign.¹¹⁹ On the 31st, the Prime Minister approved this position following discussions at 10 Downing Street that also involved Tebbit and several other ministers – the Chancellor of the Exchequer, the Chief Secretary to the Treasury, the Minister of Information Technology and the Minister of State at the Foreign Office.¹²⁰

Although it extended into the early hours of 2 August, the Turin NADs meeting achieved no further progress towards a viable five-nation EFA solution. It proved impossible to reach a compromise with France, and the Spanish were not in a position to commit themselves to a four-nation programme. Consequently, just three nations – the UK, Germany and Italy – signed an agreement to complete the EFA feasibility studies and proceed to the project definition phase. The agreement also envisaged a management structure comprising a Steering Group at the top level, an IPO and two joint companies to develop the airframe and engine. The British and German workshare was to be 38 per cent each, leaving the Italians with 24 per cent. However, the three partners agreed to keep the programme open to the participation of additional countries – France and Spain – in which case there could be an appropriate adjustment of work-sharing and the division of management responsibilities.¹²¹ They set a provisional deadline of 15 August for them to signify their continuing interest in an EFA of 9.75 tonnes BME and with a 90 KN thrust and a 50 square metres wingspan.¹²²

The Prime Minister, Heseltine, Howe and British Aerospace all contacted the Spanish within 24 hours of the Turin Agreement.¹²³ Mrs Thatcher's letter to her Spanish counterpart, Senor Gonzalez, confirmed that she had always supported Spanish participation in the EFA programme and urged him to come onboard. 'I believe that by joining this new project now at its formative stage ... Spain can share in meeting one of the largest industrial challenges Europe has tackled.'¹²⁴ The Spanish government subsequently obtained an extension of the 15 August deadline to the 28th, the first date on which they could meet after the holiday period, and Spain's accession to the programme was confirmed soon afterwards.¹²⁵ General Andres, the Spanish NAD, added his signature to the Turin agreement on 12 September.¹²⁶

By contrast, there was no expectation in London of a change in France's position. Reporting from the British embassy in Paris suggested that the French were 'slightly stunned by the outcome of the Turin meeting', but a U-turn never seemed likely, and the 15 August deadline passed without any further expression of French interest.¹²⁷ However, while there appears to have been no great disappointment over the Turin Agreement at the official and industrial levels in Paris, President Mitterrand was clearly unhappy that

France's credentials as good Europeans should so obviously have been called into question. Mitterrand did not become closely involved in the EFA negotiations until the summer of 1985 and, even at that stage, the British ambassador in Paris could describe his stance in the following terms: 'Everything he knows about the British position is likely to have been filtered through people who view the UK's attitude as being inimical to French interests.'¹²⁸

Yet when Mrs Thatcher discussed EFA with the French Prime Minister at a long-planned meeting that ironically coincided with the NADs meeting in Turin, he disclosed that while 'France's "technicians" were not in favour of the European fighter aircraft ... President Mitterrand, on the other hand, was strongly for it.'¹²⁹ EFA was certainly on the agenda when he held talks with Kohl on 24 August, although it is not clear what passed between them.¹³⁰ Then, on 11 October, Mitterrand wrote to Mrs Thatcher regretting the failure of the five-nation EFA project and proposing a 20-year programme of co-operation on aviation between European states initiated by prompt meetings between defence and foreign ministers. He continued:

I also wish that the participation of our respective aircraft industries may be envisaged in the two fighter aircraft programmes which are today under development, and that the complementarity of these, both from the operational and from the technological and industrial point of view, may once again be sought. The French government is ready to submit precise proposals in this connection.¹³¹

The UK response was predictably cautious. Mrs Thatcher's reply more than a month later asked for details of what Mitterrand had in mind.¹³² On 18 November, Heseltine met Hernu's successor^b at the French Ministry of Defence, Monsieur Quiles. When Quiles suggested a need for an agreement 'in principle' on a French contribution to EFA sub-systems and equipment, Heseltine contradicted him directly. 'Agreement in principle was not what was required. What was needed were specific proposals.'¹³³ He continued:

He had no wish ... to make political statements about collaboration before they had identified the basis for success ... There was no

b. Hernu resigned in September 1985 over the Greenpeace Affair – the sinking of the Greenpeace ship *Rainbow Warrior* by DGSE operatives while she was moored at Auckland, New Zealand, on 10 July.

objection in principle to co-operation on sub-systems, weapon systems and avionics but the EFA programme could not be held up until agreement had been reached ... He would for his part welcome such co-operation to provide a better basis next time for a truly European solution, since he deeply regretted that the European aircraft industry was now going to waste 20 years competing with similar aircraft in the same markets. To that extent, he was an enthusiast for co-operation. But he had spent two years making such enthusiastic statements about 5-nation co-operation and he had paid a very heavy political price when such co-operation had proved impossible. He did not feel very anxious to go down this same road again.¹³⁴

Heseltine's underlying concern – that further French participation would only bring more delay – was shared by the main British companies involved in the EFA programme. When he met them a few days later, in addition to British Aerospace and Rolls-Royce, he specifically invited firms such as Ferranti, GEC Avionics, Smiths, Dowty and Lucas – all potentially involved in sub-systems and equipment. However, in discussion, they each expressed broadly the same concerns to the effect that that French involvement would slow EFA's development and possibly increase costs. They also clearly doubted that French industry would be interested in co-operation.¹³⁵

On the 27th, Heseltine met Woerner and they agreed that further delays were unacceptable. The French had only tabled very general proposals, which they had suggested should be discussed at a joint meeting of foreign and defence ministers, but, as Woerner pointed out, the issue had nothing to do with foreign ministers. The requirement was for concrete proposals that could be addressed by the NADs.¹³⁶

After Heseltine's resignation in January 1986 and George Younger's appointment as Secretary of State for Defence, a four-nation NADs meeting in Bonn revealed uniform scepticism about the practicalities of the French proposals and concern about their potential to cause delay. Nevertheless, as the German Ministry of Defence was under political pressure to resume collaboration with France, they all agreed on a statement that again asked for more detail – 'intended milestones and equipment specifications, norms and standards'. This was submitted at another meeting with the French NAD in Paris the following day, and he duly agreed that the statement should form the basis of recommendations to Ministers.¹³⁷

No more detail was forthcoming afterwards. Instead, Quiles wrote to Younger about the scale of the task implied and proposed the creation of a ‘structure of work’ with both EFA and ACX (or Rafale) representation, which would report to the NADS in due course.¹³⁸ After the French parliamentary elections, Quiles was replaced by Monsieur Giraud. The NADs met again in the meantime and agreed that industry should be further consulted about the French proposals, but the new government in Paris had other priorities and finally allowed the matter to rest.¹³⁹ As part of further efforts to find a partner for the Rafale programme, they made overtures to Spain in March 1987 and again in September 1988, but the Spanish remained committed to EFA.¹⁴⁰



Another early artist's impression of EFA.

5. The Turin Parameters

Shortly after Spanish participation in the EFA project was confirmed, the MOD's Permanent Under Secretary stressed to Heseltine the importance of exploiting the lessons of the Tornado programme. Among the dangers he identified were changing military requirements and the pursuit of technical innovation for its own sake. He recommended drawing fully on the ongoing aircraft and engine experimental programmes (such as the EAP and the Rolls-Royce XG40 engine), and he envisaged that the EFA project would assign more responsibility to the prime contractor than the Tornado project, for example by requiring the contractor to select equipment for the aircraft with the minimum of official involvement and to work as far as possible on a fixed-price basis. In this context, the management structure of the aircraft and engine industrial consortia would assume particular importance. The MOD staff that had dealt with EFA's feasibility phase was being enlarged for the project definition phase under the leadership of DGA1.¹⁴¹

Meanwhile, discussions were taking place at the official and industrial levels. The original concept of a single higher official group was soon modified. Top-level direction was assigned to a Steering Committee, while a Board of Directors (BOD) assumed responsibility for the more detailed and continuous management of the EFA programme. Several Working Groups were tasked with oversight of different aspects of the project and reported to the BOD. Joint design teams for the aircraft and engine were established in Munich, and a small team of officials was also formed there to provide guidance to industry as the design progressed. At the same time, the aircraft and engine companies began investigating joint company structures and internal management arrangements with the aim of establishing two international companies in Germany early in the new year. Broad agreement on workshare arrangements reached between British Aerospace, MBB and AIT soon after Turin had to be revised in response to Spain's accession to the EFA programme, and similar steps had also to be taken to finalise engine workshare allocations. It was also necessary to establish the IPO, but this could not take place before a planned Spanish referendum on NATO membership – scheduled for 12 March 1986 (Spain had originally joined NATO in 1982).¹⁴²

In the more technical sphere, familiar difficulties soon arose. The first of a long series of EFA monthly progress reports (issued in September 1985) stated:

The performance parameters of the aircraft defined in the Turin Agreement have been estimated by the companies and as expected fall slightly below the European Staff Target (EST) values. The joint design team in Munich is working with the aim of finalising the basic configuration by the end of the year ...¹⁴³

This raised immediate questions about industry's declared intention to offer project definition phase reports at the end of March 1986, potentially allowing the development phase to proceed in July.¹⁴⁴ It also heralded the start of a protracted period of difficulty between Germany and the other EFA nations which reflected divergent national priorities. For the UK, the Turin Agreement had primarily been a means to secure a four-nation collaborative programme. The so-called Turin parameters represented minimum requirements that could be relaxed if necessary to fulfil the EST. In other respects, too, UK procurement policy was guided primarily by the EST. By contrast, the Germans were more cost-conscious. They viewed the Turin BME as a maximum and opposed any increase on grounds of cost; and they tended to favour procurement options that offered cost savings even if they fell short of the EST. They immediately reacted strongly to reports that the aircraft could not meet the combined requirements of the EST and the Turin Agreement.¹⁴⁵

Moreover, other differences soon arose over such issues as EFA's radar and engine selection for the prototypes. The following month's report again commented favourably on developments in the field of corporate and official management structures and in the spheres of aircraft and engine definition but acknowledged that several difficult issues remained to be resolved. 'A major technical uncertainty' had arisen concerning the choice of EFA's radar. Industry was preparing to seek competitive bids for new, existing or modified-existing radar systems, but there were indications that Germany was interested in a modified-existing US radar, which would be built under licence in Europe. This position was at odds with the UK preference for a new European radar developed primarily under the auspices of Ferranti.¹⁴⁶

The main corporate issues reported in the next monthly progress report concerned the appointment of senior executives and the creation of firm linkages between the aircraft and engine teams in Munich to help identify potential interface problems, but the report now recorded delays with the general definition of the aircraft and its systems, and the identification of 'a number of technical issues' that might further threaten the industrial timetable. It was also proving difficult to finalise the aircraft workshare

arrangements, although the engine workshares had been agreed. Yet the aim was still to produce an interim definition review report by the end of January and to complete the final report by the middle of the year.¹⁴⁷

The basis for all this work was the EST signed in October 1984. However, in the later months of 1985, the Air Staffs of the four EFA nations sought to refine the EST into a European Staff Requirement (ESR). This had barely been completed in the last week of November when Germany, Italy and Spain declared that they wanted the new document to be signed at 2-Star level when the EFA Steering Committee met in Madrid on 5 December. Such a document was required to form part of a Statement of Work for project definition, and it needed to have formal status for contractual reasons. UK staffs had been fully involved in generating the draft ESR and it was no different from the EST in terms of aircraft mission and point performance parameters, but there was more coverage of such areas as maintainability and support. As a final draft only appeared on 2 December, there was very little time to scrutinise the ESR before the Madrid meeting and no realistic opportunity for full staffing in accordance with established EPC procedures. DCDS(S) observed:

The evolution of EFA has followed a unique path and as a result Central Committee submissions and Ministerial approvals are out of phase with the normal process of evolving a Staff Requirement from a Staff Target. We should be able to align our procedures following PD [project definition].¹⁴⁸

There was no alternative but to sign the ESR, for the other three nations were apparently prepared to do so, and CAS (now Air Chief Marshal Sir David Craig) duly approved signature by ACDS OR (Air).¹⁴⁹ At least one senior official – the government’s Chief Scientific Advisor – nonetheless expressed disquiet on the basis that the document would have considerable status. ‘It could well be difficult for us to seek a departure from its terms later if we wanted to.’¹⁵⁰

The ESR was signed on 5 December, but this did not signify a solution to the technical obstacles first identified in September. An EFA BOD meeting held in Munich on 8-9 January 1986 was advised by the aerospace companies that they had reviewed the contents of the ESR and had concluded that they could not fulfil its requirements within the constraints imposed by the Turin Agreement.

Aircraft Basic Mass Empty (BME) was of particular concern. Industry advised that their latest estimate of BME for an aircraft with provision for the national fit items envisaged in the Turin Agreement was 9,905 kg ... Industry also claimed that in order to respect the agreed ESR in full another 612 kg would be required over and above the provision made in the 9,750 kg baseline design agreed in Turin. In other words, the aircraft which was envisaged in the Turin Agreement as weighing not more than 9.75 tonnes will on latest estimates weigh 10.517 tonnes.¹⁵¹

Understandably, this revelation was received with dismay by the assembled officials. The aerospace companies were asked to propose an aircraft standard that respected the Turin Agreement and justify the increase in weight that they claimed was necessary to fulfil the ESR. The BOD also initiated a design review of each of the aircraft systems, and of the engine, to assess the industrial design proposals and explore the scope for weight reduction. The reviews were to take place in the second week of February, after which the BOD would discuss the results with industry and consider how best to progress. Independently, UK officials were also tasked to evaluate the design to find potential compromise areas between the demands of the ESR and the Turin parameters.¹⁵²

Within days, talks were in progress between industry and official weight experts in the UK and the OR (Air) and Air Engineering staffs. However, ACDS OR (Air) had for some time suspected that the Turin weight allowance was unrealistic and that the true figure was likely to exceed 10 tonnes, and he was quick to remind his colleagues that ‘negotiations leading to the Turin Agreement “straight jacket” involved a paring of aircraft capability from a position of clear advantage over the projected threat for 1995 to one of near parity.’ He therefore warned against any further reductions of operational capability in pursuit of weight-saving.¹⁵³ Yet the EFA monthly progress report that recorded the outcome of the BOD meeting partly from industry’s perspective stated that ‘some revision of the ESR appears to be inevitable.’¹⁵⁴ The German NAD, Dr Schnell, expressed his views in more forthright terms, suggesting that the EFA programme might be ‘considered unacceptable to the Federal Republic of Germany’ unless industry adhered to the Turin Agreement.¹⁵⁵

The strength of this reaction induced industry to assume a more conciliatory position. On 30 January, the Deputy Chief Executive (Engineering) of British Aerospace wrote to Controller Aircraft (who was

UK representative on the EFA Steering Committee), insisting that all four aerospace companies understood the importance of the Turin configuration, remained convinced that it could be retained in an aircraft of acceptable capability and performance, and were working towards that end.¹⁵⁶ By 5 February, CDEC could record that there was more consensus between the four governments and their contractors. A NADs meeting held in Bonn a few days later considered the points raised in Schnell's letter, and all attendees, including industrial representatives, accepted the importance of adhering to the Turin Agreement.¹⁵⁷ But an EFA design review held in Munich between 12 and 19 February merely confirmed the gulf between the requirements of the ESR and the constraints imposed at Turin. Key problem areas included the ESR's service support demands and the projected engine weight. Industry's calculations for the project definition phase were based on the Rolls-Royce XG40 technology demonstrator, which produced 40 per cent more gross thrust than the RB199 – 90 KN. At the time of the Turin Agreement, the engine weight had been estimated at 908 kg whereas by February 1986 a figure of 960 kg seemed more likely. This weight growth had to be offset from within the ESR.¹⁵⁸ The subsequent BOD meeting decided that the issue should be referred to the EFA Steering Committee for guidance.¹⁵⁹

Early in March, a meeting of the Air Staff 'Colonels' concluded that a potential relaxation in the weight restriction of 250 to 300 kg would allow most of the design shortfalls to be restored to the baseline aircraft, and industry also produced some potential trade-off ideas, including modification of the ESR and recategorization of parts of the aircraft (gun, wing tip, DASS pods) as role equipment. The Steering Committee subsequently convened and directed the BOD to initiate industrial studies over the following eight weeks that considered variants of the baseline EFA design with the aim of finding a solution acceptable to the four-nation Air Staffs and officials and within the Turin parameters. This would be followed by another design review in May, after which the results would be presented to the Steering Committee.¹⁶⁰

This two-month delay was in addition to a predicted slip of around three months due to hold-ups in the definition of EFA's radar (see below). In this context, early hopes that international development contracts for the aircraft might be let by 1 January 1987 began to look optimistic. DGA1 initially suggested to PUS that 1 April 1987 seemed a more realistic date,¹⁶¹ but the German elections planned for roughly the same time then pushed projections back to June.¹⁶² The delays threatened to open a potential gap between project

definition and full development, and the concept of an intervening ‘definition refinement and risk reduction’ phase soon began to feature in the official records.¹⁶³

On the other hand, there was steady progress towards the establishment of the aircraft and engine consortia and the IPO. The aircraft company’s name – Eurofighter Jagdflugzeug GmbH was finalised, coining the term ‘Eurofighter’ for the first time. Spain meanwhile voted narrowly to remain in NATO, thus removing the main obstacle to the establishment of the IPO.¹⁶⁴ The Eurofighter consortium was formally launched in June, while the engine consortium, Eurojet, commenced operations in September.¹⁶⁵ The IPO came into being over the following months and was named the NATO European Fighter Development Production, and Logistics Support Management Agency (NEFMA). NEFMA’s charter received formal NATO approval on 4 February 1987.¹⁶⁶

The early difficulties in matching EFA’s design with the ESR were perhaps exacerbated by inadequate contact between the various interested parties – industry, officials, Air Staffs – in Munich in the early stages of the project. From March, the official presence there was enlarged, and this apparently had beneficial effects. The EFA monthly report in April noted:

As a result of discussions between Industry and the Officials, backed by continuous dialogue with the Officials representatives now located in Munich, Industry believe they now have a better understanding of relative priorities in the Air Staff requirements and are preparing a revised baseline which they consider should satisfy the Air Staffs requirements and respect the Turin Agreement.¹⁶⁷

Industry presented the revised baseline design to the BOD on 12 May. As reported to Minister DP at a meeting with senior industrialists and officials four days later, the design now satisfied operational requirements without exceeding the Turin BME limitation. This had been achieved partly through improvements in the definition of equipment requirements and partly through a minor relaxation to the structural integrity of the aircraft. The design had also been slimmed, thus reducing weight and drag and hence the amount of fuel needed, and the introduction of convergent/divergent nozzle technology to the engines was expected to produce increased operational performance.¹⁶⁸ The design was submitted to the Steering Committee on the 20th, and the UK representative, Controller Aircraft, afterwards reported ‘complete agreement

that industry had done a good job. Industry had been instructed to use this design as basis for completion of project definition.¹⁶⁹

Yet the level of flexibility required to achieve this outcome was not entirely apparent from Controller Aircraft's account. It was perhaps for this reason that in September Younger advised Mrs Thatcher that the revised baseline EFA design would 'satisfy the operational requirements of all four nations' as well as being compatible with the Turin parameters, when this was not actually the case. Commenting on Younger's letter, ACDS OR (Air) pointed out that it was the baseline design plus national fits which it was hoped would meet the ESR to an acceptable level. Moreover, until the four nations had been able to analyse the results of the project definition phase, it would not be possible to confirm that the proposed design (including national fits) met the ESR.¹⁷⁰

It is thus not surprising that the issue of the Turin parameters should have arisen yet again in the following spring. In April 1987, the EFA monthly report recorded that project definition had progressed via a series of specialist design reviews but that there were several features of the EFA specification for which there was still not yet full international agreement. These and other problems were calling into question industry's capacity to work within the 9.75 tonne Turin mass constraint.¹⁷¹ The Steering Committee considered the issue when it met in Munich on 7-8 May and noted that BME estimates had increased due to design alterations introduced as part of the project definition process and the non-availability of a super-lightweight alloy. The committee eventually agreed that trade-offs against the ESR should be examined, allowing for a possible 2.5 per cent mass increase above 9.75 tonnes.¹⁷²

The issue was next examined by the BOD on the 20th. The meeting revealed pronounced differences of national perspective, with the Germans officially refusing to restore capability shortfalls to the ESR that led to increased aircraft mass. However, outside the meeting, there were indications that they would accept a BME of up to 10 tonnes. The UK officials meanwhile abandoned any realistic expectation of achieving the ESR within the Turin constraints.¹⁷³ Over the next two months, they worked to bring the official German position closer to the unofficial one, an approach that finally bore fruit in July, when the BOD agreed that while 9.75 tonnes should be the target, a BME of up to 10 tonnes was acceptable.¹⁷⁴

This was apparently enough to allow the Chiefs of Air Staff to sign the ESR-Development (ESRD) in September. The project had not at this stage been cleared by the respective governments to progress into the development phase, so the interim definition refinement and risk reduction phase secured

approval to fill the gap. However, the ultimate launch of development in 1988 did not entirely settle the issue: several areas of disagreement remained, where the air forces' requirements threatened to push the BME beyond the 10-tonne target. These related to nuclear hardening, fuel capacity, undercarriage, TEMPEST, EMC, and fatigue life monitoring. On 13 July 1988, Controller Aircraft wrote to his German counterpart, Herr Weiss, warning that a lack of unity between the nations was 'being exploited by industry as a means of avoiding the issues, both technical and commercial, on which they find it difficult to satisfy the requirements of the nations'.¹⁷⁵

We must not therefore permit the erosion of significant areas of overall capability merely because industry is predicting difficulty in meeting its original promises; nor should we insist on a rigid mass ceiling irrespective of the balance to be struck between mass and performance and regardless of the effect on either development or in-service costs.¹⁷⁶

Subsequently, the Steering Committee decided that the apparently informal agreement on BME should be formally recorded in a way that ensured that the ESRD would not again be compromised by arbitrary weight limitations. The 9.75 tonne 'target' was retained alongside a maximum for contractual purposes of 10 tonnes. The committee agreed that a contractual annex to the ESRD should refer to several so-called 'mass non-compliances' in respect of design features required by the air forces of the four nations. Each non-compliance was to be subject to a strict mass control exercise. This approach finally dealt with the mass issue once and for all and provided political protection for the German government by retaining the 10-tonne limit.¹⁷⁷



*George Younger, Secretary of State for Defence
from 1986 to 1989.*

Eurofighter Typhoon: Cold War Origins



The EAP technology demonstrator at the Farnborough Air Show in 1986.



EAP airborne at the same event.

6. Radar (1)

The selection of EFA's radar was a sensitive issue for the UK. The GEC-Marconi Foxhunter radar procured for the Tornado ADV (the F3 in RAF service) was a revolutionary design that ran into considerable difficulty during development; its entry into service was long delayed and the original cost estimates were substantially exceeded. The Germans did not buy the Tornado ADV and relied heavily on American technology for airborne radar in the 1980s. They would nevertheless have been fully aware of the UK's problems with Foxhunter. The MOD thus found itself in an awkward position. Fundamentally, the requirement was for a radar that achieved a significant capability advance but without the risks that had been associated with Foxhunter. By contrast, the Germans were prepared to accept a less capable radar in return for lower costs and technical risks.

These divergent perspectives proved enormously difficult to reconcile. As early as March 1986, a meeting of the Steering Committee recorded that the Germans favoured a radar based on the Hughes APG-65 whereas the UK preferred a derivative of Ferranti's Blue Vixen.¹⁷⁸ The Germans had already decided to procure the APG-65 for their Phantom fleet and saw obvious advantages – at least in terms of cost and support – in fitting the same radar into EFA. The claimed cost savings were apparently used to gain political backing for the Phantom radar upgrade: the German government offered the Bundestag a degree of commonality between the Phantom and EFA radars long before long before the agreed four-nation radar selection process had run its course.¹⁷⁹

By May, the airframe companies had been tasked to run a competition in which radar manufacturers from all four nations were invited to submit bids to equip EFA. Bids were sought against a tender package that included a Cardinal Point Specification (CPS) complying with the operational requirement for the radar specified in the ESR. The tender package, although prepared by the airframe companies, required acceptance by the four nations before issue. The nations also agreed that, during project definition, three radar options would be kept open – a new radar development, an adaptation of an existing US radar or an adaptation of an existing European radar.¹⁸⁰

During the summer, industry submitted the radar tender documentation for official evaluation, and the Directorate of the Air Staff reported to CAS on 4 September that officials of all four nations were preparing a 'Request for Proposals'. This would be issued by the end of the month with responses

required by mid-November. The four nations would need to endorse which ever radar was then adopted.¹⁸¹

In October, Controller Aircraft reported that the radar tender package was almost complete and would be issued to European radar companies later in the month. These now comprised consortia led by Ferranti and including FIAR of Italy and INESEL of Spain, and by AEG of Germany. AEG had been joined by the UK manufacturer, GEC, and participation by FIAR and INESEL again seemed likely. The four nations had agreed that radar selection would be determined through competition and that all options remained open until the competition had been held.¹⁸² However, the timetable then slipped again, and it was not until December that the tender documentation was issued. A deadline for responses of 4 March 1987 was subsequently extended to 19 March.¹⁸³

The EFA monthly report of March-April 1987 recorded that responses to the radar tender had been received and that technical and commercial assessments were under way.¹⁸⁴ Yet while all four nations had signed up to the competition process, and while consideration of the radar tenders was still very much in progress, German officials began promoting an entirely different approach whereby EFA was initially fitted with an interim radar based on established technology; they envisaged that a completely new European high-technology radar would then be developed in the longer term and retro-fitted as part of a mid-life aircraft upgrade. This concept emerged at a Steering Committee meeting in May, with the Eurofighter representative apparently serving as a German mouthpiece. According to Controller Aircraft, they ‘would effectively have aborted the competition against the agreed specification’.

They wished to review the specification with the aim of reducing cost and risk by degrading the performance level to be achieved at ISD.^c In addition, they wished the nations to undertake a technology programme for the next generation of radar ... I made it absolutely clear that so far as the UK was concerned, the competition should proceed through the assessment stage (on the basis of acceptable criteria) to the point of a Eurofighter recommendation. Nations would then decide what was acceptable in terms of cost and risk.¹⁸⁵

c. ISD – In-Service Date.

The committee agreed to toe this line, at least for the time being. Controller Aircraft's uncompromising stance reflected the UK's belief that EFA could only meet the anticipated Soviet threat if it fulfilled requirements in terms of aerodynamic performance, radar cross-section, *and* radar performance.

The competition had still not produced a winner by 1 July, when a meeting between CAS, VCDS, Controller Aircraft and DGA 1 referred to the radar as 'a potential showstopper unless the Germans could be persuaded of the need for a compliant (or nearly compliant) radar'. The issue was to be reconsidered by the BOD and then the Steering Committee, but it seemed possible that ministerial involvement might also be necessary.¹⁸⁶ When the Steering Committee finally met in Madrid on 3 September, their discussion revealed fundamental disagreements regarding the essential characteristics of the radar.¹⁸⁷ Of note, despite all the preceding work undertaken on staff requirements and targets, German and Spanish detection performance requirements were lower than those of the UK and Italy. Harmonisation between the four nations had proved impossible, and the issue of compliance thus remained open to national interpretation.¹⁸⁸

Four bids had been received from the consortia. The Ferranti radar was now known as the ECR-90, while the AEG radar had been renamed the MSD-2000; the non-compliant bids were the Ferranti Super Vixen and the AEG MSD-Basic. At the Steering Committee meeting, Germany agreed with the UK and Italy that the non-compliant bids should not be considered but promoted the concept of a semi-compliant radar, which involved fitting a more powerful transmitter to the MSD-Basic to achieve the UK's required detection ranges. However, UK requirements extended beyond the detection range into areas such as non-cooperative identification, Radar Identification and Direction (RAID), and Electronic Counter-Countermeasures (ECCM). Ultimately, the four nations agreed to examine the German proposals to see if it was possible to relax the radar's specification to reduce costs without unduly affecting its performance.¹⁸⁹

Their deliberations eventually produced a decision that Eurofighter should invite the radar consortia to resubmit tenders against a revised specification for the compliant radars and, in addition, for one alternative proposal: a radar that was substantially compliant but less costly. The four nations now reached an agreement on a common range requirement. The specification was originally scheduled for issue on 20 October, but the Germans then withdrew their agreement to the range requirement and queried another part of the specification that they had previously approved – that the computer software should be written in ADA (which was then being adopted

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as standard software programming language by the US Department of Defence and the UK MOD). The transparent effect of these and other proposed German amendments would have been to relax the specification in areas that would have benefited their preferred solutions – MSD-2000 or an enhanced MSD-Basic. At this point, the other three nations ran out of patience and tasked NEFMA to resolve the issue. Ultimately, the second request for tenders was issued in December. Bids were to be returned by the end of January 1988 and a selection decision was expected in April.¹⁹⁰



EFA design mock-ups from the late 1980s.

7. An Interim Engine

The debate on EFA's radar was pursued alongside an entirely separate disagreement concerning the selection of an interim engine for the aircraft. It is frankly surprising that this seemingly straightforward issue should also have generated a degree of controversy. A fact accepted by all four EFA nations was that the airframe would probably be ready to fly before the engine. As premature launch of the new engine could have had serious consequences in terms of both cost and programme disruption, it was clear that early prototypes would have to be powered by an established interim type. Rolls-Royce was Europe's largest aero-engine manufacturer, and the Tornado's RB199 had been produced by a UK, German and Italian consortium. That an aircraft of EFA's prominence should first take to the air powered by anything other than a European design was commercially (if not politically) unthinkable and might well have generated doubts about the confidence and capacity of the four nations to develop a new and advanced fighter engine.¹⁹¹ A decision was required before EFA's development began so that the airframe could be designed to accommodate the engine. Selection of the engine should have been a simple exercise conducted chiefly between Eurofighter and NEFMA, with their decision then being rubber-stamped by the Steering Committee.

That the issue might not be so cut and dried was first suggested by an EFA progress report covering the period May-June 1986. This document recorded that, at the request of the officials, Eurofighter was preparing detailed definitions of the interim engine and ground support requirements for prototype flying so that full costings could be obtained by competitive tendering from General Electric, USA, and Turbo-Union Ltd for the GE404 and RB199 engines respectively.¹⁹² In October, after receipt of the tenders, Controller Aircraft noted that while the UK and Italy believed that the interim engine should be the RB199, Germany and Spain favoured the GE404.¹⁹³

The subsequent deliberations extended through to the spring of 1987. Finally, in May, another EFA monthly report announced not surprisingly that Eurofighter had formally recommended that the RB199 be adopted as the interim engine. This recommendation was being evaluated by NEFMA, who would report to the next BODs meeting. 'The known German Official preference for the GE404 is expected to create problems in reaching an agreed solution.'¹⁹⁴

Before NEFMA produced their evaluation, there was another scheduled meeting of the Steering Committee. The committee heard that while the

GE404 appeared marginally better than the RB199 in terms of its technical performance, this was more than outweighed by the commercial advantages of the RB199 (which included the fact that it was cheaper). Controller Aircraft recorded:

I took the line that only exceptionally should the nations upset a Eurofighter recommendation over an item of equipment without direct relevance to the production aircraft, and I urged on my colleagues an early agreement that the recommendation should be allowed to stand. Predictably, my German colleague could not accept this. This may reflect simple lack of preparedness on his part; but more likely is evidence of the known German preference for the GE404. The EFA Board of Directors will consider the matter further, and I hope reach early agreement.¹⁹⁵

At the next BOD meeting, the German representative expressed doubts that the Eurofighter evaluation had been properly conducted and said that if 'realistic' exchange rates were used and the resale value of the GE404 was taken into account, it was more attractive commercially as well as technically than the RB199.¹⁹⁶ However, by the time that the Steering Committee met in September, NEFMA had investigated Eurofighter's recommendation in favour of the RB199 and had concluded that it was entirely valid. With the UK and Italian representatives arguing strongly for the RB199, the Spanish then withdrew their previous support for the GE404, leaving Germany completely isolated. The Germans were then asked to reconsider their position and, within a period of four weeks, state their arguments in full if they felt unable to join the other nations.¹⁹⁷

Despite the four-week deadline, a German statement favouring the GE404 was still under consideration by officials in December.¹⁹⁸ During the following spring, it became clear that German interest in the GE404 extended beyond the early EFA prototypes and was linked to growing concerns over the cost of the project, which are described in more detail below. Finally, in April, nearly a year after EFA recommended adoption of the RB199 as the interim engine, Dr Woerner (who was still the German Defence Minister) revealed to Younger that elements in his party in Germany saw in an up-rated version of the GE404 a possible alternative to the EJ200 – the planned production engine.¹⁹⁹ Apparently, Woerner did not share their outlook, but he sought and received a written statement of how the UK viewed this proposal. Younger wrote:

If it is to be acceptable to the Royal Air Force, EFA must substantially meet all the requirements set out in the ESRD endorsed by the four Chiefs of Air Staff as recently as last September. The performance of the engine is clearly one of the key parameters and the entire UK national approval process has been predicated on the assumption that EFA's engine will be the EJ200, not least because the projected Growth 2 version of the GE404 engine would fall short of the performance specified in the ESRD. I can see little prospect of convincing my Cabinet colleagues to reopen such a fundamental issue at this late stage.

I am sure you will understand that, if you were to pursue this option, the results of the UK approval process would be invalidated and I should have to start again from scratch. The effect on aircraft performance, together with the inevitable delay to programme timescales, would jeopardise the viability of this vital four-nation project and could force the United Kingdom to withdraw. For these reasons, I could not agree to the substitution of the GE404 for the EJ200.²⁰⁰

Germany's subsequent agreement to accept the RB199 as the interim engine for the first two EFA prototypes was recorded in the progress report covering June and July 1988, although the first aircraft was ultimately powered by the Rolls-Royce Spey.²⁰¹

8. Development

The Germans floated the idea of abandoning one of the two basic pillars of the EFA project in April 1988 against a background of increasing budgetary and cost concerns. In September 1987, as we have seen, the four Chiefs of Air Staff signed the ESRD, paving the way for the EFA development phase (although the definition refinement and risk reduction phase continued for the time being). Yet in the very same month, Younger was warned of growing German budgetary difficulties, which were generating pressure in Bonn to consider off-the-shelf American alternatives to EFA such as the F-16 or F/A-18 Super Hornet.²⁰² At the time, he was not sufficiently concerned about these reports to raise them directly with Woerner.²⁰³

The gravity of Germany's problems was therefore not fully appreciated until, shortly before a meeting of NATO's Nuclear Planning Group at Monterey at the beginning of November, Woerner requested a discussion with the other EFA defence ministers 'in the margins'.²⁰⁴ This began with a statement from Younger that, subject to the outcome of a forthcoming EPC meeting on 6 November, the UK was on course to begin EFA development in early 1988. His Spanish and Italian counterparts echoed his optimism, but Woerner warned that he could not count on the German government's support. There were issues of finance and opportunity cost – military programmes that would have to be cut to make way for EFA. He was expecting a 'tough fight' with his fellow Cabinet ministers and with the budget and defence committees of the Bundestag. He then demanded better cost control, claiming that costs had doubled over two years; he had to be seen to be controlling costs if he was to obtain Cabinet and parliamentary approval. He went on to recommend an attempt 'to squeeze industry as much as possible before the development MOU was signed' and warned against allowing the air forces to extend capability requirements during the development process. With a better appreciation of Woerner's position, the other ministers then agreed that the NADs of the four nations should meet as soon as possible to produce a plan for saving unnecessary costs.²⁰⁵

The NADs convened in Bonn early in December. Despite instigating the meeting, the Germans did not table any cost-saving proposals. The UK produced a list of well-established cost-control measures, which the NADs agreed should be pursued by NEFMA, and they also decided that industry

should be pressured to reduce so-called maximum prices^d by around 4 per cent on the grounds that, while the development programme was sound, the prices quoted by industry were causing political difficulties to defence ministers as they sought government approval for the programme. Subsequently, Eurofighter offered a 3 per cent reduction subject to certain qualifications and conditions, and Eurojet offered 4 per cent on a similar basis. The UK NAD, CDP, acknowledged that this would only produce limited savings for the four EFA nations, but it would give industry an incentive to manage the programme to time and budget.²⁰⁶

Predictably, Woerner was dismayed by the outcome of the Bonn meeting and claimed that it would be ‘very difficult for the government of the Federal Republic of Germany to win parliamentary approval for this project’ unless substantial progress was made. He remained convinced that more could be done to reduce development costs and limit cost increases.²⁰⁷ His stance placed Younger in a particularly difficult position. The EPC meeting on 6 November had apparently been little more than a formality, and the committee’s approval for the EFA project left him with just one more hurdle to jump – the top-level OD – to secure a UK go-ahead for development. OD consideration of EFA was therefore scheduled for 20 January. However, as it would have made little sense to approach the OD before the German position was clarified, the meeting was postponed.²⁰⁸

On 23 December, Younger replied to Woerner that he shared his concerns about controlling costs. At that time, as the cost of development work was so uncertain, maximum prices were being negotiated with industry, but the plan was to switch to fixed-price contracts in the longer term. On this basis, in addition to the 3-4 per cent cuts already agreed by Eurofighter and Eurojet, Younger believed that it would be possible to negotiate further substantial reductions over the costs as then predicted.²⁰⁹

The Christmas and New Year holidays then intervened, so it was not until the middle of January that Younger discussed the situation with Woerner over the telephone. Woerner reiterated his commitment to EFA and assured Younger that he aimed to secure German progression to development before

d. The maximum price formula was typically applied to military contracts for development or early production work before large-scale production allowed fixed prices to be agreed. Typically, they set an absolute maximum payable to the contractor. If actual costs exceeded this maximum, the contractor would bear the loss; if costs fell below the maximum, an agreed formula was normally applied to determine how savings might be shared between the government and the contractor.

he left office in May, yet at the same time he raised several issues that were under discussion in Germany that all stemmed from the perceived excessive cost of the EFA programme. These included the possibility of further co-operation with the French, American attempts to promote the F/A-18 in Bonn, and the introduction of fixed prices. He claimed that he had secured a promise from German industry to cut development costs by 1,068 million Deutschmarks (DM) but voiced concern that the UK did not appear interested in containing or controlling prices.

Younger assured him that this was not true, and the two ministers then agreed to hold face-to-face talks in London on 20 January.²¹⁰ They duly met at RAF Northolt and devised a series of proposals which, with the agreement of their Spanish and Italian colleagues, were subsequently presented to industry by officials. They were not negotiable: industry was advised that 'the governments were only prepared to go ahead with the programme on this basis.'²¹¹

The first consolidated the conditional price reductions offered by Eurofighter and Eurojet into an unconditional 4 per cent reduction, while the second involved a series of specific savings in German national costings and other areas, such as the consortia's administrative costs. Lower maximum prices would result from these reductions, and industry would be required to accept liability for 50 per cent of all costs between 96 per cent and 100 per cent of the maximum price. Any excess over the new maximum price would be borne by industry alone subject to a limit of 75 per cent of the allowable profit. This scheme effectively imposed an additional 2 per cent reduction on the maximum price and increased industry's financial liability for the contract as a whole. On this basis, it was estimated that the UK would achieve a reduction in maximum prices of 6 to 7 per cent, while Germany would reduce its outlay on the development programme to a figure Woerner believed he could sell to the German government and the Bundestag. Further savings were anticipated over time as maximum prices were replaced by fixed prices.²¹²

The various cost-saving measures were accepted by industry, albeit with some reluctance.²¹³ However, the delayed submission of EFA development for OD approval opened the door to closer questioning in Whitehall, the Secretary of State himself calling a top-level MOD meeting on 11 February 1988 to confirm that the programme's £1,800 million development cost to the UK was affordable. One particularly problematic issue concerned the provision for Defence R&D spending in the government's most recent (1987) Public Expenditure Survey. This had made no allowance for EFA. CDS (the

former CNS, Admiral Sir John Fieldhouse) also questioned the scale of the UK EFA buy – 200 production aircraft. This purchase, added to the cost of development, promised to raise the UK's total outlay to £6,550 million.²¹⁴

In light of their discussion, Younger confirmed his willingness to recommend EFA development to his OD colleagues but sought to strengthen the OD submission paper to reflect the new measures to reduce development costs and tighten contractual terms, and emphasise the close technical and financial supervisory control being maintained. This was, to say the least, opportunistic, given that the MOD would probably not have pursued these measures in the absence of German pressure. Younger also directed that the OD submission should highlight the financial difficulties involved in accommodating EFA into the wider defence procurement programme but argued that the military importance of the aircraft justified measures to make room for it.²¹⁵ The submission subsequently addressed the issue of R&D costs in the following terms:

There remains the R&D cost which, though far less than that of P120^e (£1,800M against £2,750M), is still very great. Because the ceilings on Defence R&D which were imposed ... in February 1986 were based on projections in my Department's Long Term Costing which did not include EFA (which was then at an early planning stage), it follows that EFA could only be accommodated within those ceilings at the price of displacing other projects, and of unacceptable damage to the rest of my equipment programme when FD [full development] of EFA is in full swing ... This price would be too high. If OD colleagues agree with me that the right course is to embark on FD of EFA, the ceilings on Defence R&D spending will in my view need to be raised ... If colleagues cannot agree now that the R&D ceilings should be so increased, very regretfully my advice must be that we shall have to stand aside from the project even though all the other arguments – operational, industrial and political – tell in favour of our participation.²¹⁶

At the same time, the Director of Air Plans produced a brief for CAS, which helped him to explain to CDS why the RAF needed 200 aircraft. The figure was partly based on one-for-one replacement of the Phantom and the Jaguar, which had been agreed by the EPC in April 1985. It was also calculated on

e. A national UK design by British Aerospace.

the basis of forecast attrition rates, which were influenced by experience with different aircraft types and by military judgement.²¹⁷

The OD submission (see APPENDIX 2) was cleared by the Treasury in the last week of February, and CDS (the Armed Forces representative on the OD) sought and received from CAS a briefing on the submission before the committee convened on 7 March.²¹⁸ Yet it was never likely, given the financial implications, that the OD would approve EFA development in a single sitting. The Prime Minister had a background in science and a political commitment to maintain close control over public expenditure; problems in the military aircraft procurement area, notably with the AEW Nimrod (cancelled in 1986) had been politically damaging. Mrs Thatcher also famously interested herself in the detail of policy. Therefore, it is hardly surprising that the OD deferred a decision pending further investigation of the case for EFA. The specific issue of opportunity costs was raised as well as the problem of the R&D cost ceiling.²¹⁹

On the 16th, the Prime Minister received a detailed brief from the senior MOD officials and RAF officers responsible for the programme, which involved deliberations on the threat EFA was designed to counter and a variety of capability matters. However, there was not time for Mrs Thatcher to pursue all the issues that concerned her, so her Private Secretary afterwards sent her full list of 34 questions to the MOD. They ranged across such areas as Soviet capabilities, out-of-area operations, Beyond Visual Range (BVR) capabilities, close combat simulations, computer software, radar and engine development, manufacturers' airframe guarantees, reliability and maintainability, weaponry, radar cross-section, the number of aircraft to be purchased, costs, timescales, alternatives to EFA and opportunity costs.²²⁰

Subsequently, the brief addressed to the Prime Minister had also to be presented to the other members of the OD.²²¹ This led to questions from Downing Street and the Chief Secretary to the Treasury, John Major, about whether the UK might consider purchasing the upgraded F/A-18, now known as the Hornet 2000, from the USA instead of EFA.

Younger did his best to explain that the Hornet 2000 was nothing more than a vague and poorly defined concept that would not meet the performance and capability requirements of the EFA nations, but Major was still arguing the case for this aircraft or another US concept, the Advanced Tactical Fighter (which ultimately produced the F-22) up to the eve of the next, decisive, OD session. Justifiably exasperated, Younger pointed out to him on 19 April:

All the points you now raise were taken into account in reaching our decision to recommend EFA. Earlier correspondence made this clear and I understand that our officials have discussed these and other points in great detail over many months. I am disappointed therefore that there still appears to be some lack of understanding in the Treasury of the current status and availability of information about Hornet 2000 and the ATF ... In summary, this is a major decision that has to be taken now. An immense amount of work has been carried out over the last three years by the four partners, and this has resulted in a well-defined project which is the most cost-effective solution – by a considerable margin – to the requirement. I cannot recommend either Hornet 2000 or ATF to my colleagues, nor can I accept further delay to await more details on these projects before a final decision is reached.²²²

To the Prime Minister, Younger wrote:

You have asked for my personal assurance that the EFA programme represents the most cost-effective solution available to the vital requirement for an agile air defence fighter to replace the ageing Phantom and Jaguar aircraft now in service with the RAF. I am entirely satisfied that it is, and by a considerable margin. In addition to the Chief of Defence Staff who will be present in person at the meeting of OD tomorrow, all my senior advisers, including the Chief of the Air Staff (Air Chief Marshal Sir David Craig), the Chief Scientific Adviser (Sir Richard Norman), the Chief of Defence Procurement (Mr Peter Levene), and the Controller Aircraft (Air Chief Marshal Sir David Harcourt-Smith) endorse this judgement without reservation.²²³

Meanwhile, MOD officials worked frantically with the Treasury to achieve the required relaxation of the Defence R&D expenditure ceiling. The Treasury ultimately agreed to raise the ceiling for the years that seemed likely to be the most challenging financially by a sum of £325 million.²²⁴

On the 21st, the OD duly met and approved EFA's progression to the development phase, subject to confirmation that the other three nations would approve development as well. However, having apparently won the domestic battle, Younger was once again confronted by the unpleasant reality of multi-national collaborative procurement projects. While both the

Germans and the Italians confirmed that they were likely to approve development imminently, it became clear that the Spanish had budgetary problems.²²⁵ He nevertheless delivered a statement in Parliament on the 25th confirming the UK decision to proceed to development, partly because it seemed likely to encourage the other nations to follow suit. Germany and Italy did so early in May, but Spain hesitated.²²⁶ During a visit to Madrid, CAS was warned by the British ambassador about the capacity of the Spanish contractor SENER to participate in the EFA engine programme. 'He said that they had no significant technical capability and the factory they would use was no more than a green field.'²²⁷

Early in June, another EFA monthly report noted that the MOU for the development phase had been signed by the UK, Germany and Italy, and that Spain's signature was expected later in the month, but the Spanish position was still unclear when the Steering Committee next convened on 20 July. Their representative, General Salas, explained that, due to Spanish governmental changes, no ministerial meeting on EFA development could take place before the 22nd, immediately before the holiday season. Signature of the development MOU was thus unlikely before August. Spain's capacity to achieve its 13 per cent workshare in all the prescribed areas was looking somewhat doubtful, with potential shortfalls in the areas of avionics and engine accessories, and he suggested that these might be made good later through increased participation in ground equipment and simulators. The other nations, although seeking to be flexible, could not agree to shoulder higher costs during the development phase against a promise of greater Spanish participation downstream. To the UK, Spain's problems were of particular concern because it was already clear that her engine enterprise would require extensive support from Rolls-Royce – support for which the British government could not accept financial liability.²²⁸

As the clock ticked on, the position threatened to become even more complicated. With the development MOU signed by three of the four nations, the next key step was the signature of development contracts with industry. This could not take place before Spain signed the development MOU, but Italy's budgetary process required the commitment of expenditure before the end of the calendar year. Meanwhile, in the background, the French put pressure on Madrid to reconsider participation in the Rafale programme.²²⁹

Seeking to co-ordinate the responses of the other EFA nations, CDP discussed the situation with his German counterpart, Herr Schnell, on 7 September. According to his record,

Herr Schnell ... had discussed with his staff the possible consequences of Spain now withdrawing from EFA. They had indicated that this would not produce an impossible situation, and that in particular not all of the 13% of Spain's participation would need to be found by the other 3 partners, since there would be costs saved if Spain were not a partner, not least of which would be the cost of the Spanish prototypes. The Germans feel, however, that the effect on the Italians of Spain withdrawing might be more serious, especially if any renegotiation of the programme thereafter would cause delays. The Germans feel it most important that the known Spanish difficulty over their workshare of Eurojet, where they may be seeking reduction in their development share from 13% to 11%, should be accommodated by the other partners if at all possible. This would undoubtedly be preferable to a defection by Spain from the programme.²³⁰

On the 15th, ahead of a Prime Ministerial visit to Madrid, Younger spoke to his Spanish counterpart, Senor Serra, and found him cautious, if not pessimistic, about the Spanish government's position. In particular, the Minister for Industry was concerned at the implications of Spanish investment in the aero-engine programme. He feared that Spain would have to invest heavily in an industrial infrastructure that would become redundant in less than a decade. 'A solution to the industrial aspects would require very close co-operation between Rolls-Royce and SENER.'²³¹ However, by the 20th, he was reporting 'good progress with his colleagues'.²³² The Spanish cabinet was not likely to abandon EFA for Rafale and would reach a final decision on the issue in the following week. The MOD reported to Downing Street:

Provided the inherent difficulties of industrial participation and finance could be solved this week (and we do, in fact, have a Spanish team visiting today to have talks with Peter Levene and Rolls-Royce), Serra was confident that Cabinet approval would be forthcoming; and that he would be given authority to sign the MOU and a little more money.²³³

Ultimately, the Spanish were received not only by Rolls-Royce but by senior Dowty and British Aerospace executives, and by representatives of the Society of British Aerospace Companies (SBAC). One member of the Air

PE staff noted: 'It is worth recording that within the space of a day the Spanish met nearly all the top UK and international industrialists and officials intimately connected with the EFA programme, including the chairmen of the boards of NEFMA, Eurofighter and Eurojet. They should be able to report that they have been heard with courtesy and sympathy by the most important people in the EFA programme.' Among other things, they received assurances on a range of issues that included equipment workshare arrangements and investment from both Dowty and Rolls-Royce.²³⁴ Where Rolls-Royce was concerned, this would soon lead to the establishment of ITP Aero in Spain under joint venture arrangements with SENER to fulfil Spain's workshare on the EJ200. The impasse nevertheless continued.

Yet by the time the NADs met in Brussels in mid-October, a breakthrough had occurred. All four nations now apparently agreed that the Spaniards' signature of the development MOU might be accompanied by signature of a side letter designed to address their concerns.²³⁵ On the 20th, Serra telephoned Younger and announced that 'the technical barriers to Spanish signature of the EFA development MOU had now largely been overcome.' He would shortly be presenting to the Spanish Cabinet his recommendation for Spanish participation in the programme. They were likely to reach a final decision at their meeting on the 28th. Spain would then be in a position to sign the MOU at a forthcoming meeting of the Independent European Programme Group (IEPG)^f in Luxembourg early in November.²³⁶ It was duly signed on the 9th, and NEFMA, acting on behalf of the four nations, signed the main development contracts with Eurofighter and Eurojet on 24 November 1988.²³⁷ This was nearly two and a half years later than the date originally proposed for the beginning of development. By this time, within the MOD, EFA's Initial Operational Capability target date of 1996 had been replaced by a 'UK Confidential Policy Date' of 1998.²³⁸

f. An independent informal grouping of European members of NATO, formed in 1976 with the aim of promoting European collaboration in defence equipment matters.

9. Radar (2)

Attention now turned back to the vexed question of radar selection. Following requests to industry in December 1987 for refinement of their proposals for the radar, revised bids were tabled by the two consortia led by Ferranti and by AEG of Germany (and which included GEC, now referred to in the records by the name of their subsidiary Marconi). Six separate bids were received (four from Ferranti, two from AEG). Of these, four (two from Ferranti and the two AEG bids) were judged worthy of assessment. It was always clear that evaluation and subsequent consideration of these bids by the four EFA nations would take time. In May 1988, a brief for Younger suggested that no decision was likely before July.²³⁹ In July, the Steering Committee set a deadline for selection of the radar one month after the signature of the main development contract for Eurofighter.²⁴⁰

An EFA monthly report noted in October that assessment of the radar tenders was taking longer than anticipated. Although the field had been narrowed down further to the ECR-90 and the MSD-2000, Eurofighter had been unable to produce a clear recommendation for one or the other. Particular problem areas included the MOU covering the use of APG-65 data in MSD-2000 and the lack of a German partner in the ECR-90 consortium. A meeting of the BOD was to take place in mid-November to consider radar selection, but it seemed unlikely that the issue would be resolved at BOD level.²⁴¹

In January 1989 it became clear that no agreement was possible. To quote the relevant EFA monthly report,

Eurofighter have reported on their assessment of the bids for EFA's radar. The consortium has been unable to agree on a selection recommendation and the report reflects differences of opinion between British Aerospace and MBB. The MBB assessment appears to be strongly influenced by MoD Bonn's stated preference for the MSD-2000, produced by the AEG-led consortium.²⁴²

By contrast, British Aerospace and NEFMA assessed that only ECR-90 would meet the operational requirement, and this was also the view of the UK Project Office in the MOD, supported by an independent assessment commissioned from the technology company Scicon.²⁴³

On 6 February, Controller Aircraft advised CDP that the Project Office had been considering the respective merits of ECR-90 and MSD-2000 in association with the Defence Staff and specialists from the Royal Signals and Radar Establishment and the Royal Aeronautical Establishment. They had assessed all areas of the competing bids – operational, technical risk, cost, workshare and MOU aspects. Their unequivocal conclusion was that for operational and technical reasons, ECR-90 was substantially better than MSD-2000. Indeed, their assessment was that with ECR-90, EFA would provide robust opposition, but with MSD-2000 it would be less capable than the perceived threat. In terms of cost, assessed from development through to production, the two radars were similar.²⁴⁴

A variety of factors influenced the German stance. Germany's part in the EFA development programme was subject to rigid budgetary constraints in the Bundestag, where the position of Helmut Kohl's coalition government was also challenged by strong opposition to EFA among left-wing politicians. There was also a perception inside German government, the Luftwaffe, and the media that the UK was coming to dominate the EFA programme by taking a lead role in the three highest-profile spheres of airframe, engine and radar, although Siemens had by this time been incorporated into the ECR-90 consortium. It is not clear that the Germans lacked confidence in the ECR-90 radar itself; they repeatedly argued that it involved greater risk than MSD-2000 but this was not true on purely technical grounds. Their real doubts concerned Ferranti's capacity to deliver it on time and on cost. If Ferranti failed in this regard, the impact would be greatest in Germany, where MBB had the task of integrating the radar into the airframe. Complicating matters was the fact that German ministers and their procurement officials did not all speak with one voice and at varying times emphasised different aspects of their case for buying MSD-2000 rather than ECR-90.

Ferranti's financial position became a source of growing concern. In 1987, against MOD advice and the wishes of the Ferranti family, they bought an American defence contractor named International Signal and Control (ISC). Following the purchase, Ferranti International PLC was established with a multi-divisional structure that included Ferranti Defence Systems, which was responsible for the ECR-90 radar. However, Ferranti's accountants subsequently identified a massive fraud in an ISC subsidiary, which had been employed to inflate ISC's value at the time of the merger. It also transpired that a significant part of their business had been based on illegal arms sales.

Among the British officials, statesmen and RAF officers involved in the deliberations over EFA radar selection, the true scale of Ferranti's problems was not appreciated before the second half of 1989; it was only in September that the company revealed losses of £215 million, and the Serious Fraud Office launched an investigation. Indeed, it was reasonable to suppose that the award of the radar contract might shore up their balance sheet. Consequently, for some months, the official arguments were overwhelmingly based on operational considerations: ECR-90 fulfilled the agreed staff requirement whereas MSD-2000 did not.

A Steering Committee meeting on 28 February 1989 heard German objections to ECR-90 on cost grounds but ultimately directed the BOD to finalise a selection recommendation by the end of March.²⁴⁵ However, when the Steering Committee reconvened in April, little real progress had been achieved. The Germans were now less focused on the costs of the respective radars, but they turned instead to the issue of the financial liability which both radar consortia had accepted if they failed to fulfil their contracts. The UK record described this as 'the major contribution they would make from profit and company funds to consequential costs caused by any radar delay' – in fact, some 13 per cent of those costs.²⁴⁶

Although the UK's outlook was substantially shared by Italy and Spain, it was clear that the critical disagreement was between the UK and Germany. It is thus not surprising that the issue of radar selection was increasingly addressed on a bilateral basis. On 19 April, CDP met his German counterpart, Herr Ruppelt, and heard still more about the political opposition to EFA in Germany and the costs and risks involved in buying ECR-90. There was no meeting of minds in either regard, but they decided to task independent bodies in both the UK and Germany to collaborate in producing a technical assessment of the radar options with a single conclusion.²⁴⁷

Subsequent exchanges reconfirmed that only ECR-90 met the RAF's requirements and that Italy and Spain favoured it over MSD-2000. Both radars fulfilled German requirements. AEG and Marconi had offered to cut the price of MSD-2000, but both radar prices fell within the allowance included in the overall aircraft price quoted by Eurofighter, which Germany had accepted in the main development contracts the previous November. The joint independent technical review instituted by CDP and Ruppelt meanwhile concluded that the two radars involved comparable risks. Nevertheless, during the last week of May, the Germans proposed that the other three nations bear any financial burden above that accepted by the Ferranti-led

consortium resulting from delays in radar development if ECR-90 was chosen.²⁴⁸

When the Steering Committee met again on 29 May, and NEFMA presented a discussion document that overwhelmingly recommended the selection of ECR-90 for EFA on operational and technical grounds, deadlock ensued. There was a long debate on risk-sharing, but none of the proposals tabled were acceptable to all parties. ‘The meeting more or less foundered at this point.’²⁴⁹ On 5 June, CDP met Ruppelt again. The German NAD insisted that ECR-90 would cause delays and cost increases relative to the integration work undertaken by MBB. In his view, the risks involved in writing new software as required by ECR-90 were significantly higher than those involved in employing largely existing software via the evolution of MSD-2000 from the APG-65. Moreover, APG-65 would offer a fall-back solution if the new radar ran into difficulties. CDP replied that the UK was simply concerned to get the right radar.

It was clear from the independent report that the MSD-2000 did not meet UK requirements; nor was it right for Italy, whereas the ECR-90 was acceptable from the point of view of German requirements.²⁵⁰

He also raised UK concerns about the proportion of MSD-2000 workshare that would remain with the United States and which would have to be paid for in dollars.²⁵¹

Ruppelt then returned to the issue of consequential costs resulting from the failure of industry to fulfil radar development contracts on time and on contract, suggesting that the existing 13 per cent cap could, in a worst-case scenario, lumber the German government with a bill for 100 million DM. He said that Bonn was prepared to meet costs in excess of the agreed limit of 13 per cent in respect of MSD-2000 and asked if the other three governments would accept a similar liability in relation to ECR-90. CDP replied that he could not offer a government-to-government solution but could ask UK industry to increase their liability above 13 per cent. Ruppelt said that this would potentially allow the German government to accept the ECR-90 radar option. CDP therefore agreed to talk to Ferranti and British Aerospace, while Ruppelt promised to tackle Siemens (Ferranti’s German partner) and MBB.²⁵²

CDP approached Sir Derek Alun-Jones of Ferranti the very next day and secured his agreement to consult Siemens with a view to offering the

Germans a higher indemnity. Alun-Jones told CDP that he believed they could agree satisfactory terms if it was only necessary to cover the German share of the potential liability.²⁵³ However, while Ferranti's subsequent proposals to the German government apparently conformed with Ruppelt's demands, news of the company's financial difficulties was spreading by this time, and UK proponents of ECR-90 were also being confronted by opposition from the new German Minister of State for Defence, Ludwig-Holger Pfahls. Dr Pfahls had responsibility for procurement, among other things, and exercised considerable influence. It was said that he was happier to reduce the capability of EFA than to exceed the budget and that he was a strong personal advocate of MSD-2000, his stated motives being the alleged risk and cost of ECR-90.^{254g} On 8 June, Younger spoke to the German Defence Minister, Dr Stoltenberg, but the record states that it was his subordinate, Pfahls, who said that the proposals from Ferranti were not enough:

There was a critical situation over the company and rumours of a hostile buy-out in the next couple of weeks. A Government-to-Government guarantee was needed, covering DM100-120M.²⁵⁵

Younger pointed out that Ferranti had produced 'a special deal which had been tailored to meet German concerns. He had no doubts about their capacity to pay the indemnity.'²⁵⁶ Yet when CDP again spoke to Ruppelt, the German NAD declared that Stoltenberg now wanted a complete risk analysis of the EFA programme, which should proceed on a 'design to budget' rather than a 'design to requirement' basis – arguments that the British Embassy in Bonn had already linked directly to Pfahls.²⁵⁷ MBB had also warned that selection of ECR-90 would result in higher costs and delays, and the Bundestag – for EFA alone – was refusing to agree to the annual inflation

g. Curiously, Stoltenberg, Ruppelt and Pfahls all became embroiled in a series of later scandals relating to illegal arms exports. Stoltenberg and Ruppelt were forced out of office in rapid succession in 1992, while Pfahls's behaviour ultimately landed him in jail. Under investigation for his role in an armoured car sale to Saudi Arabia in 1991, he fled Germany in 1999 and spent several years on the run before his final arrest in Paris in 2004. The enormous effort expended on his apprehension and extradition stemmed from the original charge of corruption levelled against him by the German authorities, but the corruption charge was ultimately dropped, and Pfahls was only found guilty of tax evasion and accepting bribes when he was tried in the following year.

allowance normally permitted for defence projects. In response, CDP again insisted that the acquisition of MSD-2000 was 'out of the question' and reminded Ruppelt that three studies, including the most recent joint and independent investigation, had concluded that MSD-2000 did not satisfy the agreed staff requirement. He also confirmed for a second time that the UK could not offer a government-to-government indemnity for consequential costs above the agreed 13 per cent limit.²⁵⁸

The EFA radar selection issue was now gaining a profile that extended far beyond the London and Bonn Defence Ministries. It was rapidly becoming the subject of newspaper articles, letters from concerned industrialists and constituency MPs (including letters to the Prime Minister) and questions in Parliament. As concern about Ferranti's financial situation grew, it became clear that the radar contract could decide the company's future: thousands of jobs depended on ECR-90.

The next key meeting occurred at the top level in the margins of another IEPG gathering on 28 June – this time in Estoril, Portugal. After the reiteration of the usual arguments and confirmation that Germany was in a 3-1 minority, Stoltenberg placed his cards firmly on the table. He was not convinced that the promise of a commercial indemnity would deliver. Younger drew the conclusion that the solution lay in finding an alternative acceptable to the German government as an insurance against the risks of cost and time overruns.²⁵⁹ In further discussions on 17 July, Ruppelt again sought a government-to-government indemnity and CDP again refused. It was unacceptable to the Treasury and inequitable to the industrial companies involved – notably Marconi due to their participation in the MSD-2000 consortium. Effectively, the government would be offering financial support to one British company in competition with another. Instead, he suggested that the indemnity should remain with Ferranti and be backed by a bank guarantee. The British government would act as arbitrator of the indemnity.²⁶⁰

Ruppelt agreed to put this proposal to Stoltenberg although he did not anticipate a positive response. His prediction proved accurate, for Younger's final conversation on the subject with his German counterpart merely drew another demand for absolute protection from delays and cost over-runs during radar development.²⁶¹ Shortly afterwards, Younger was replaced at the MOD by Tom King. Among the first letters King received was a communiqué from the former cabinet minister, Lord Prior, Chairman of GEC. At this stage, GEC were still backing MSD-2000 on the basis of Marconi's role, and Prior was seeking access to the new Secretary of State to

determine whether his position replicated Younger's.²⁶² King was advised against any meeting on the basis that it would probably be reported to Bonn, encouraging Stoltenberg's determined promotion of MSD-2000. GEC had already had ample opportunity to make their case.²⁶³

Throughout August, the deadlock continued. During another session in the West German capital on the 14th, Controller Aircraft confronted Ruppelt with the elementary fact that the UK position was based on the operational performance of the radar, whereas Germany attached more importance to its cost. Ruppelt did not deny it; moreover, he added that 'if FRG were to accept ECR-90 there must be no cost risk at all for MBB and that they now assessed the potential risk, for which they required an HMG guarantee, as being MDM 220.' He then went on to state that his true preference was for all four nations to adopt the APG-65, after which the EFA states and France would develop an entirely new radar for a mid-life update; the Germans had first tabled this proposal *two years* earlier. Controller Aircraft left him in no doubt that this approach was unacceptable to the UK. In his words, 'Such a route would leave us with no effective capability in ECM conditions until well into the next century.'²⁶⁴ Five days later, the opening of the border gate between Austria and Hungary initiated the chain reaction that brought about the disintegration of the Eastern Bloc, the reunification of Germany and the end of the Cold War.

At this point, as the depth of Ferranti's financial problems became clear, UK officials briefly (and in obvious desperation) considered whether MSD-2000 might be acceptable if its shortcomings were addressed. CDP suggested this approach to Ruppelt on 30 August, and the Germans then agreed that the MSD-2000 consortium should study the radar's main operational deficiencies to establish whether it could be improved. They also offered an unlimited financial guarantee to the other nations that MSD-2000 would be completed to cost and required performance.²⁶⁵ Unsurprisingly, news of this development soon leaked out and provoked a strident protest from Sir Derek Alun-Jones of Ferranti to the Prime Minister and the Secretary of State for Scotland – Ferranti Defence Systems was based in Edinburgh. The Scottish Secretary then also wrote to the Prime Minister and strongly pressed the case for ECR-90, and there were further approaches from concerned MPs and Trades Unions.²⁶⁶

The MSD-2000 consortium submitted revised technical proposals for their radar in the third week of September. These comprised two lists of additional features. List A involved minor changes at no extra cost while list B introduced significant changes for an extra 49 million DM, most of which

the Germans agreed to fund. On the 22nd, Controller Aircraft advised CDP that the proposals raised a number of technical questions, which his staff were pursuing with German industry. List A was unacceptable to the UK and even list B did not change the basic duty cycle of the radar. Meanwhile, in relation to ECR-90, the problem of the commercial indemnity offered by Ferranti had acquired an even greater significance due to publicity surrounding their losses from the ISC fraud. Controller Aircraft advised Ruppelt's Technical Director that the MOD expected to continue doing business with Ferranti, but their discussion inevitably touched on the need for action to rescue the company, including a possible change of ownership. As for the indemnity, the sum involved was now estimated at between 100 and 150 million DM.²⁶⁷

The UK technical investigation of the improved MSD-2000 was finally completed at the beginning of November. It concluded that the revised proposals merely reinforced the original British assessment: in its enhanced form, the radar involved higher technical risks and still failed to match the EFA requirement.²⁶⁸ On the 3rd, with the Berlin Wall on the brink of destruction, CDP delivered a gloomy report to Mr King.

In brief, as a result of the continuing uncertainty over Ferranti's future, we are hamstrung for the moment. Even if they were persuaded of the merits of ECR-90, I cannot imagine the Germans switching their current support to the Ferranti bid at present given the company's current financial circumstances and the uncertainty surrounding its future. Even in the UK, we could not contemplate placing a contract of this size and importance at the present time with Ferranti, a company in such an uncertain condition. At the same time, it must be open to real doubt whether any serious bidder for Ferranti will be prepared to make a realistic offer until the EFA radar decision is made ... It seems certain that the Germans will seek to exploit Ferranti's current weakness and to try to drive matters forward in favour of MSD-2000.²⁶⁹

By the time the NADs reconvened to discuss EFA radar selection, the position was becoming critical. EFA prototype manufacture was under way at all four partner companies, with front fuselage assembly at British Aerospace Warton particularly well advanced. Meanwhile, Eurojet had achieved all their scheduled milestones with the EJ200, and three design verification engines had run for some 160 hours and achieved the required

thrust, fuel consumption and engine handling qualities.²⁷⁰ But a radar for EFA had not even been selected yet. Both the Italians and the Spanish expressed considerable unease at the lack of a decision and concern about possible price rises resulting from the delay letting the radar contract. The UK and German representatives remained at loggerheads. Ruppelt could see no alternative to MSD-2000 as a common radar solution; if the other nations would not accept it, Germany might proceed on a purely national basis, adopting the APG-65. Both the British and the Italians pointed out that the capability of the APG-65 fell so far short of requirements that its incorporation into the aircraft would mean resubmission of the entire EFA project to national authorities, and possible rejection.

CDP then proposed a collaborative solution between AEG – now rebranded TST – and Ferranti. Ruppelt replied that TST and Ferranti had in fact been examining some such approach, but their work was unlikely to produce clear results before the spring. CDP suggested that this timeline might be accelerated, and the other NADs agreed.²⁷¹ This was transparently misconceived – a further reflection of the NADs’ utter desperation by the end of 1989.

On the 27th, CDP confirmed to Mr King that Ferranti and TST had initialised an agreement under which they would jointly develop a radar for EFA – a hybrid of ECR-90 and MSD-2000. He estimated that this might cost up to 100 million DM extra and add six months to the development timetable, but nevertheless recommended it as a viable solution – with Controller Aircraft’s backing.²⁷² However, when King met Stoltenberg in the margins of NATO’s Defence Planning Committee (DPC) the following day, the German Defence Minister denied any knowledge of the proposed arrangement and withdrew to seek clarification. When they reconvened the following day, Stoltenberg was predictably unhappy and blamed German industry for keeping him in the dark, but in truth he had not been briefed by Ruppelt. He viewed the proposed joint venture without enthusiasm but agreed to have it thoroughly examined.²⁷³

On 6 December, Mr King wrote to the Prime Minister, casting doubt on Stoltenberg’s willingness to accept the joint TST/Ferranti radar. He also warned that Germany might soon opt for a national solution to the radar problem, in which case the UK would have to consider the available options. As he put it, ‘I would welcome a very early view on the line that you and colleagues would support in the event that the Germans finally reject an ECR-90-based solution.’²⁷⁴

Mrs Thatcher subsequently agreed that, as a negotiating tactic, King and his staff might if necessary inform the Germans that the UK would adopt a three-nation ECR-90,²⁷⁵ but the Germans were never likely to be intimidated by empty threats. On the 15th, Stoltenberg told King that he had received a full assessment of the proposed TST/Ferranti radar. The joint venture would cause a nine-month delay, raise costs by 100 million DM, increase the risk of follow-on costs, and end the association between Hughes and TST. He could not support it. Moreover, Germany would only agree to consider ECR-90 if the British government provided a guarantee covering the financial risks involved, which his advisers now estimated at 200 million DM. If, by January, the other EFA nations still refused to accept MSD-2000, Germany would have to consider a national alternative.²⁷⁶ A brief meeting between Mr King and the responsible senior MOD staff agreed on the 19th that it was becoming difficult to envisage an outcome involving a common radar for all four nations.²⁷⁷

Soon after Christmas, Mr King arranged a further meeting with Stoltenberg on 22 January 1990. According to his subsequent letter to the Prime Minister, there were early signs that the German Defence Minister was more open to compromise for political and budgetary reasons. However, he would only consider ECR-90 on two conditions. First, he had to be convinced that Ferranti was a safe bet; second, he had to be able to demonstrate to the Bundestag that Germany would face no extra costs if the radar was delivered late to MBB.

Stoltenberg was completely unaware that, over the preceding days, GEC had been negotiating with Ferranti International to buy Ferranti Defence Systems, including its airborne radar division. King now advised him that a decision was imminent and that an announcement of the purchase was expected very shortly. As he told Mrs Thatcher afterwards, 'This not unnaturally came as a great surprise to the Germans and, in my opinion, was instrumental in persuading them that they could now accept an ECR-90 solution.' King also proposed appending a side letter of interpretation to the EFA development MOU to provide the necessary insurance to Germany against any financial risks associated with ECR-90. This would be supported by a 'back-to-back' agreement with GEC under which they – if possible, in concert with the other members of the consortium – would be prepared to provide a guarantee against any extra costs at MBB attributable to delays or defaults with the radar up to a ceiling of 200 million DM. The consortium's liability would be limited to that figure, and there would be no charge to public funds. Stoltenberg agreed that such an arrangement would meet his

concerns and undertook to recommend it to the German government with a view to reaching a final decision over the next two or three weeks.²⁷⁸

GEC's £310 million purchase of Ferranti Defence Systems was made public the following day, and the announcement provoked immediate questions in Parliament about the implications for EFA radar selection. Minister DP provided the following response:

My right hon. Friend the Secretary of State has met his German counterpart on five occasions for discussions on EFA since coming into office barely five months ago. The last was only yesterday. I recognise and, to a certain extent, share the frustration of hon. Members over the time that it is taking to decide on the future of the radar for EFA. Collaborative programmes are undoubtedly beneficial in terms of commonality of equipment, spares and support, and produce financial savings from longer production runs. We must also recognise, however, that there is sometimes a price to be paid in terms of the time taken to make decisions. I hope that the hon. Gentleman will accept my assurance that a decision is very close.²⁷⁹

Another three months of negotiations were required for GEC to complete the take-over of Ferranti and for the indemnity arrangements to be revised accordingly before their incorporation into the proposed side letter. GEC were understandably reluctant to incur the full 200 million DM liability, but there was at first some uncertainty about the willingness of other members of the radar consortium to accept equitable shares.²⁸⁰ After TST replaced Siemens in the radar consortium, Stoltenberg agreed that they should take a proportion of the indemnity, and CDP flew out to Rome and Madrid on 3 April in an all-out effort to gain assurances from Italy and Spain.²⁸¹ He confirmed his success in both capitals to Mr King the following day:

We will now inform GEC that their partners have the green light to negotiate, and to request that they now agree to provide us with the full counter-indemnity as quickly as possible. Thereafter, and subject to your receipt of the replies from your European colleagues, and the approval of your British colleagues, you should be able to sign the side letter no 3 and the radar contract should be able to be placed by Eurofighter ... P.S. I am greatly indebted to No 32

Squadron, Royal Air Force, without whose invaluable help at very short notice, I would not have been able to complete this task.²⁸²

On the 20th, Mr King advised the Prime Minister that the side letter had been drafted and agreed by EFA partners, but the staged ministerial signing event arranged in Brussels on the 23rd failed in near-farcical circumstances after internal GEC correspondence was leaked to the NADs and then presented to Stoltenberg. He 'was extremely displeased, and the end result was an instruction to withhold signature of the intergovernmental agreement pending further discussions.'²⁸³ The NADs finally signed the side letter early in May 1990.²⁸⁴



Air Chief Marshal Sir David Craig, Chief of the Air Staff from 1985 to 1988, Chief of the Defence Staff from 1988 to 1991.

In Retrospect

The final selection of EFA's radar drew a line under a process that had started at the beginning of 1983. The aircraft's primary design features were settled at last, just as the Cold War drew to a close. While in most respects the protracted saga of EFA's birth cannot be viewed as a desirable model for the future, we should not underestimate the achievements of those who saw the project through to full development. They included politicians, RAF officers, officials from the MOD, the Foreign Office and the Treasury, and industrialists from across the aerospace industry. This breadth of support provided the means to promote EFA – indeed, to fight for it – at key points throughout the period covered by this study and at many different levels. Additionally, it is important not to overlook the more successful aspects of the project in these years. Experimental work undertaken by the main industrial contractors was particularly important: EFA's ultimate success owed much to British Aerospace's EAP and Rolls-Royce's XG40. The two technology demonstrators helped to prove concepts and reduce the scale of the challenges facing industry after EFA's development was formally approved. The precise savings in time and cost would be difficult to quantify, but every pound spent by the government on these two projects in the 1980s was later repaid many times over.

Yet the two demonstrators might be seen as exceptions that prove the rule. Both were largely national projects and subject to relatively simple UK approval and supervisory processes. By contrast, the multinational EFA experienced long delays caused by the definition of the basic project and design parameters, and the cost concerns of participating nations. The aircraft was only cleared for development in October 1988, and this was more than a year before a radar selection decision that should have led to airframe, engine and radar development running broadly in parallel.²⁸⁵

Between 1983 and 1990, ministerial leadership of the MOD passed through three Secretaries of State and five Minister DPs. There was a similar rotation of senior RAF officers into and out of key positions even if the officials responsible for procurement were not so frequently changed. The MOD itself was substantially reorganised in the mid-1980s. Yet the UK's position on the EFA requirement remained consistent throughout. The turbulence that so often characterised the project in these years stemmed largely from the difficulty of achieving alignment with the other participating nations and the ill-fated attempt to incorporate France into a five-nation collaborative venture.

Michael Heseltine strongly favoured collaboration with France in the early stages of the EFA project. His extended efforts to achieve a compromise with the French stemmed from his longer-term record of supporting multinational collaborative ventures, the perceived wastefulness of Anglo-French competition in the context of US dominance of the military aerospace market, the potential complementary strengths of France and the UK in the airframe and aero-engine fields, and the promise of lower costs resulting from the participation of five rather than four nations. The Mirage's success in overseas markets might also have helped to secure lucrative export orders for EFA, and the German government strongly favoured a collaborative arrangement that included France.

However, Heseltine's vision proved impossible to reconcile with the rivalry that existed between the major aerospace manufacturers, France's determination to dominate the project, and the gulf between the operational requirements of the *Armée de l'Air* and those of the other four air forces. Dassault's considerable political influence also limited the scope for genuine compromise. Consequently, negotiations with the French largely involved concessions that cut back the original OEST and reduced EFA's anticipated margin of superiority over the more advanced Warsaw Pact fighters. This process was viewed with dismay by the RAF, which was acutely aware of the Tornado F3's air-to-air combat limitations and determined that the new aircraft should possess the dogfighting capabilities that the F3 lacked. It was soon abundantly clear that the fighter envisaged by France would not provide them.

Furthermore, the UK, Germany and Italy fully understood the strength of France's negotiating position and became increasingly suspicious that this was being deliberately exploited to delay the EFA project while the development of ACX/Rafale moved rapidly forwards. The French stance became increasingly suspect during the first half of 1985, during which time they proposed further extended studies of the EFA requirement and the revision of the EST. They also demanded project management from Paris and introduced naval operational requirements that had not featured in the EST.

At the time, it was argued in official, RAF and government circles that Heseltine was conceding too much in his attempts to secure French participation. Arguably, the issue should have been forced sooner, allowing project definition to start earlier. Yet we should not underestimate the strength of German support for collaboration with France. It is unlikely that the Chancellor Kohl and his government would have agreed to participate in

the four-nation EFA programme until every possible effort had been expended on reaching an accommodation with the French, and there were also differences between the UK and Germany over the technical parameters of the aircraft that were not resolved until the spring of 1985.

Ultimately, there were no real winners or losers in this process. While effective and well managed collaboration between European aircraft manufacturers might have improved their capacity to compete with the United States (as Heseltine maintained), the official records suggest that the many and varied problems involved in managing a four-nation project would have been magnified in a five-nation undertaking. To that extent, EFA probably benefited from France's departure. It is hard to imagine a five-nation partnership surviving throughout EFA's development and the seismic strategic shocks of the 1989-91 period, and the withdrawal of one of the leading nations later on would have generated far greater difficulties than the French disconnection in 1985. At the same time, the French genuinely wanted partners for the ACX/Rafale project – albeit on their terms – and subsequently spent several years seeking alternative collaborative arrangements without success. They were left with a far larger bill for Rafale than they originally anticipated but with a simpler programme management task given that the aircraft was almost entirely built in France.

For the remaining EFA nations, any expectation that the project might subsequently advance along more consensual lines cannot have lasted long. Friction was soon evident between Germany and the other states, which stemmed chiefly from cost concerns, associated political pressures and industrial considerations in Bonn. The UK's determination to procure an aircraft that fulfilled the defined operational requirements clashed directly with Germany's repeated demands for tighter cost control.

The results included a series of drawn-out arguments over the Turin Parameters and the choice of the interim engine (RB199 vs. GE404), extended deliberations on the cost of the programme, and gridlock over EFA's radar selection. This latter problem was compounded by Germany's established relationship with Hughes for airborne radar procurement and mounting evidence that the radar favoured by the other three EFA nations was designed by a company – Ferranti – that was in desperate financial trouble. The first round of tenders failed completely, the second took an entire year but to no avail, and the arguments then continued throughout 1989 as the Ferranti crisis deepened. A solution was only finally provided by GEC's acquisition of Ferranti Defence Systems in the early months of 1990.

Yet if the history of the EFA project during the last years of the Cold War is hardly a compelling advertisement for the multinational collaborative defence procurement concept, there was no obvious alternative in the 1980s. With the RAF desperate to obtain a new fighter capable of challenging the most modern Soviet aircraft, the government insisted that there would be no solution that did not involve collaboration. A purely national approach was deemed unaffordable, and the disadvantages of buying a foreign aircraft were all too obvious. The implied abandonment of the UK military aerospace industry and the cost in terms of lost jobs and high-technology industrial capacity would have been particularly damaging politically in an era of industrial decline and high unemployment.

A foreign – almost certainly American – purchase would also have represented another major step along the road to total dependence on the US for military aircraft. Furthermore, such fighters as were available ‘off the shelf’ could not deliver a sufficient air-to-air combat advantage, and their replacements existed only as concepts. There was no guarantee that they would progress into development, let alone production. Ultimately, the F-22 programme amply demonstrated the potential costs involved in purely national projects. It was deemed too expensive even by many US commentators, and a UK purchase of sufficient size for the RAF would have been far beyond the realms of affordability.

The list of procurement options considered in the 1980s – national, collaborative or foreign – is not necessarily exhaustive. History might provide a case for exploring hybrid alternatives – a clear national design lead alongside a buy-in of collaborative or foreign sub-systems and equipment, whether off-the-shelf or developed in tandem with the basic aircraft. Some such approach might perhaps prove more straightforward in project management terms than the multi-nation, multi-enterprise consortium-based model. Yet there appears to have been no appetite in the early 1980s to reconsider the established collaborative approach or instigate more than quite limited changes to the procurement and industrial structures developed for the Tornado, and experience with the Jaguar and the Tornado pointed to an arrangement that included France, Germany and Italy. Moreover, if the EFA project was subject to a particularly high level of inter-governmental friction in the 1980s, some disagreement between participating nations in such complex and costly ventures is always likely. The key requirement of the military, official and industrial procurement machinery must therefore be flexibility and the capacity to deal with friction as and when it occurs. It will never be possible to eliminate friction altogether.

Eurofighter Typhoon: Cold War Origins

Equally, it would be unrealistic to expect that there will be no need for periodic compromises or concessions to achieve consensus across all participating nations and progress at the industrial level. The story of EFA's Cold War origins suggests that the key is to adopt negotiating positions that provide room for limited manoeuvre but not a reduction of capability below the specified requirement. It does not suggest that this will be easy.



*Tom King, Secretary of State for Defence
From 1989 to 1992*

APPENDIX A

Key dates in early Typhoon development

Date	Detail
01/12/1983	The UK, France, Germany, Spain and Italy Chiefs of Air Staff agree and issue an outline Air Staff Target for a new combat aircraft to enter service with the respective air forces for all five nations in the mid-1990s.
01/07/1984	Launch of initial feasibility study for new European combat aircraft.
23/04/1985	Chief Scientific Adviser (CSA) seeks Ministerial approval for project definition phase.
07/05/1985	OD agree to project definition phase for EFA and studies into alternatives, including UK national solution.
01/08/1985	France withdraws from European combat aircraft partnership in favour of its own national solution.
01/08/1985	Commencement of project definition phase.
19/09/1985	First full meeting of the EFA Steering Group, which became the Board of Directors (BOD).
05/12/1985	European Staff Requirement (ESR) agreed.
05/12/1985	First full meeting of the EFA Steering Committee.
21/02/1986	Treasury approval for EFA project definition.
28/04/1986	BOD agrees to the extension of the project definition phase until 30 Sep 86 in view of additional tasks placed on industry.
12/05/1986	EPC approves (ex-committee) extension of project definition phase to 30 Sep 86.
01/06/1986	Formation of Eurofighter Jagdflugzeug GmbH (EF GmbH) in Munich as the primary weapons system (aircraft) contractor.
02/06/1986	MOD seeks Treasury approval for P120 evaluation.
07/06/1986	Finalisation of baseline build standard for weapon system.
09/06/1986	Treasury approval for P120 evaluation.

Eurofighter Typhoon: Cold War Origins

23/06/1986	Contract with British Aerospace for EFA project definition studies, effective from 1 Sep 85 until 31 Jul 86, but later extended to 30 Sep 86.
26/06/1986	Contract with Rolls-Royce for EFA Engine project definition studies, effective from 1 Sep 85 until 31 Jul 86, but later extended to 30 Sep 86.
08/08/1986	British Aerospace flies the Experimental Aircraft Programme (EAP) advanced technology demonstrator, ZF534, from Warton.
01/09/1986	Completion of project definition phase.
01/09/1986	Eurojet Turbo GmbH formed to develop and produce the EJ200 engine.
1/10/1986	Start of definition refinement and risk reduction phase – effective until 31 Jul 87.
21/10/1986	European Fighter Aircraft (EFA) General MOU 1 Signed. This MOU was concerned with the general principles governing the conduct of the programme.
18/11/1986	MOU 2 – Project Definition phase signed. This MOU covered the definition work necessary to enable partners to reach a decision on whether to proceed jointly with full development.
27/11/1986	EPC agreement (ex-committee) to definition refinement and risk reduction phase (retrospectively from 1 Oct 86).
27/11/1986	MOD seeks Treasury approval for definition refinement and risk reduction phase funding.
12/1986	First issue of EFA radar tender documentation.
15/12/1986	MOD seeks Ministerial approval for definition refinement and risk reduction phase.
18/12/1986	Treasury approval for definition refinement and risk reduction phase expenditure.
19/03/1987	Deadline for responses to first EFA radar tender request.
30/07/1987	EPC approves (ex-committee) extension of definition refinement and risk reduction phase to 31 Dec 87,

Eurofighter Typhoon: Cold War Origins

	with assumed start date for full development of 1 Jan 88.
06/11/1987	EPC endorses submission for full development of EFA.
12/1987	Second issue of EFA radar tender documentation.
31/01/88	Deadline for responses to second EFA radar tender request.
21/04/1988	OD agrees to EFA full development. Cabinet informed.
25/04/1988	S of S announces to Parliament UK decision to embark on full development, subject to satisfactory contractual negotiation.
04/05/1988	Germany announces decision to embark on EFA development.
16/05/1988	MOU 3 Development phase signed by UK, Germany and Italy. This MOU covered the design, development and demonstration of a weapon system along with cost and risk assessments which would enable participants to reach a decision on whether to proceed jointly with a production phase.
09/11/1988	MOU 3 Development phase signed by Spain.
24/11/1988	Main development contracts signed by NEFMA.
25/11/1988	First UK (retrospective) payment released to Eurofighter for development work undertaken prior to contract signature, covering the period Jan to Oct 88.
29/11/1988	First UK (retrospective) payment released to Eurojet under main development contract, covering period Jan-Oct 88.
28/02/1989	EFA Steering Committee directed BOD to finalise radar selection by 31 Mar 89.
10/04/1989	EFA Steering Committee recorded continued deadlock between the four nations on EFA radar selection.
03/11/1989	CDP reported to Secretary of State for Defence that proposed improvements to MSD-2000 radar would fail to meet the EFA requirement.
23/01/1990	Minister DP advised Parliament of GEC acquisition of Ferranti Defence Systems, paving the way for selection of ECR-90 radar for EFA.

APPENDIX B

CDP to Secretary of State for Defence, 14 November 1984

EFA Negotiations

You may wish for an early report on the NADs' meeting which was held in Bonn on Monday to prepare for the Ministerial discussions in The Hague next week. A fuller brief will be provided within the next few days.

2. After a difficult debate lasting some 7-8 hours all five NADs agreed the attached formal report to Ministers. It does not recommend that any decisions of substance should be made at the Hague.

3. It does suggest that Ministers should ask their Air Staffs to reconsider the European Staff Target (EST) which they recently signed, because full compliance with its performance, mission and capability targets would imply an aircraft mass substantially larger than the 9½ tonne compromise weight reached in Madrid. Formal direction by Ministers will be required before we can conduct joint industrial studies at higher weights because France regards 9½ tonnes as an absolute limit.

4. It also suggests continuation of the Industrial studies into an aircraft having an in-service mass limit of 9½ tonnes since work done since Madrid has cast considerable doubt, at least in UK, German, Italian and Spanish eyes, about whether such an aircraft could achieve the performance and capability expected when the Madrid agreement was reached. Resolution of this can only be obtained from more detailed studies.

5. In the light of these uncertainties it has not been possible to make any recommendation, at this stage, about the various engine issues.

CAS to CDP, 15 November 1984

EFA

1. I have been keeping in close touch with EFA activities during the run-up to the Ministers' meeting in The Hague on 22/23 Nov. I was encouraged to learn that, following the recent officials and Air Staff meetings in Paris, we were in a firm 4-on-1 position, with the French in the minority. It was heartening to hear that the Germans were emphasising performance rather than weight, and that they were beginning to distance themselves from the French. This change in emphasis, combined with the UK lead in hot-end engine technology, seemed to augur well for the future.

2. I was therefore disappointed to read the NADs report, at this interim stage, following your meeting in Bonn on 12 Nov. The report implies that the French position on a/c weight should be the basis for further work, and that the other nations, and in particular their Air Staffs, are out of line. The specific points I would like to make are:

a. Interim FS Report. My staff advise me that the Interim Industrial report states clearly that EST operational capability (in terms of manoeuvrability, range/payload and equipment) is not compatible with a 9.5 tonne BME as required by the July Ministerial Resolution. That being so, we have an entirely new debate, and French insistence on the weight limit should be no more influential on the outcome than our own (4 nation) insistence on performance at, or very close to, that specified in the recently endorsed EST. These points are not clearly spelt out in the NADs report, and I believe that it is important that the Secretary of State should be specifically briefed on them.

b. Engine Thrust. I understand that the Paris meeting established clearly the wish of 4 nations to have a minimum thrust of 90 Kn. The minimum in-service requirement is very important, but is not mentioned in the NADs report.

c. NADs Recommendations. Recommendations 5.1 and 5.2 appear to anticipate the EST being downgraded and amended to become

compatible with a 9.5 tonne BME. This would be a far-reaching conclusion which should surely be counter-balanced by the need to revise weight upwards to meet EST (or near EST) performance? For my part, I am prepared to instruct my own Air Staff to discuss with the Air Staffs of the other 4 nations the relationship between weight and critical aspects of manoeuvrability, payload/range and weapon system effectiveness. However, I believe that very convincing arguments will have to be put forward before we can consider accepting any further compromise in these areas. I would certainly not expect any compromises to be made before the completion of current Technical and Industrial Studies.

May I ask that these important points are reflected in the brief to the Secretary of State for his forthcoming meeting?

APPENDIX D

Secretary of State for Defence to the Prime Minister, 26 February 1985

European Fighter Aircraft

In my minute of 19th July last I reported the agreement reached in Madrid by Defence Ministers of the United Kingdom, France, Germany, Italy and Spain to launch a six-month collaborative technical and industrial Feasibility Study of a single-seat twin-engined European Fighter Aircraft (EFA). The report on this study has just been received in national capitals and is now being analysed and assessed. Since the participating nations will shortly have to decide on the next step forward, I wish to give colleagues forewarning of the major and complex issues that the Government will need to consider. I stress that the military, technical and financial assessment is not yet finished, and to this extent therefore our perspective is provisional and incomplete.

2. The industries of the five nations have not achieved unanimity in their joint study, and two proposals have been put forward: a majority proposal from the industries of the United Kingdom, Germany, Italy and Spain, and a French proposal from Dassault, based on their demonstrator aircraft the ACX. (We should not be too encouraged by being with the majority because the French industry and their Government sponsors have been at pains to keep their links with the other three nations in good repair; I return to this below). The two airframe proposals are very similar, and both conform to the weight specification of 9½ tonnes basic mass empty (BME), with a tolerance of ¼ tonne upwards or downwards, as previously agreed by all the nations. There is however a significant difference in engine size, with the French proposing an engine some 10% smaller than the majority proposal.

3. As foreshadowed in my minute of 2nd July last, in parallel with the 5 nation study of EFA we have undertaken our own independent studies of alternative options available to us, assuming that funding can be found from the defence budget. These are a twin-engined national development; a single-engined national development; an off-the-shelf purchase of a United States aircraft (F15, F16, F18 or F20); and building an American aircraft under licence in the UK. These studies too are incomplete but will be brought to a conclusion in time to enable all options, including EFA, to be considered together.

4. The issues as I see them are as follows:-

- (a) Success in meeting the military requirement;
- (b) Cost;
- (c) Industrial impact;
- (d) The benefits of collaboration, and whether collaboration can be secured.

I deal with these in turn.

5. The military requirement. This is for an aircraft with sufficient speed, acceleration and agility not only to defeat in air combat the fighters which the Soviets will be able to deploy after 1995 (probably improved versions of the already highly capable FLANKER and FULCRUM), but also to remain effective against increasingly powerful opposition throughout the first two decades of the new century. It must also be adequately equipped, and this affects weight. The 9½ tonne specification for EFA is a compromise, agreed by my French counterpart M. Hernu and myself, between the 10½ tonnes or so which my military advisers judged to be necessary and the lighter design of 8½ tonnes initially favoured by the French. The preliminary assessment of our Defence Staff is that the four-nation version of EFA would possibly yield an acceptable margin of superiority provided the ¼ tonne upward tolerance (see paragraph 2 above) was used, giving a BME of 9¾ tonnes and thus providing the space required for equipment; and provided also that an engine of adequate thrust was installed (see next paragraph). Since the French tend to disregard the tolerance and to look on tonnes as a rigid limit, there may be a difficulty here. A heavier nationally-developed aircraft would give greater confidence of fully meeting the operational requirement and countering the forecast threat; likely developments of existing US designs would be inferior.

6. Engine size is important. Disagreement with the French over this reflects not only our desire to give the aircraft adequate performance and capability to meet the threat, but also a unique British need to re-engine the air defence variant of the Tornado later in its life, for which purpose only the larger EFA engine would be adequate.

7. Cost. No cost comparison based on industrial proposals is yet available. In-house parametric studies suggest that the total programme cost to the UK

of a twin-engined national development would be some 15-20% dearer than a collaborative EFA, but judgement must be reserved until we have the true figures.

8. Industrial impact and collaboration. These go together. I have already reported on the initiative which my fellow Defence Ministers and I took in The Hague last November to strengthen the work of the Independent European Programme Group (IEPG) and to give a new impetus to equipment collaboration in Europe. The next fighter aircraft provides the greatest challenge in this field. If we could avoid the duplication of design and development effort which has up till now characterised the military aircraft scene in Europe the prizes would be enormous. The participating nations would start with their own requirements amounting in total to 800-1000 aircraft, and might readily expect to approach that number in the export market. While the Tornado started with a three-nation home base of a similar size, only Dassault with their Mirage series of designs (of which some 1500 have been sold abroad) have come close to providing a challenge to the dominance of the United States. Collaboration on an EFA, if attainable, would thus open up new export opportunities for British industry; equally important, the financial burden of developing a major new aircraft would be shared among five partners, to that extent easing the pressure on the defence budget.

9. It is in this politico/industrial area that I believe the main difficulties lie. While in my judgement M. Hernu and some of his senior advisers are genuinely interested in seeking a collaborative programme which includes the United Kingdom, we know that he is under tremendous pressure from French industry, from their trade unions and perhaps from some other Government departments to continue with a national military aircraft procurement policy which has proved extremely successful in the past. An element of collaboration with other European nations would be acceptable to this lobby only if it took place under clear French leadership.

10. Our own industry, while willing to cooperate on equal terms, have strong reservations about whether this is possible given current French attitudes. British Aerospace (BAe) in particular are concerned that their interests should not be sacrificed in a deal which tacitly allowed Dassault to take the lead on the airframe in exchange for Rolls-Royce being given the lead on the engine. However, since the French seem keen to establish their engine

company SNECMA in a position from which it could challenge Rolls Royce in world markets, it may be that the French themselves would not press for such an exchange.

11. Realising the political realities which we both face, Hernu and I have agreed that a collaborative project can go ahead only on the basis that there can be "no winners and no losers" in each of the three main sectors: airframe, engine and equipments. It will in my view require a conjunction of political will at the highest level to achieve this.

12. I have concentrated on the Anglo-French relationship because I believe that this is the linchpin of the whole project. In my judgement Germany, Italy and Spain would fall in line with any reasonable Anglo-French agreement. Should we not be able to reach agreement with the French, however, I do not think we can assume that the close relationship built up between the United Kingdom, Germany and Italy on the Tornado project would automatically ensure the isolation of the French. While much warmth and understanding remains among the military and procurement staffs who have been and are still involved in Tornado, we have to recognise the strength at the political level of the Paris-Bonn axis, and we must acknowledge that we could find ourselves the isolated party.

13. The next steps. My military, technical and financial staffs are working hard to complete their assessment as rapidly as possible. I have already made clear my wish that the Department of Trade and Industry should be fully associated with this work, and this applies equally to the Treasury and the Foreign and Commonwealth Office to the extent that they wish to be involved. This will be important because the 5-nation Ministerial meeting to consider the results of the Feasibility Study, originally planned for March, is now expected to take place in late April or early May, and we shall need to have a national position ready by then. Peter Rees has drawn attention to the awkward coincidence of timing between the impending discussions on EFA and the BAe offer for sale. Clearly this needs to be watched, but we cannot realistically expect the EFA problem to stand still for a period of weeks until the BAe sale is out of the way.

APPENDIX E

Chief Executives of British Aerospace (Sir Raymond Lygo), Messerschmitt-Bolkow Blohm (Dr Hanns Arnt Vogels), Aeritalia, Societa Aerospaziale Italiana (Dr-Ing Renato Bonifacio) and CASA, Construcciones Aeronautics SA (Fernando de Caralt) to Secretary of State for Defence, 8 June 1985

We are writing to express our concern that very little real progress on a five-nation basis, has been made this year on the important matter of the new European Fighter and to seek your help in resolving the key issues which are preventing our industries' responding effectively to your requests.

The present situation is that our four companies have put forward a joint aircraft proposal to meet the performance requirements of the EST with a target weight of 9.5 tonnes, a maximum weight of 9.75 tonnes, and engine of 88KN (after 150 hours in service) having sufficient volume for equipment to give an effective operational capability to meet the requirements of our Air Forces.

We have also agreed between us the way the programme can be jointly managed.

Unfortunately, we do not have an agreed joint design between the five nations including France, because the French have insisted upon a different interpretation of the allowances for weight growth and for operational equipment. Also, until after your meeting in Rome, Avions Dassault-Breguet would not discuss technical matters in sufficient depth to permit the joint study of a single concept. There has been an exchange of information during the last few weeks, but unfortunately, the major difficulty over the definition of weight allowances still remains. Further, since the meeting with the NADS on 3rd June, we have an additional difficulty in that we have been requested to study the French Naval version for which we have no clear specification, but Dassault insist that it is an integral part of the main programme and therefore we are again at an impasse on technical work.

These difficulties will be reflected in the report which we are giving to the NADS for your meeting in London on 17th and 18th June.

As regards organisation, we have made some limited progress with Dassault but on the key questions of location, overall management responsibility, technical leadership and work shares, we have been unable to make real progress.

We understand that the engine manufacturers are suffering similar difficulties in defining a joint engine and their own management arrangements.

In summary, whilst we have made good progress between our four companies, we have to say that we have made no real progress during the last six months on a five-nation basis.

Unfortunately, we detect no change in the basic French desire to have a smaller aircraft (which does not meet the EST operational requirement), and in the objective of Dassault to have effective overall leadership for the project. So far the main differences have been expressed in the form of technical arguments about performance and weight, but these fundamental differences cannot be solved by our engineers, therefore, further discussions on this basis will not achieve any progress. The key issues have to be clarified at a political level so that we can enter the project definition stage, which we hope will start this summer, with a clear and agreed statement of requirements and objectives. If the basis of work in this important next phase remain ambiguous we shall make no further progress during the next year, leaving the same set of problems still before us next Spring. We think that such a situation must be avoided.

We are all positively in favour of a five-nation solution, but we are seriously concerned by the possibility of continued delay. We have, very reluctantly, come to the conclusion that the most profitable way forward for this very important European initiative is to build upon the high level of agreement already achieved by our four industries by making it clear at the highest political level to our French friends, that we intend to continue our co-operation and that they have to make up their minds now if they wish to work in a truly joint programme, but at the same time to assure them that the door remains fully open for them to join this programme if they so wish. We recognise that such an approach could have political difficulties, but we are quite clear that the continued ambiguity and further delay will be very damaging to hopes of successful European collaboration.

APPENDIX F

Secretary of State for Defence to the Prime Minister, 18 June 1985

European Fighter Aircraft

During the last two days, there have been three further meetings of Defence Ministers concerned in the European Fighter Aircraft project; I should report the outcome.

2. Although it had been hoped that the industries of the five nations would work together to produce a single set of options for Ministers to address, in the event this did not prove possible and we had before us 16 alternative permutations on the basic mass empty (BME), wing area, and engine thrust of the aircraft. On these issues, the Germans, the Italians and ourselves sought an aircraft designed to a 9.75 tonne limit, with an engine thrust of 91.7 kilonewtons, in order to meet the European Staff Target. The French took the line that an aircraft with an engine of this capability was incompatible with the weight limit and that the aircraft should be designed to a 9.5 tonne weight limit, with the remaining 250 kg set aside as a specific contingency, with an engine thrust of 84 kilonewtons. The Spanish position was somewhere in the middle.

3. On the organisation to manage the project and its location, again the Germans, ourselves and the Italians stressed that we sought an equal partnership and that the location of the headquarters and the allocation of top posts within the organisation should be looked at as a package. I made clear our first preference for the headquarters to be in London. The French put in a bid that a “joint design office” responsible for the integration of the project should be located in Paris and that the Technical Director of the project should also be French. They offered that Britain could head one of the industrial consortia. I emphasised that these proposals would amount to French domination of the project and were not acceptable.

4. On work shares, there was some movement towards agreement that shares during development should be 24.5% for the United Kingdom, France and Germany, 16.5% for Italy and 10% for Spain. France put in a bid for a bigger work share to take account of their stated requirement for additional aircraft for the French Navy, but did not rule out that this could be addressed at the

stage of setting work shares for production. This argument would apply equally to production work shares on the engine which would take account of our requirement for additional engines for the re-engining of the air defence variant of the Tornado.

5. There was no time for a discussion of the interim engine, on which we have the support of the Italians only for adopting the RB199.

6. This sets out in headline form the formal position which emerged during the plenary sessions. There was also a good deal of private exploration of positions. At the outset, Dr Woerner emphasised the importance he attached to reaching an early decision and his unwillingness to compromise on the characteristics of the aircraft if this meant that the requirement would not be satisfied. He appeared to have the agreement of his Government to proceeding, if the French were unwilling to move, on a three or four-nation basis. Equally, as time went on, he showed himself most reluctant to bring about or to participate in a decisive break at this stage because of the political consequences for the wider Franco-German relationship. Senatore Spadolini, while also committed to an aircraft of the characteristics which we seek, was also reluctant for there to be a breakdown before the Milan summit is out of the way.

7. To meet German concerns that all opportunities for agreement should be explored, I convened a final meeting today restricted to Ministers only. This produced an agreement that one last attempt should be made to find a common five-nation solution but, to meet British and German concerns for the matter to be resolved, a deadline has been set of 15th July. By that date industry is to finalise the feasibility study for one aircraft with a BME of 9.5 tonnes, plus an allowance for 140kg of equipment, plus a contingency of 110kg: this “compromise” on weight was devised by the Germans to go some way towards French concerns but is acceptable to us. Industry are to look at three options for engine thrust: 91.7 (our preferred solution), 90 (which the Germans and Italians would now accept), and 84 (the French formal position, although informally they went at one stage as high as 87 kilonewtons). A form of words has been agreed which implies that, if there is no common solution by 15th July, those nations able to agree on a common project will go ahead. We have pencilled in the possibility of a final Ministerial meeting on 22nd July in Bonn, although there is German reluctance to preside over a meeting which could represent the break-up of the project.

8. Realistically it seems unlikely, on all the past form, that the French will move towards an aircraft of sufficient size and engine thrust to satisfy the military requirement: a five-nation solution acceptable both to Britain and to France therefore is difficult to see. Of alternative combinations, the firmly stated military and industrial requirements of the Germans and the Italians would point towards agreement on a three nation project (UK, Germany, Italy) which meets our requirement. But I have to say that the political concerns about such a course which have been exhibited by Dr Woerner in the last two days are very real and we cannot rule out the possibility of the French moving sufficiently to offer a politically tempting alternative. The position then remains finely balanced. I think it will be necessary for colleagues to consider our final position when the industrial report is to hand and before any possible meeting with my European counterparts.

9. I am copying this minute to the Foreign and Commonwealth Secretary, the Chancellor of the Exchequer, the Secretary of State for Trade and Industry and Sir Robert Armstrong. In view of its contents I should be grateful if it could be given a restricted distribution within Departments.

APPENDIX G

Secretary of State for Defence to the Prime Minister, 26 July 1985

European Fighter Aircraft Negotiations

1. Events have continued to move since I last reported on the 5 Nation EFA negotiations. The National Armaments Directors met in Madrid on Tuesday and, as Dr Woerner had previously told me, the German delegate tabled a 'final compromise' proposing an aircraft design of 9.75 tonnes basic mass empty (BME), having an engine thrust of 90 Kilonewtons and a wing area of 50 square metres.

2. The German compromise also made proposals for management structures which shared the key posts between nations in an equitable way and suggested Munich as the international headquarters. Worksharing was proposed on an equal partnership basis with the United Kingdom, France and Germany taking one quarter of the work each during development, with the remaining quarter split between Italy and Spain. Production workshares would be on the basis of national requirements for numbers of aircraft.

3. Officials of Italy and the United Kingdom both agreed to submit these proposals to their Ministers for consideration. France made a counter-proposal more closely aligned to their national design (87 Kilonewton thrust, 49 square metres wing area) while Spain floated in between.

4. Following this meeting of officials, Dr Woerner visited Paris on Wednesday to explain the German position to President Mitterand and M. Hernu. He subsequently told me that, whilst there is still a clear gap between the French position and the other nations, the German Government is suggesting one last meeting at Ministerial level to try and forge a 5 Nation agreement to enter the Project Definition phase. Such a meeting could take place next Tuesday at a location yet to be agreed. As you know, I am also hoping to have a private meeting with President Mitterrand in the next day or so.

5. Since the meeting of Defence Ministers would be our last chance to achieve a 5 Nation solution to EFA, we need to be quite clear on the 'bottom line' for our negotiating position. I therefore held a meeting yesterday evening with the Managing Directors of British Aerospace, Rolls-Royce and Ferranti to discuss the situation. Geoffrey Pattie was present. The Chief of

the Defence Staff, the Chief of the Air Staff and my senior officials were also in attendance.

6. We fairly rapidly reached complete agreement that the German compromise described above was acceptable as a basis for agreeing a 5 Nation Project Definition study, even though the engine thrust of 90 Kilonewtons and wing area of 50 square metres are slightly below our preferred figures of 91.7 Kilonewtons and 51 square metres.

7. But France will certainly press for lower figures and Dr Woerner has told me privately that he will if necessary go down to 89 Kilonewtons and 49.5 square metres. I therefore sought the views of my military advisers and industry on these figures and, after considerable discussion, all present at my meeting agreed that, if it became necessary in order to reach a five-nation agreement to enter the Project Definition phase, I could as a last resort and as part of a total agreed package accept a 9.75 tonne design having engines of 89 Kilonewtons thrust and a wing area of 49.5 square metres.

8. Industry were generally very supportive of the organisation, location and workshare proposals made by Germany, but there are other key issues in the package which will also have to be resolved satisfactorily. In particular I agreed the following points with industry:

a. Although the maximum use will be made of data obtained from the British and French demonstrator programmes, EFA must be a completely new aircraft design and not a "stretched" version of the French demonstration aircraft.

b. British Aerospace should have a share of two important areas of the programme: firstly the design, development and manufacture of the aircraft front fuselage, and secondly the location of flight testing.

c. Only Rolls Royce have the necessary experience to undertake development of the high pressure turbine (a view which I know that Germany and Italy endorse).

9. At our discussion in OD on 7 May 1985 (OD(85) 5th Meeting) we agreed on the technical and administrative objectives I should pursue in the negotiations. In the light of subsequent developments I now need to determine the irreducible bottom line to which we might go in order to secure a successful 5 nation solution of the project. With the support of my military

advisers and industry, I therefore propose to adopt the following absolute bottom line for agreement on a 5 nation Project Definition study for EFA:

1. The aircraft must be of a new collaborative design and not a derivative of any existing single nation's design.

b. The aircraft design is to have a Basic Mass Empty (BME) of 9.75 tonnes and a wing area of not less than 49.5 square metres.

c. The engines must have a nominal thrust of not less than 89 Kilonewtons.

d. Development workshares are to be on the basis of the United Kingdom, France and Germany taking equal shares of about 25% and, as the opportunity arises, we should insist on the high pressure turbine being part of the Rolls-Royce package and British Aerospace having a share in the front fuselage design and manufacture and in flight testing.

e. The German proposal for locating the international headquarters in Munich and for sharing the key posts between nations in an equitable way.

10. In the event that agreement is not possible between the 5 Nations on the above basis, Dr Woerner will almost certainly wish to go ahead without France. I would support this, although in those circumstances I would intend that the Project Definition study should be based on the design proposed by the industries of the 4 nations having a 9.75 tonne BME, an engine thrust of 91.7 Kilonewtons and a wing area of 51 square metres. In no case would I agree to a 4 nation solution that went below the German compromise position – upon which they might insist – of 90 Kilonewtons engine thrust and a 50 square metres wing.

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

APPENDIX H

ACDS OR(Air) to DCDS(S), 16 January 1986

European Fighter Aircraft – Basic Mass

You may recall Reference A which highlighted my view that weight growth and equipment fit had been inadequately allowed for in Company 9.5 Tonne + 250 kg Basic Mass Empty (BME) aircraft proposals. I provided evidence, which was supported by the PE, that a realistic BME would be in excess of 10 Tonnes. You will have seen from Reference B that the cat is now out of the bag on the weight issue. None of the essential facts presented by the 4 Companies at the January Board of Directors meeting came as any surprise to me; I was only surprised that the Companies chose to make their revelation quite so soon rather than nearer the end of the Project Definition phase.

In taking the next steps in this critical issue, it is vital that Industry and Officials argue from the same datum. To this end talks are already planned within the next few days between appropriate UK (Company and Official) weight experts, and the OR(Air) and Air Engineering staffs. Obviously full staff support will be given to the international meetings outlined by DGA1 in Reference B.

DGA 1's minute heralds a difficult period ahead and I feel it is timely to reiterate the underlying military need for this aircraft. Negotiations leading to the Turin Agreement 'straight jacket' involved a paring of aircraft capability from a position of clear advantage over the projected threat for 1995, to one of near parity. It is clear that any further significant trimming of operational capability (the sum of aerodynamic, range/payload and equipment performances) could result in a design inferior to that we expect in the WP inventory at the end of the century.

APPENDIX I

Dr Manfred Woerner, Minister of Defence of West Germany, to Secretary of State for Defence, 17 December 1987

The meeting that we all agreed in Monterey should be held between our armaments directors and representatives of the industries participating in the EFA has in the meantime taken place. It was to serve two purposes: First, to reduce development costs and second, to effectively limit cost increases.

According to the reports I have received the meeting did not produce any significant results.

I regret this very much. As I said in Monterey, it will be very difficult for the Government of the Federal Republic of Germany to win parliamentary approval for this project unless substantial progress is made in both fields.

I therefore ask you to understand that I do not wish to content myself with the result achieved.

It seems to me not at all unrealistic to make progress in both areas if we stand together and express our unmistakable political will as defence ministers vis-a-vis industry. There are indications that the costs assessed at present for development and procurement do indeed leave room for a reduction.

In view of the huge sums at stake here, I believe that as a necessary next step for the continuation of the cooperative programme we should jointly task the state secretaries to negotiate a substantial cost reduction and effective cost limitation.

This would have to take place right at the beginning of next year so that unnecessary delays in the programme are avoided. If you could agree to this proposal, I will ask State Secretary Dr. Timmermann to arrange the details of the further proceeding with his colleagues.

APPENDIX J

THE EUROPEAN FIGHTER AIRCRAFT

Memorandum by the Secretary of State for Defence (formally approved by the OD on 21 April 1988)

1. In May 1985 (OD(85) 5th Meeting) the Committee approved a negotiating position for my predecessor for impending discussions with European colleagues on the projected European Fighter Aircraft (EFA). On 2 August 1985 my predecessor informed the Committee that agreement had been reached with Germany and Italy (but not with France, who withdrew from the project) on the characteristics of an EFA and arrangements for a project definition (PD) phase. Shortly afterwards Spain joined the programme.

2. The PD phase has now been completed and follow-up work on design refinement and risk reduction is in hand. We now need to decide whether or not to sign up for full development (FD) of a 4-nation EFA at an estimated cost to the UK of £1800M at average 1986/87 prices. I recommend that we do so.

3. The operational role and main characteristics of EFA are summarised at Annex A. The RAF needs EFA to replace its air defence Phantoms and ground attack Jaguars at the end of their lives and to complement the Tornado F3 air defence aircraft. We face a major threat from Soviet bombers, armed with stand-off missiles and capable of reaching any part of the UK, which can now be escorted at least to the point of missile release by long-range agile fighters. The Tornado F3, although a highly capable aircraft, cannot cope with such escorted raids alone; without an agile fighter such as EFA the escort fighters could limit the Tornados' opportunities to engage the bombers, many of which would succeed in attacking their targets. The only alternative to an agile fighter might be a strong defensive shield of modern surface-to-air missile systems; but these would be very expensive in the numbers required and, being land-based, would in any case lack the range required to hit the bombers before they launched their missiles. In the central region of NATO, where the threat is predominantly from fighter-bombers, the existing Phantoms are already outclassed. Availability of EFA, in conjunction with the modern weapons in the defence programme, would dramatically improve the effectiveness of our air defences in the UK and the Central and Northern Regions of NATO, swinging the balance of attrition

(which in the absence of EFA would be to the enemy's advantage) heavily in our own favour. Studies have been made to compare EFA's effectiveness with that of a number of alternative options (listed at Annex B), including UK national programmes of the kind discussed by OD in May 1985. The studies concluded that EFA is the most capable option, and that all options except the national P120 are grossly inferior to EFA and would indeed be ineffective against the threat foreseen. As Annex B shows, the P120 would cost us substantially more in both budgetary and R & D terms.

4. I am accordingly satisfied that EFA promises to be not only the best military solution but also the most cost-effective. In terms of technology however it is a highly demanding project and there are significant technical risks, notably as regards engine and radar performance and the possibility of weight growth (though the risks have been reduced through demonstrator programmes for airframe and engine). This raises two questions: can the required performance be achieved and will effective contractual disciplines be applied to ensure that the contractors meet the specification within cost?

5. As regards the first question, my experts have made what they judge to be a realistic assessment of the minimum performance EFA is likely to achieve. Even at that level of performance it would still be far superior to all the other options save P120; but, more important, it would still be adequate to counter the threat. The P120 would be subject to the same technical risks as EFA and is as I say more expensive. As regards the second question, the proposed procurement arrangements are summarised at Annex C. Payment to the contractors will be tied to achievement; the onus will thus be on them to achieve the specified performance. The development programme will be controlled through regular technical milestones which will be linked to progress payments, and the contractor will not be paid in full except on demonstrated achievement of a complete work package. Both prime contracts will be covered initially by maximum prices (for all but 15% of the Eurofighter contract – see Annex C paragraph 2), to be converted to fixed prices, against which the contractors will then assume unlimited financial liability to meet the contractual requirements. Industry's acceptance of this risk demonstrates their own confidence that the performance can be achieved and thus provides powerful reassurance for us.

6. In January my German colleague and I agreed proposals for reducing the maximum prices of the prime contracts below the cost figures quoted in this

paper. After obtaining the agreement of the Italian and Spanish Defence Ministers we put these to industry, with whom our officials have since negotiated a satisfactory outcome. These measures will increase the incentive for industry to perform, because their profit margins will be at significantly more risk, without prejudicing the contractual remedies available to us.

7. The British aerospace industry is now geared to moving ahead with EFA and is expecting a commitment by the Government. Although the industrial arguments are not primarily my concern, EFA is central to the planning of British Aerospace, Rolls Royce and most of the rest of the British aerospace industry.

8. £1800M is a huge sum, and I do not wish to minimise the size of the commitment which I am inviting colleagues to undertake (there is no way of reducing the commitment; FD is the logical next step once PD and follow-up work have been completed). Prudently, therefore, I have had to consider what the position would be in the very worst and I trust unlikely case in which the project went so badly wrong that we wished to wind it up or disengage from it. The results of this analysis are summarised at Annex D. The potential losses are considerable, though obviously their extent depends on the circumstances of our withdrawal. The other side of the coin is that the withdrawal terms would be equally onerous for our partners, and their very severity minimises any risk that they would let us down once we were all committed to FD.

9. At a total cost to the UK of £6550M for development and production of 200 aircraft for the RAF, the project is one of our most expensive. Compared with Trident, which has a longer procurement period and a slower build-up of expenditure, the procurement of EFA is expected to consume about the same proportion of the defence budget over its period of procurement, but a higher proportion of our equipment spending (though the latter would still be less than the share taken by the Tornado programme, which involved two variants of aircraft and a higher UK offtake (385 planes)). The peak years of expenditure on EFA (1993-2003) would be later than those of Trident (1989-1994); the overlap between expenditure on the two projects is therefore not a major difficulty. But I do not underestimate the budgetary problem. I shall have difficulty in accommodating EFA's cost in the peak years within defence budgets no greater in real terms than those in the current PES period.

However, the military importance and priority of EFA leave me with no option but to find room for it, despite the difficulties of funding.

10. There remains the R & D cost which, though far less than that of P120 (£1800M against £2750M), is still very great. Because the ceilings on defence R & D which were imposed by E(A) [see endnote 214] in February 1986 were based on projections in my Department's 1985 Long Term Costing which did not include EFA (which was then at an early planning stage), it follows that EFA could only be accommodated within those ceilings at the price of displacing other projects and of unacceptable damage to the rest of my equipment programme when FD of EFA is in full swing. (In 1994/95, for example, in order to accommodate the £205M required for EFA I should have to jettison some 13% of the R & D programme which could otherwise have been afforded within the present ceiling of £1550M, which itself represents a reduction of one-third below the 1985/86 level.) This price would be too high. If OD colleagues agree with me that the right course is to embark on FD of EFA, the ceilings on defence R & D spending will in my view need to be raised.

11. Based on the latest assessment of the defence programme affordable within the PES 87 control totals, I would be content in the period up to 1991/92 (the final year of PES 88) to meet two-thirds of the currently assessed R & D cost of EFA; but for subsequent years the problems I face in meeting the E(A) constraints are such that an increase equal to the full R & D cost of EFA in these years will be required. The increases in the R & D ceilings which I seek are shown in line 2 of Annex E. (As Annex E shows, this would still yield a reduction of virtually one-quarter in total defence R & D spending by 1994/95, consistent with stated Government policy.) If colleagues cannot agree now that the R & D ceilings should be so increased, very regretfully my advice must be that we shall have to stand aside from the project even though all the other arguments – operational, industrial and political – tell in favour of our participation.

12. At their meeting in May 1985 OD instructed my predecessor to take steps to make it possible for the UK to withdraw from the EFA programme without political difficulty at the conclusion of the PD phase, if this proved necessary. That decision point has now been reached. It is of course open to us to pull out of the project. If we do so, it will almost certainly collapse, and the likelihood is that an alternative project led by France will emerge. But I do

not propose that we should take the course of withdrawal. On the contrary, I am clear that the only way of meeting the RAF's requirement for an agile fighter is to proceed with the development of EFA on the terms I have described above.

13 . I invite colleagues:-

- (a) to agree that the UK should participate in the full development of a 4-nation EFA;
- (b) to note that the total estimated cost of development and production of 200 aircraft for the RAF is £6550M;
- (c) to note that participation will only be possible if the annual ceilings on defence R & D expenditure are raised;
- (d) to agree that the ceilings should be raised as proposed in paragraph 11.

ANNEX A: FUNCTION AND CHARACTERISTICS OF EFA

1. EFA's primary role will be air defence, ie interception and destruction of attacking aircraft and cruise missiles; it will also have a secondary air-to-surface role, ie attacking targets on the ground and tactical reconnaissance. Its characteristics, of which the most important are agility and ability to engage airborne targets beyond visual range, are defined in a European Staff Requirement (ESR) to which the military staffs of the four partner nations have all subscribed. For the UK EFA is planned to replace the RAF's Phantoms and Jaguars, whose fatigue life will begin to expire towards the end of the century. RAF EFAs would be deployed in the UK (mainly in south-east and eastern England), in Germany and, as necessary during operations, in Norway, Denmark or outside the NATO area. The principal threat they would counter is that of attacking Soviet bombers, some armed with stand-off missiles and others with free fall bombs, escorted by high-performance fighters of the new generation (FLANKER, FULCRUM and FOXHOUND) armed with highly capable air-to-air missiles with ranges of up to 75 kilometres.

2. The ESR is based on the so-called “Turin parameters” which were agreed by the three original partner nations (UK, Germany and Italy) in August 1985. (Spain too accepted them.) These were an aircraft weight of 9.75 tonnes Basic Mass Empty (BME); a wing area of 50 square metres; and two engines each with a thrust of 90 kilonewtons. Design of the aircraft has proceeded on this basis. As one outcome of PD the four nations have agreed a revised BME just short of 10 tonnes. The addition of an allowance for UK national fits, together with MOD’s assessment of the mass growth likely in a programme of this nature, will result in a higher figure estimated at 10.57 tonnes. This higher figure has been used in performance studies.

3. It is estimated that EFA could enter RAF service in 1998. MOD’S forward planning assumes that 200 aircraft will be purchased for the RAF; no decision on numbers has yet been made. The UK’s declared offtake, on which the UK workshare is based (see Annex C paragraph 1), is 250.

ANNEX B: ALTERNATIVE OPTIONS CONSIDERED

1. The following alternative options have been examined by MOD alongside EFA:-

- (a) P120 – a national design by British Aerospace, with a Rolls Royce engine (the RB540);
- (b) P120A – a lower performance version of (a);
- (c) an improved version of the McDonnell-Douglas F18, built either in the USA or under licence in the UK;
- (d) a mixture of further Tornado F3 and Harrier GR5, the former already in RAF service, the latter shortly to enter it.

Of these, only the P120 would provide the minimum acceptable performance against the military requirement. Two other possibilities, the Advanced Tactical Fighter (ATF) planned for the US Air Force, and an advanced short take-off and vertical landing (ASTOVL) aircraft, were also considered but were rejected after initial scrutiny on grounds of uncertainty, risk and cost.

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2. The comparative costs of the main contenders are as follows (all figures at average 1986/87 prices, dollar conversions at £1=\$1.50):-

	Cost of development	Cost of acquisition (development, production, initial spares etc)	£M Cost of acquisition plus operating and support costs over 20 years
EFA	1800	6550	14100
P120	2750	8100	15400
*-----			
P120A	1400	5850	13100
Improved F18:			
US built	300	4400	11300
Built under licence in UK	500	5100	11900
Tornado F3/ Harrier GR5	100	3950	11850

* All options below this line fail to meet the minimum acceptable level of performance.

ANNEX C: PROPOSED PROCUREMENT ARRANGEMENTS

1. For the development phase of the project, work has been allocated to the partners in the following proportions:-

UK	33%
Germany	33%
Italy	21%
Spain	13%

Each nation will pay for the work undertaken by it.

2. Two prime contractors are envisaged, both based in Munich, with whom separate development contracts will be placed:-

- (a) Eurofighter, the prime contractor for the entire aircraft. This is a consortium consisting of British Aerospace, MBB/Dornier (Germany), Aeritalia (Italy) and CASA (Spain);
- (b) Eurojet, the prime contractor for the engine. This is a consortium consisting of Rolls Royce, MTU (Germany), FIAT (Italy) and SENER (Spain).

Eurofighter will be responsible for integration of the engine and all other equipments into the aircraft. Under the terms of the contracts Eurofighter and Eurojet will be required to meet the prescribed specifications and to demonstrate that they have done so on the basis of specific acceptance criteria. Both contracts will be subject to incentive price terms: initially maximum prices, to be converted later (as soon as possible, and in any event before each work package is 33% complete) to fixed prices. This applies to all but 15% of the Eurofighter contract; it is not possible to agree maximum prices for 100% of the work at the outset since precise equipment standards and weapon interfaces are not fully specified at that stage. As the equipment competitions are completed and other current uncertainties are removed it will be possible to bring these elements of the programme within the maximum price. Industry has agreed that all work will be brought within a

maximum price at least twelve months before the start of production activities. While a maximum price regime is in force, any excess over the maximum that may be incurred will be borne by the contractor up to a limit of 75% of his profit. Beyond that point the contractor may be required to continue working at no profit. The contractor's liability will be unlimited in respect of work covered by fixed prices. The development programme will be controlled by means of a system of technical milestones. A proportion of regular progress payments will be retained against the achievement of milestones and will not be paid in full except on successful completion of a package of work. If achievement of a milestone were delayed more than six months, the payment plan would be reviewed.

3. A new engine, the EJ200, is planned for EFA. An established interim engine will be used in the early prototype aircraft; there is a competition between the American GE404 and the European RB199.

4. There are two contenders for the radar, both based on existing radar systems. One is offered by a consortium led by Ferranti, based on their Blue Vixen radar for the Sea Harrier; the other by a consortium led by AEG (Germany), based on an American radar (the Hughes APG 65).

5. The project will be managed by an intergovernmental agency (NEFMA), also based in Munich.

ANNEX D: CONDITIONS APPLYING IN THE EVENT OF WITHDRAWAL

1. It is proposed that the withdrawing partner should be liable for the rundown costs of his own national industry; the costs of transferring the means of production (if the other partners so wished); and other costs to enable the programme to continue (if that is the case). The formal limit of liability would be the withdrawing nation's overall liability under the Memorandum of Understanding (ie its declared share of the development outlay, which for the UK is likely to be a little less than £1.8 bn at average 1986/87 prices). But the partners would be required to negotiate to find the most economical way of discharging the withdrawing partner's liability.

2. The cancellation charges which Eurofighter and Eurojet would make would reflect their own forward commitments (which they will be required to minimise as far as possible) and those of their sub-contractors (which for sound procurement reasons are not required to be minimised).

3. The cost to the UK of withdrawal has been calculated on the basis of two alternative assumed dates (mid-1991 and late 1992) and in three alternative situations:-

- (a) joint termination of the programme by agreement among all the partners;
- (b) UK withdrawal leading to joint termination;
- (c) UK withdrawal with the other partners going ahead.

In any of these situations the UK would have to pay the costs it had incurred so far, which are estimated at £270M by mid-1991 and £520M by late 1992. The further costs described below are additional to these sums.

4. In the event of joint termination the UK would have to pay the rundown costs of UK industry and a 33% share of the liquidation costs of NEFMA. The best estimate of cost to the UK is:-

cancellation in mid-1991	-	£160M
cancellation in late 1992	-	£180M.

5. In the event of UK withdrawal resulting in joint termination the corresponding best estimates are:-

cancellation in mid-1991	-	£200M
cancellation in late 1992	-	£230M.

These figures could be increased if the other nations tried for a time to continue before eventually abandoning the project. The UK would not be required to reimburse the other nations for their nugatory costs.

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6. In the event of the UK withdrawing but the other partners going ahead, the cost to the UK would be higher than in paragraph 5 because the UK would additionally have to give 3 months' formal notice (and pay its share of the costs meanwhile) and also to meet the costs identified in paragraph 1. No precise estimate could be made of the cost to the UK without an industrial quotation based on highly controversial assumptions. However, it is roughly estimated that the overall liability in this worst case would be:-

mid-1991	-	£350M
late 1992	-	£380M.

(There would be an additional liability of some £100M on account of production investment if this had already been approved.)

7. There would be a relatively modest effect in the short term on overhead charges to MOD on other non-competitive defence contracts. The long-term effect would depend on wider decisions outside the EFA programme.

ANNEX E: DEFENCE R&D CEILINGS

£M at average 1986/87 prices (i.e. LTC 87 prices)										
	85/6	86/7	87/8	88/9	89/90	90/1	91/2	92/3	93/4	94/5
1) E(RD) Ceilings	2325	2271	2151	2110	2010	1910	1890	1780	1640	1550
2) Increase sought for EFA				-	17	25	43	185	214	205
3) Revised Ceiling sought				2110	2027	1935	1933	1965	1857	1755

Reduction between 1985/86 and 1994/95 under existing ceilings (line 1): 33.3%

Reduction between 1985/86 and 1994/95 under enhanced ceilings (line 3): 24.5%

Note: Ministerial ceilings stop short at 1994/95. Any ceilings imposed beyond that year would need to allow for the following expenditure on EFA:

£179M in 1995/96, £164M in 1996/97, £144M in 1997/98, £456M in later years.

APPENDIX J

ACDS OR (Air) to PS/CAS, 22 July 1988

EFA: Mass Related Issues

1. In Reference above, I highlighted some urgent EFA Weapon System Specification issues related to a then reluctance in GE to accept a mass accounting proposal. I am happy to say that, as a result of this week's Steering Committee meeting, the mass related issues on EFA are now resolved to the satisfaction of all 4 nations.
2. Significantly GE now agrees there will be no relaxation of the requirements in the ESR-D. The target basic mass empty remains at its 'Turin' value of 9.75 tonnes and the 'not to exceed' mass in the contract would remain at 10 tonnes. The masses of the items at issue will be listed in an annex to the Weapons Systems Specification and exceedences over 10 tonnes will be accepted at this stage as non-compliances. These will be closely monitored by NEFMA in relation to Eurofighter's declared mass contingencies. CAS will recall that a mass of 10,570 kgs was used in our performance calculation for the studies presented to the EPC
3. Because of the capitulation of GE, the subject of con/di nozzles was not raised, however my staffs, in conjunction with PE will be keeping a careful eye on that area.
4. Finally, although not strictly an OR issue, you will wish to know that the RB199 was selected as the interim engine for the first 2 EFA prototypes.

APPENDIX K

CDP to APS Secretary of State for Defence, 16 June 1989

EFA Radar

I am attaching a draft reply to the letter from Charles Powell dated 13 June.

I finally had the opportunity of speaking to the German National Armaments Director, Wolfgang Ruppelt, this afternoon. He had been difficult to contact, and said that he would have preferred not to speak to me before Monday, as he was having further meetings with the German Chief of the Air Staff.

He said to me that Dr Stoltenberg had looked into the EFA programme, although of course it was fairly new to him, and had decided that he wanted a complete risk analysis of the total programme. Mr Ruppelt was proposing to send a letter at the beginning of next week to me and to the Italian and Spanish Armaments Directors setting out his concerns, and the German insistence that the programme must go ahead on a “design to budget” rather than a “design to requirement” basis. He insisted that MBB had complained that adopting the Ferranti radar would result in considerable extra on-costs and a delay in the delivery of software of some 22 months. He also said that the German Parliament had now decided that solely in the case of the EFA programme the normal yearly inflation which was allowed on all other projects would now not be permissible.

I said to him that we had discussed many times the question of the radar problem, and he put to me several times that if we would accept the MSD 2000 radar, the whole problem could be resolved immediately. I told him that that was out of the question since 3 studies, one of which had been jointly carried out with his staff on an independent basis, had shown that the MSD 2000 radar, in many areas, did not meet our requirement. I further pointed out that we had arranged through Ferranti to offer them appropriate guarantees and he once again expressed their concern to obtain a Government guarantee. I said that we were not prepared to contemplate this since, in any event it was quite unnecessary.

He then went on to say, in confidence, that there was now considerable comment in Germany that UK is getting far more than their fair share of the high-tech and desirable work, such as the engine, and now perhaps the radar, and that this was causing further friction.

I said that we really could not continue on this very unsatisfactory basis without a speedy resolution, and said that the Ministers and the National Armaments Directors of the 4 partner nations should discuss this in detail when they meet in Lisbon. He agreed that this would be very useful and said that Dr Stoltenberg would be ready to do this. He also added, however, that Dr Stoltenberg had commented that he would not be ready to take any decision by the end of June.

I am afraid that the German position is very much in line with what I had feared when I outlined the position to the Secretary of State in Paris. I believe that they will continue to prevaricate for some considerable time before reaching any firm decision. Their motives for so doing can only be the subject of speculation.

In the meantime I think we must now prepare ourselves for the meeting in Lisbon, which will clearly be of considerable importance. I will explain the position to my colleagues, the Italian and Spanish National Armaments Directors, and will ask CA to ensure that the staffs are fully briefed so that hopefully all the Ministers come able to discuss the matter in some detail.

I have spoken this afternoon to Sir Raymond Lygo and impressed on him the need for British Aerospace to pressurise MBB, who are clearly being considerably less than helpful in this matter. He undertook to do so forthwith.

APPENDIX L

Secretary of State for Defence to the Prime Minister, 22 January 1990

EFA Radar

I met my German colleague today for discussions on a range of Anglo/German issues, including in particular the choice of radar for EFA.

2. In accordance with your guidance, I pressed Dr Stoltenberg very hard to accept ECR-90 on both technical and operational grounds and made clear that we could not under any circumstances accept another radar. He for his part continued to argue that MSD 2000 was perceived in Germany as a less risky proposition (which I disputed); and that it would not be possible to let such a large contract with Ferranti in its current state. It was clear, however, that he was anxious to reach a decision on the radar, partly for budgetary reasons, but chiefly since he believes that without a positive decision in the next two or three weeks, there is a real risk that pressures, from the SPD, the FPD and even from within the CDU/CSU, to cancel the programme will prevail in the months preceding the general elections in the Federal Republic. Nor did he want to be left with the responsibility of precipitating a two radar solution by going against the preference of the other three partners.

3. After some discussion he indicated accordingly that he could consider ECR-90 on two conditions. These were, firstly, that for reasons of financial prudence he had to be convinced that Ferranti was a safe bet. Secondly, for both political and budgetary reasons, he had to demonstrate to the Bundestag that Germany faced no risk of extra costs arising from the late delivery of the radar by the ECR-90 consortium to Messerschmitt Bolkow Blohm (MBB), the company responsible for integrating the radar into the aircraft.

4. On the first of these points, I was able to tell him that we were aware that GEC has been discussing with Ferranti over the past few days the possibility of acquiring Ferranti's Edinburgh operation (Ferranti Defence Systems) including the airborne radar division. We understood that a decision was now imminent and that an announcement was likely very shortly. This not unnaturally came as a great surprise to the Germans and, in my opinion, was instrumental in persuading them that they could now accept an ECR-90 solution.

5. On the question of shedding the perceived technical risk associated with ECR-90, I sought to respond to Dr Stoltenberg's concerns, which he had raised in a letter to me, by exploring the possibility of appending a 'side letter' of interpretation to the Memorandum of Understanding (MOU) on the development of EFA, similar to the proposals made by Germany to guarantee the other nations against risks associated with MSD 2000. This would be supported by a 'back-to-back' agreement with GEC under which they – if possible in concert with the other members of the consortium – would have to be prepared to provide a guarantee against any extra costs at MBB attributable to delays or defaults on the part of the ECR-90 consortium, up to a ceiling of DM 200 million. The consortium's liability would be limited to DM 200 million in current cash terms, i.e. the sum would not be proofed against inflation. There would be no charge to public funds. Dr Stoltenberg agreed that an arrangement of this nature met his concerns and undertook to recommend it strongly to his Ministerial colleagues, with a view to reaching a final decision within the next two or three weeks.

6. We recognised that any further consideration of this proposal would be ad referendum to our respective Ministerial colleagues. I believe, however, that Stoltenberg sees this way forward as a solution to this long running problem, as do I. If both Governments can agree to this course of action within the next two to three weeks, we shall get the radar we want for the RAF. We shall also avoid all the problems and extra expense of a two radar solution, guarantee a very substantial body of work for Ferranti Defence Systems in Edinburgh, and tie the Germans in, at a critical period in East/West relations, to a collaborative programme to develop a major new weapons system.

7. I recognise that colleagues will wish to take an urgent view of these latest developments, and my officials stand ready to brief other Departments as required. I recognise also that Nicholas Ridley will wish to receive early advice from the Director General of Fair Trading concerning the impact of GEC's proposed purchase of Ferranti Defence Systems. As Ferranti Defence Systems' major customer, however, I have looked carefully at the implications of the purchase and do not believe that there are any adverse implications to which I shall need to draw attention...

DRAMATIS PERSONAE

Sir Derek Alun-Jones, Chairman of Ferranti, 1982-1990

Field Marshal Sir Edwin Bramall, UK Chief of the Defence Staff, 1982-1985

Adam Butler, UK Minister for Defence Procurement, 1984-1985

Alan Clark, UK Minister for Defence Procurement, 1989-1992

Air Chief Marshal Sir David Craig, UK Chief of the Air Staff, 1985-1988
(as Marshal of the Royal Air Force, UK Chief of the Defence Staff, 1988-1991)

Admiral Sir John Fieldhouse, UK Chief of the Naval Staff, 1982-1985
(as Admiral of the Fleet, UK Chief of the Defence Staff, 1985-1988)

Air Chief Marshal Sir David Harcourt-Smith, UK Controller Aircraft, 1986-1989

Charles Hernu, Minister of Defence of France, 1981-1985

Michael Heseltine, UK Secretary of State for Defence, 1983-1986

Sir Geoffrey Howe, UK Foreign Secretary, 1983-1989

Tom King, UK Secretary of State for Defence, 1989-1992

Helmut Kohl, Chancellor of West Germany, 1982-1990

Norman Lamont, UK Minister for Defence Procurement, 1985-1986

Peter Levene, UK Chief of Defence Procurement, 1985-1991

Air Chief Marshal Sir Douglas Lowe, UK Chief of Defence Procurement, 1982-1983

Sir Raymond Lygo, British Aerospace Managing Director, 1983-1986, and Chief Executive, 1986-1989

Francois Mitterrand, President of France, 1981-1995

John Nott, UK Secretary of State for Defence, 1981-1993

Geoffrey Pattie, UK Minister for Defence Procurement, 1983-1984

Sir David Perry, UK Chief of Defence Procurement, 1983-1985, and Chief of Defence Equipment Collaboration, 1985-1987

Dr Ludwig-Holger Pfahls, Minister of State for Defence of West Germany/Germany, 1987-1992

Sir Ralph Robins, Managing Director of Rolls-Royce Aero-Engine Division, 1984-1989, Deputy Chairman, June 1989-1991

Air Chief Marshal Sir John Rogers, UK Controller Aircraft, 1983-1986

Wolfgang Ruppelt, National Armaments Director of West Germany/Germany, 1989-1992

Dr Helmut Schnell, National Armaments Director of West Germany before Ruppelt

Narcís Serra, Minister of Defence of Spain, 1982-1991

Sir Donald Spiers, UK Controller Aircraft, 1989-1994

Dr Gerhard Stoltenberg, Minister of Defence of West Germany/Germany, 1989-1992

Norman Tebbit, UK Secretary of State for Trade and Industry, 1983-1985

Margaret Thatcher, UK Prime Minister, 1979-1990

The Lord Trefgarne, UK Minister for Defence Procurement, 1986-1989

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Air Chief Marshal Sir Keith Williamson, UK Chief of the Air Staff, 1982-1985

Dr Manfred Woerner, Minister of Defence of West Germany, 1982-1988

George Younger, UK Secretary of State for Defence, 1986-1989

GLOSSARY OF ABBREVIATIONS

ACA	Agile Combat Aircraft
ACAS (OR)	Assistant Chief of Air Staff Operational Requirements
ACDS OR (Air)	Assistant Chief of Defence Staff Operational Requirements (Air)
ACX	Avion de Combat Experimental
AST	Air Staff Target
BME	Basic Mass Empty
BOD	Board of Directors
BVR	Beyond Visual Range
CAS	Chief of the Air Staff
CDEC	Chief of Defence Equipment Collaboration
CDP	Chief of Defence Procurement
CDS	Chief of the Defence Staff
CGS	Chief of the General Staff
CNS	Chief of the Naval Staff
COS	Chiefs of Staff Committee
CPS	Cardinal Point Specification
CSA	Chief Scientific Adviser
DCA	Deputy Controller Aircraft

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DCDS(S)	Deputy Chief of Defence Staff (Systems)
DGA1	Director General Aircraft 1
DM	Deutschmarks
DPC	NATO's Defence Planning Committee
DSO	Defence Sales Organisation
DTI	Department for Trade and Industry
EAP	Experimental Aircraft Programme
EFA	European Fighter Aircraft
ECCM	Electronic Counter-Countermeasures
EPC	Equipment Policy Committee
ESR	European Staff Requirement
ESRD	ESR-Development
EST	European Staff Target
FCA	Future Combat Aircraft
HDS	Head of Defence Sales
IEPG	Independent European Programme Group
IPO	International Programme Office
ISC	International Signal and Control
MOU	Memorandum of Understanding
MOD	Ministry of Defence

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PE	Ministry of Defence Procurement Executive
NAD	National Armament Director
NEFMA	NATO European Fighter Development Production, and Logistics Support Management Agency
OD	Cabinet Defence and Overseas Policy Committee
OEST	Outline European Staff Target
OST	Outline Staff Target
PUS	Permanent Under-Secretary
SBAC	Society of British Aerospace Companies
ADV	Tornado Air Defence Variant
VCAS	Vice-Chief of the Air Staff
VCDS	Vice-Chief of the Defence Staff

NOTES

(All AIR, DEFE and PREM files held by UK National Archives)

1. Group Captain Chris Granville-White, 'The Evolution of the Eurofighter Typhoon,' Royal Air Force Historical Society Journal, No. 79 (2022), p. 132. British Aerospace signed a contract with the MOD for an ACA demonstrator in May 1983.
2. Hansard, P110 Aircraft, Vol. 19, debated on 1 Mar 82.
3. Hansard, P110 An Agile Combat Aircraft, Vol. 29, debated on 27 Oct 82.
4. Granville-White, 'The Evolution of the Eurofighter Typhoon,' Royal Air Force Historical Society Journal, No. 79 (2022), p. 133.
5. AIR 8/3995, Secretary of State for Defence to Prime Minister, 26 Feb 85.
6. Ibid.
7. AIR 8/3995, Secretary of State for Defence to Prime Minister, 26 Feb 85. Not all MOD staff accepted such calculations at face value; see AIR 8/3996, DCDS(S) to DCA, 3 Apr 85.
8. AIR 8/4056, Confidential Annex to COS 8th Meeting/85 held on 13 May 85; COS paper COS (Misc) 123/186/1, European Fighter Aircraft: A Future Fighter for the RAF, 3 May 85.
9. Granville-White, 'The Evolution of Eurofighter Typhoon', pp. 133-135.
10. DEFE 71/1108, Report by CDP of Discussions with Dassault, SNECMA and with M. Martre during visit to France 2-5 May 1983.
11. DEFE 71/1108, CDP to Minister DP, 13 May 83.
12. DEFE 71/1108, HDS to PUS, 15 Jul 83.
13. DEFE 71/1108, CDP to Minister DP, 13 May 83.

14. DEFE 71/1108, OR40 (RAF), Wing Commander C. Granville-White, to ACAS (OR), 10 Oct 83.
15. DEFE 71/1108, ACAS (OR) to VCAS, 19 Oct 83.
16. DEFE 71/1108, ACAS (OR) to VCAS, 11 Oct 83.
17. DEFE 71/1108, D/DDOR4(RAF)/8/1/8/1/961/A of 4 Nov 83.
18. DEFE 71/1108, ACAS (OR) to VCAS, 8 Nov 83.
19. DEFE 71/1108, ACAS (OR) to PS/CAS, 9 Nov 83.
20. DEFE 71/1108, ACAS (OR) to PS/CAS, 17 Nov 83.
21. DEFE 71/1108, ACAS (OR)/10/18/158 of 2 Dec 83.
22. DEFE 71/1108, ACAS (OR) to PS/CAS, 17 Nov 83; CAS to Min(DP) and CDP, 20 December 1983.
23. DEFE 71/1108, CAS to Minister DP and CDP, 20 December 1983. Further references to the EFA Working Group refer to this group and should not be confused with the Air Staff Working Group that generated the OEST.
24. DEFE 71/1108, DCA to Minister DP, 18 Jan 84.
25. AIR 8/3995, DCA to APS/S of S, 15 Nov 84.
26. AIR 8/3995, Secretary of State for Defence to Prime Minister, 26 Apr 85.
27. AIR 8/4056, CDEC to PS/Secretary of State for Defence, 12 Feb 86.
28. AIR 8/3995, Secretary of State for Defence to Prime Minister, 26 Apr 85.
29. AIR 8/3995, DCA to APS/S of S, 15 Nov 84.
30. AIR 8/3995, ACAS (OR) to CAS, 31 Oct 84.
31. AIR 8/3995, ACAS (OR) to CAS, 31 Oct 84, and quoting DCA.

32. AIR 8/3995, note of a meeting held in the office of Minister DP, 7 Nov 84.
33. AIR 8/3995, CDP to Secretary of State for Defence, 14 Nov 84.
34. Ibid.
35. AIR 8/3995, CDP to Secretary of State for Defence, 14 Nov 84, background note.
36. AIR 8/3995, CAS to CDP, 15 Nov 84.
37. AIR 8/3995, EFA – A Paper by the Defence Sales Organisation, 12 Nov 84; Secretary of State for Trade and Industry to Secretary of State for Defence, 14 Mar 85; PS to Secretary of State for Trade and Industry to PS to Secretary of State for Defence, 20 Mar 85.
38. AIR 8/3995, Minister DP to Secretary of State for Defence, 15 Nov 84.
39. AIR 8/3995, Minister for Industry and Information Technology, DTI, to Minister DP, 20 Nov 84.
40. AIR 8/3995, RH Robins to Secretary of State for Defence, 20 Nov 84.
41. AIR 8/3995, Sir Raymond Lygo to Secretary of State for Defence, 19 Nov 84.
42. AIR 8/3995, Secretary of State for Defence to Prime Minister, 26 Feb 85.
43. AIR 8/3995, Minister DP to Secretary of State for Defence, 15 Nov 84.
44. AIR 8/3995, Lygo to CDP, 6 Dec 84; CDP to Robins, 7 December 1984.
45. AIR 8/3995, EFA brief, 14 Dec 84.
46. AIR 8/3995, DGA1 to DCA, 22 Jan 85; DGA1 to DCA, 11 Feb 85.
47. AIR 8/3995, CDP to Secretary of State for Defence, 12 Feb 85.

48. Ibid.

49. AIR 8/3995, DGA1 to DCA, 18 Feb 85.

50. Ibid.

51. AIR 8/3995, APS/Secretary of State for Defence to PS/CDP, 20 Feb 85. Attendees included PUS, Controller Aircraft, VCDS, DCDS (Systems), DCA, and ACDS (OR).

52. AIR 8/3995, ACDS OR (Air) to DCDS(S), 4 Mar 85; see also D/DFS/2/53 (57/85), by DFS, CD Coxhead, 20 Mar 85.

53. Ibid.

54. AIR 8/4056, CDEC to PS/Secretary of State for Defence 12 Feb 86; AIR 8/3995, APS/Secretary of State for Defence to PS/CDP, 4 Mar 85.

55. AIR 8/3995, Lygo to Secretary of State for Defence, 5 Mar 85.

56. AIR 8/3995, APS/Secretary of State for Defence to PS/CDP, 12 Mar 85.

57. Ibid.

58. AIR 8/3995, Foreign Secretary to Secretary of State for Defence, 12 Mar 85.

59. AIR 8/3996, D/DCA(PE) 8/18, by DCA, 1 Apr 85.

60. Ibid.

61. AIR 8/3996, DCDS(S) to DCA, 3 Apr 85. Hall was a former fighter pilot, who had commanded 111 Squadron (Lightnings) in the 1960s; his exceptional competence in the cockpit earned him an Air Force Cross and was reflected in his appointment as Officer Commanding the Empire Test Pilots' School in 1971.

62. AIR 8/3996, ACAS to DCA, 3 Apr 85.

63. AIR 8/3996, Secretary of State for Defence to Prime Minister, 15 Apr 85; author's italics.
64. AIR 8/3995, CDP to Secretary of State for Defence, 13 Mar 85.
65. AIR 8/3996, British Embassy Paris to MODUK, PS to Secretary of State, 29 Mar 85.
66. Ibid.
67. AIR 8/3996, British Embassy Bonn to MOD, PS to Secretary of State for Defence, 4 Apr 85.
68. AIR 8/4056, CDEC to PS/Secretary of State for Defence 12 Feb 86.
69. AIR 8/3996, DGA1 to DCA, 1 Apr 85.
70. AIR 8/3996, DGA1 to DCA, 12 Apr 85.
71. AIR 8/3996, APS/Secretary of State for Defence to PS/CDEC, 16 Apr 85.
72. AIR 8/3996, CDS 1227/107, 22 Apr 85.
73. See for example AIR 8/3996, Enclosure 69, Final Report of the Review Committee on EFA Studies, 27 Feb 85; AIR 8/4039, PS/VCDS to PS/Secretary of State for Defence, 24 Jun 85.
74. AIR 8/3996, British Air Attaché Paris to MODUK AIR, PS/CAS, 24 Apr 85.
75. AIR 8/3996, APS/Secretary of State for Defence to PS/CDEC, 16 Apr 85.
76. AIR 8/3996, CAS to CDEC, 22 Apr 85.
77. AIR 8/3996, PS/CAS to PS/CDEC, 18 Apr 85.

78. COS paper COS(Misc) 123/186/1, European Fighter Aircraft: A Future Fighter for the RAF, 3 May 85.

79. PREM 19/1691 f242, Cabinet Secretary to Prime Minister, 17 July 1985, attaching conditions agreed at meeting OD(85) 5th Meeting on 7 May 1985. The final condition clearly reflected expectations that France would seek to dominate the marketing organisation as well as the industrial project.

80. PREM 19/1691 f242, Cabinet Secretary to Prime Minister, 17 July 1985. In his minute, the Cabinet Secretary suggested to Mrs Thatcher that she might 'wish to take the opportunity of reminding Mr Heseltine that a meeting of OD will be required before substantive decisions on the launching of the project definition phase can be agreed, unless the conditions meet the requirements laid down by OD on 7 May.'

81. AIR 8/4056, Confidential Annex to COS 8th Meeting/85 held on 13 May 85.

82. AIR 8/4056, CDEC to PS/Secretary of State for Defence, 12 Feb 86.

83. AIR 8/4039, Chief Executives of British Aerospace (Sir Raymond Lygo), Messerschmitt-Bolkow Blohm (Dr Hanns Arnt Vogels), Aeritalia, Societa Aeronautica Italiana (Dr-Ing Renato Bonifacio) and CASA, Construcciones Aeronauticas SA (Fernando de Caralt) to Secretary of State for Defence, 8 Jun 85.

84. AIR 8/4039, British Embassy Bonn to MOD UK, PS/Secretary of State for Defence, 14 Jun 85; Robins to Secretary of State for Defence, 13 Jun 85.

85. AIR 8/4039, Secretary of State for Trade and Industry to Secretary of State for Defence, 14 Jun 85.

86. AIR 8/4039, Secretary of State for Defence to Prime Minister, 18 June 1985.

87. Ibid.

88. AIR 8/4039, AS/Air (PE)1 to DCA, 19 Jun 85.

89. AIR 8/4039, Foreign Office to British Embassy Paris, Rome, Madrid and Bonn, 24 Jun 85.
90. AIR 8/4039, Foreign Office to British Embassy Paris, 24 Jun 85 (covering letter from Secretary of State for Defence to defence ministers of other four EFA nations).
91. AIR 8/4039, CDEC to Secretary of State for Defence, 26 Jun 85.
92. AIR 8/4039, Air Burpomat Paris to MODUK Air, General B. Capillon, CAS of French Air Force, to CAS, 1 Jul 85.
93. AIR 8/4039, Hernu to Secretary of State for Defence, 1 Jul 85.
94. AIR 8/4039, PS/CAS to PS/Secretary of State for Defence, 2 Jul 85.
95. AIR 8/4039, DGA1 to PS/CDEC, 2 Jul 85.
96. AIR 8/4039, IR Yates, Deputy Managing Director (Aircraft), British Aerospace, to Secretary of State for Defence, 2 Jul 85.
97. AIR 8/4039, MODUK Air to MOD Paris, CAS to General Capillon, 4 Jul 85.
98. AIR 8/4039, FCO to MODUK, 3 Jul 85.
99. AIR 8/4039, record by HM Ambassador of Points raised by Minister DP with Dr Woerner, 3 Jul 85.
100. AIR 8/4039, PS/Foreign Secretary to PS/Secretary of State for Defence, 10 Jul 85.
101. AIR 8/4039, DCA to CDEC, 10 Jul 85.
102. AIR 8/4039, A/ACDS OR (Air) to PS/CAS, 10 Jul 85.
103. AIR 8/4039, DCA to CDEC, 10 Jul 85.
104. AIR 8/4039, CDEC to Secretary of State for Defence, 11 Jul 85.

105. AIR 8/4039, PS/CDEC to PS/Secretary of State for Defence, 12 Jul 85.
106. AIR 8/4039, Note of a meeting held on 10 July 1985 by Minister DP. Also present was Dr Walter Wallmann, Vice Chairman, Christian Democratic Union, their Private Secretaries, and the UK AD Nuclear Policy and Security (A).
107. AIR 8/4039, A/ACDS OR (Air) to PS/CAS, 15 Jul 85.
108. AIR 8/4039, CDEC to Secretary of State for Defence, 16 Jul 85.
109. AIR 8/4039, British Embassy Rome to MOD UK, 17 Jul 85, recording visit to Rome of Minister DP, 15-17 Jul 85; PS/Secretary of State for Defence to PS/Foreign Secretary, 17 Jul 85.
110. AIR 8/4039, MODUK to British Embassy Bonn, 18 Jul 85.
111. AIR 8/4039, PS/CAS to PS/Secretary of State for Defence, 19 Jul 85.
112. AIR 8/4039, CDEC to Secretary of State for Defence, 24 Jul 85.
113. AIR 8/4039, PS/Secretary of State for Defence to Prime Minister, 26 Jul 85.
114. AIR 8/4039, PS/CAS to APS/Secretary of State for Defence, 26 Jul 85.
115. PREM 19/1691 f218, Secretary of State for Trade and Industry to Prime Minister, 30 Jul 85; Charles Powell minute to Prime Minister, 30 Jul 85.
116. AIR 8/4039, PS/Secretary of State for Defence to Prime Minister, 26 Jul 85.
117. Michael Heseltine, *Life in the Jungle: My Autobiography* (Hodder & Stoughton, London, 2000), p. 275. See also PREM 19/1691 f231, FCO minute (draft message from the prime Minister to President Mitterand), 25 Jul 85.
118. AIR 8/4052, Secretary of State for Defence to Prime Minister, 2 Aug 85.

119. PREM 19/1691 f218, Charles Powell minute to Prime Minister, 30 Jul 1985.
120. PREM 19/1691 f216, No. 10 record of conversation, 31 Jul 85.
121. AIR 8/4039, Statement by the Secretary of State for Defence, 2 Aug 85; see also PREM 19/1691 f184, Secretary of State for Defence to Prime Minister, 2 Aug 85.
122. AIR 8/4039, FCO London to MODUK, 14 Aug 85.
123. AIR 8/4052, PS/Secretary of State for Defence to Charles Powell, 10 Downing Street, 2 Aug 85.
124. AIR 8/4052, Prime Minister to the Spanish Prime Minister, Senor Gonzalez, 2 Aug 85.
125. AIR 8/4052, APS/Secretary of State for Defence to DGA1, 12 Aug 85; CDEC to PS/Secretary of State for Defence, 3 Sep 85.
126. AIR 8/4052, CDEC to Secretary of State for Defence, 13 Sep 85.
127. AIR 8/4052, Foreign Office to MODUK, 3 Aug 85; 14 Aug 85.
128. PREM 19/1760 f151, British Embassy Paris to MODUK, 30 Jul 85.
129. AIR 8/4052, Prime Minister's Meeting with the Prime Minister of France, 1 Aug 85.
130. AIR 8/4052, FCO London to MODUK, 14 Aug 85.
131. AIR 8/4052, President Mitterrand to Prime Minister, 11 Oct 85.
132. AIR 8/4052, Prime Minister to President Mitterrand, 15 Nov 85.
133. AIR 8/4052, PS/Secretary of State for Defence to PS/CDEC, 19 Nov 85.
134. Ibid.

135. AIR 8/4052, PS/CDEC to PS/Secretary of State for Defence, 21 Nov 85; PS/Secretary of State for Defence to PS/Secretary of State for Trade and Industry, 28 Nov 85.
136. AIR 8/4052, PS to Secretary of State for Defence to PS/Secretary of State for Trade and Industry, 28 Nov 85.
137. AIR 8/4056, CDEC to PS/Minister DP, 5 Feb 86; CDEC to PS/Secretary of State, 10 Feb 86.
138. AIR 8/4056, Quiles to Secretary of State for Defence, 25 Feb 86.
139. AIR 8/4056, Secretary of State for Defence to Giraud, 10 Apr 86.
140. AIR 8/4055, FCO London to MODUK, relaying signal from British embassy Madrid, 13 Mar 87; DDEC to AUS (EC), 19 Mar 87; AS/Air (PE)1 to DDEC, 25 Mar 87; AIR 8/4040, CDP to Controller Aircraft, 15 Sep 88.
141. AIR 8/4052, PUS to Secretary of State for Defence, 17 Sep 85.
142. AIR 8/4052, DCA to APS/Secretary of State for Defence, 17 Sep 85, EFA monthly report, Sep 85.
143. AIR 8/4052, EFA monthly report, Sep 85.
144. Ibid.
145. AIR 8/4052, UKDEL NATO to MODUK, 29 Oct 85.
146. AIR 8/4052, DGA1 to APS/Secretary of State for Defence, 18 Oct 85, EFA monthly report, Oct 85.
147. AIR 8/4052, EFA monthly report, Nov 85.
148. AIR 8/4052, DCDS(S) to CAS, 25 Nov 85.
149. AIR 8/4052, DCDS(S) to CAS, 25 Nov 85; PS/CAS to MA/DCDS(S), 26 Nov 85. Craig succeeded Williamson on 15 October 1985.

150. AIR 8/4052, Chief Scientific Advisor to DCDS(S), 28 Nov 85.
151. AIR 8/4056, EFA Board of Directors meeting, 8-9 Jan 86. This was a somewhat gloomy meeting, which also flagged up problems involving the continuity of industrial activity from project definition to full development, the delayed formation and staffing of the IPO, equipment selection procedure and categorisation, and the radar specification.
152. AIR 8/4056, EFA Board of Directors meeting, 8-9 Jan 86.
153. AIR 8/4056, ACDS OR (Air) to DCDS(S), 16 Jan 86.
154. AIR 8/4056, EFA monthly report, Dec 85/Jan 86.
155. AIR 8/4056, Schnell to CDP, 14 Jan 86.
156. AIR 8/4056, Yates to Controller Aircraft, 30 Jan 86.
157. AIR 8/4056, CDEC to PS/Minister DP, 5 Feb 86; CDEC to PS/Secretary of State for Defence, 10 Feb 86.
158. AIR 8/4056, undated and unsigned brief on current EFA situation, Enclosure 40.
159. AIR 8/4056, DASB&C brief, EFA – Meeting with Secretary of State for Defence, 24 Mar 86; EFA monthly report, Jan-Feb 86.
160. AIR 8/4056, DASB&C brief, EFA – Meeting with Secretary of State for Defence, 24 Mar 86; EFA Steering Committee meeting, 13 Mar 86.
161. AIR 8/4056, DGA1 to PUS, 6 Mar 86.
162. AIR 8/4055, EFA monthly report, Mar-Apr 86.
163. AIR 8/4055, CSA to Minister DP, 12 May 86.
164. AIR 8/4056, EFA monthly report, Feb/Mar 86.
165. AIR 8/4056, EFA monthly report, Apr/May 86.

166. AIR 8/4056, EFA monthly report, Jan/Feb 87.
167. AIR 8/4055, EFA monthly report, Mar/Apr 86.
168. AIR 8/4055, Note of meeting held on 16 May 86 between Minister DP and industry; also present were CDP, Controller Aircraft, DCDS(S) and other senior procurement staff.
169. AIR 8/4055, Controller Aircraft to CDP, 21 May 86.
170. AIR 8/4055, DCDS OR (Air) to DCDS(S), 9 Oct 86.
171. AIR 8/4055, EFA monthly report, Apr/May 87.
172. AIR 8/4055, Controller Aircraft to CDP, 14 May 87.
173. AIR 8/4055, DGA1 to DCA, 28 May 87.
174. AIR 8/4055, EFA monthly report, June/July 1987; see also Controller Aircraft to CDP, 9 Sep 87.
175. Air 8/4040, Controller Aircraft to Weiss, German Ministry of Defence, 13 Jul 1988.
176. Ibid.
177. DEFE 13/2500, EFA Steering Committee meeting, 20 Jul 1988.
178. AIR 8/4056, EFA Steering Committee meeting, 13 Mar 86.
179. AIR 8/4055, Note of meeting held on 16 May 86 between Minister DP and Industry; DEFE 13/2501/1, Controller Aircraft to APS/Secretary of State for Defence, 15 Aug 89.
180. AIR 8/4055, CSA to Minister DP, 12 May 86.
181. AIR 8/4055, EFA monthly report, 30 Aug to 30 Sep 86; DASB&C to PS/CAS, 4 Sep 86.

182. AIR 8/4055, Controller Aircraft to CSA, 17 Oct 86.
183. AIR 8/4055, EFA monthly report, Dec 86/Jan 87.
184. AIR 8/4055, EFA monthly report, Mar/Apr 87.
185. AIR 8/4055, EFA Steering Committee meeting, 7-8 May 87.
186. AIR 8/4055, meeting between CAS, VCDS, Controller Aircraft and DGA 1, 1 Jul 1987.
187. AIR 8/4055, EFA Steering Committee meeting, 3 Sep 87.
188. AIR 8/4055, brief for CAS by D/DDOR4 (Air), 15 Sep 87.
189. Ibid.
190. AIR 8/4048/2, PS/Controller Aircraft to PS/Secretary of State for Defence, 30 Oct 87; AIR 8/4051, EFA monthly report, Oct/Dec 87.
191. AIR 8/4056, CSA to Secretary of State, 23 Apr 85, Annex B.
192. AIR 8/4056, EFA monthly report, May/June 86.
193. AIR 8/4055, Controller Aircraft to CSA, 17 Oct 86.
194. AIR 8/4055, EFA monthly report, Apr/May 87.
195. AIR 8/4055, EFA Steering Committee meeting, 7-8 May 87.
196. AIR 8/4055, EFA Board of Directors meeting, 20-21 May 87.
197. AIR 8/4055, EFA Steering Committee meeting, 3 Sep 87.
198. AIR 8/4051, EFA monthly report, Oct/Nov 87.
199. AIR 8/4040, APS/Secretary of State for Defence to DCA, 21 Apr 88; Secretary of State for Defence to Woerner, 26 Apr 88.

200. AIR 8/4040, Secretary of State for Defence to Woerner, 26 Apr 88.
201. AIR 8/4040, EFA monthly report, Jun/Jul 88.
202. AIR 8/4055, AUS (EC) to PS/Secretary of State for Defence, 10 Sep 87.
203. AIR 8/4055, PS/Secretary of State for Defence to AUS (EC), 10 Sep 87.
204. AIR 8/4048/2, PS/Controller Aircraft to PS/Secretary of State for Defence, 30 Oct 87.
205. AIR 8/4048/1, PS/Secretary of State for Defence to PS/Controller Aircraft, 9 Nov 87.
206. AIR 8/4051, CDP to Secretary of State for Defence, 9 Dec 87.
207. AIR 8/4051, Woerner to Secretary of State for Defence, 17 Dec 87.
208. AIR 8/4051, CDP to APS/Secretary of State for Defence, 18 Dec 87.
209. AIR 8/4051, Secretary of State for Defence to Woerner, 23 Dec 87.
210. AIR 8/4051, APS/Secretary of State for Defence to PS/CDP, 15 Jan 88.
211. AIR 8/4051, APS/Secretary of State for Defence to PS/CDP, 21 Jan 88.
212. AIR 8/4051, APS/Secretary of State for Defence to PS/CDP, 21 Jan 88; AS/Air(PE)1 to Ms Diana Seammen, HM Treasury, 2 Mar 88.
213. AIR 8/4051, APS/Secretary of State for Defence to PS/CDP, 9 Feb 88; DASB&C to PS/CAS, 10 Feb 88.
214. AIR 8/4051, APS/Secretary of State for Defence to AUS (Systems), 11 Feb 88. The meeting was attended by Mr Younger himself, Minister DP, US of S (DP), CDS, PUS, CAS, CSA, CDP, Controller Aircraft, VCDS, DCDS(S), DCDS (P&P) and DUS(RP); 10 year cash ceilings for Defence R&D had been set in February 1986 by the Ministerial Steering Committee on Economic Activity (Sub-Committee on Economic Affairs (E(A))) to enable scarce R&D resources to be re-deployed in the civil sector.

215. AIR 8/4051, APS/Secretary of State for Defence to AUS (Systems), 11 Feb 88.
216. AIR 8/4051, Memorandum by the Secretary of State for Defence, OD (88) 2, circulated on 26 Feb 88.
217. AIR 8/4051, D Air Plans to PS/CAS, 22 Feb 88.
218. AIR 8/4051, DASB&C to PS/CAS, 2 Mar 88.
219. AIR 8/4051, 2nd DUS to DUS(RP), 8 Mar 88.
220. AIR 8/4051, Charles Powell, 10 Downing Street, to PS/Secretary of State for Defence, 16 Mar 88.
221. AIR 8/4051, APS/Secretary of State for Defence to PS/Controller Aircraft, 17 Mar 88.
222. AIR 8/4040, Secretary of State for Defence to the Chief Secretary of the Treasury, 20 Apr 88.
223. AIR 8/4040, Secretary of State for Defence to the Prime Minister, 20 Apr 88.
224. AIR 8/4040, Secretary of State for Defence to the Chief Secretary of the Treasury, 18 Apr 88.
225. AIR 8/4040, Secretary of State for Defence to the Prime Minister, 25 Apr 88.
226. AIR 8/4040, PS/DCA to APS/Secretary of State for Defence, 26 Apr 88.
227. AIR 8/4040, PS/CAS to PS/Controller Aircraft, 25 Apr 88.
228. AIR 8/4040, EFA Steering Committee meeting, 20 Jul 88; PS/CDP to APS/Secretary of State for Defence, 25 Jul 88.

229. AIR 8/4040, PS to Secretary of State for Defence to Charles Powell at 10 Downing Street, 7 Sep 88.
230. AIR 8/4040, CDP to PS/Secretary of State for Defence, 8 Sep 88.
231. AIR 8/4040, APS/Secretary of State for Defence to PS/CDP, 15 Sep 88.
232. AIR 8/4040, PS/Secretary of State for Defence to Charles Powell at 10 Downing Street, 20 Sep 88.
233. Ibid.
234. AIR 8/4040, AS/Air (PE)1 to PS/CDP, 21 Sep 88.
235. AIR 8/4040, CDP to PS/Secretary of State for Defence, 19 Oct 88.
236. AIR 8/4040, APS/Secretary of State for Defence to PS/CDP, 21 Oct 88.
237. AIR 8/4040, PS/Controller Aircraft to PS/Minister DP, 24 Nov 88.
238. AIR 8/4040, EFA Steering Committee meeting, 20 Jul 1988.
239. AIR 8/4040, AS/AIR (PE)1 to APS/Secretary of State for Defence, 12 May 88.
240. AIR 8/4040, Controller Aircraft to CDP, 22 Jul 88.
241. AIR 8/4040, EFA monthly report, Aug/Oct 88.
242. DEFE 13/2501/2, EFA monthly report, Nov 88/Jan 89.
243. Ibid.
244. DEFE 13/2501/2, Controller Aircraft to CDP, 6 Feb 89.
245. DEFE 13/2501/2, Controller Aircraft to CDP, 28 Feb 89.
246. DEFE 13/2501/2, EFA Steering Committee meeting, 10 April 1989.

247. DEFE 13/2501/2, CDP to Controller Aircraft, 19 Apr 89.
248. DEFE 13/2501/2, PS/Controller Aircraft to APS/Secretary of State for Defence, 23 May 89, CDP to PS/Secretary of State for Defence, 23 May 89.
249. DEFE 13/2501/2, EFA Steering Committee meeting, 29 May 89.
250. DEFE 13/2501/2, British Embassy Bonn to MODUK, PS/CDP, 5 Jun 89.
251. Ibid.
252. Ibid
253. DEFE 13/2501/2, CDP to Secretary of State for Defence, 6 Jun 89.
254. DEFE 13/2500, British Embassy Bonn to MODUK, personal for Minister DP, 12 Jul 89.
255. DEFE 13/2501/2, PS/Secretary of State for Defence to PS/CDP, 8 Jun 89.
256. Ibid.
257. DEFE 13/2500, British Embassy Bonn to MODUK, personal for Minister DP, 12 Jul 89.
258. DEFE 13/2501/2, CDP to APS/Secretary of State for Defence, 16 Jun 89.
259. DEFE 13/2501/2, EFA quadripartite meeting, 28 Jun 89.
260. DEFE 13/2501/2, EFA Radar: Discussion with German officials, 17 Jul 89
261. DEFE 13/2501/2, PS/Secretary of State for Defence to PS/CDP, 20 Jul 89.

262. DEFE 13/2501/2, Lord Prior to Secretary of State for Defence, 27 Jul 89.

263. DEFE13/2501/1, PSO/Controller Aircraft to APS/Secretary of State for Defence, 10 Aug 89.

264. DEFE 13/2501/1, Controller Aircraft to APS/Secretary of State for Defence, 15 Aug 89.

265. DEFE 13/2501/1, Meeting in Bonn on EFA Radar on 30 Aug 89; PS/Secretary of State for Defence to Charles Powell in Downing Street, 1 Sep 89; PS/Secretary of State for Defence to Charles Powell in Downing Street, 1 Sep 89.

266. DEFE 13/2501/1, Sir Derek Alun-Jones to Secretary of State for Defence, copied to the Prime Minister and the Secretary of State for Scotland, Malcolm Rifkind, 4 Sep 89; Rifkind to Prime Minister, 7 Sep 89; Gavin Strang MP to Prime Minister, 8 Sep 89; Larry Brooke, MSF Union, to Secretary of State for Defence, 13 Sep 89.

267. AIR 8/3912, Controller Aircraft to CDP, 22 Sep 89. The previous day, Controller Aircraft had discussed the situation with Jochim Heyden, Ruppelt's technical deputy, in Bonn.

268. AIR 8/3913/2, CDP to Secretary of State for Defence, 3 Nov 89.

269. Ibid.

270. AIR 8/3913/2, EFA monthly report, Sep/Nov 89.

271. AIR 8/3913/2, NADS meeting, 16 Nov 89.

272. AIR 8/3913/2, CDP to PS/Secretary of State for Defence, 27 Nov 89.

273. AIR 8/3913/2, meetings between the Secretary of State for Defence and the German Defence Minister in the margins of the DPC, 28-29 Nov 89.

274. AIR 8/3913/2, Secretary of State for Defence to Prime Minister, 6 Dec 89.

275. AIR 8/3913/2, Charles Powell, 10 Downing Street, to Brian Hawtin at the MOD, 15 Dec 89.
276. AIR 8/3913/2, Stoltenberg to Secretary of State for Defence, 15 Dec 89.
277. AIR 8/3913/2, APS/Secretary of State for Defence to PS/CDP, 19 Dec 89.
278. AIR 8/3913, Secretary of State for Defence to Prime Minister, 22 Jan 90.
279. <https://publications.parliament.uk/pa/cm198990/cmhansrd/1990-01-23/Debate-16.html>, Column 872.
280. AIR 8/3913, DGA1 to APS/Secretary of State for Defence, 28 Mar 90.
281. AIR 8/3913, CDP to Secretary of State for Defence, 4 Apr 90.
282. Ibid
283. AIR 8/3913, Secretary of State for Defence to Prime Minister, 20 Apr 90; CDP to Lord Weinstock, MD of GEC, 25 Apr 90.
284. AIR 8/3913, Secretary of State for Defence to Stoltenberg, 4 May 90.
285. Air 40/4040, EFA Steering Committee meeting, 20 Jul 1988.