

REPORT OF STUDY
of
AIRCRAFT ACCIDENT INVESTIGATION PROCEDURES
IN THE ARMED SERVICES

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by
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REPORT OF STUDY
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Part I - Present Procedure

1. Introduction. I was appointed on 19th May 1986 by the then Minister of State for Defence Support to conduct the study with the following terms of reference:-

"To examine the reports and investigate the methods of conducting inquiries into military aircraft accidents in all three Services and MoD(PE) in order to establish whether alternative procedures, or any other features, would be more efficient or effective in determining the cause of accidents".

2. Method of Study. I commenced by discussing the current methods of investigating aircraft accidents with the officers responsible for flight safety policy in each Service and MoD(PE). I then examined Regulations and documents governing the conduct of inquiries and read many accident reports and summaries, relating chiefly to the period 1980 to 1985. Notices were placed in Service publications indicating the nature of my study and inviting personnel to submit any comments on the present practice of conducting inquiries. I visited two Naval Air Stations, three RAF Stations and the headquarters of the Army Air Corps. I also visited RAE Farnborough and A&AEE Boscombe Down and I attended two sittings of an RAF Board of Inquiry into a recent accident. Representations were received from a number of officers, both serving and retired, and evidence was taken from officers in the Australian and Canadian Forces. I discussed with Air Commodore Hine the report of his Working Party which examined RAF Boards of Inquiry Regulations in January 1983, and I investigated the use of accident data recorders in the RAF.

3. Interpretation of the Terms of Reference

3.1 "Aircraft Accident" is defined in broadly the same terms in all three Services and MoD(PE). In all cases it is consequent upon Category 3, 4 or 5 damage* to the aircraft and/or fatal or major injuries being sustained. Since those occurrences in which Category 1 and 2 damage and minor or no injury is sustained do not fall within the definition of "Aircraft Accident", the procedure for their investigation was not examined in this study.

3.2 Whilst the definitions used in the Army and RAF Regulations do not specify that the occurrence must necessarily take place during the period of operation of an aircraft, the Royal Navy Regulations do so specify. The result can be that an accident to an RAF aircraft falling off a trestle in a hangar during maintenance, or to an Army aircraft damaged by a ground vehicle is included in aircraft accident statistics, while a Naval aircraft stowed on board ship

* See Appendix A for Accident Damage Categories.

which is damaged by shifting stores in high seas is not. In this study I have considered only those accidents which occur during the period of operation of the aircraft, and I have used the definition "Period of Operation" stated in the Royal Navy Regulations.

3.3 The term "flight recorder" is used in the generic sense to include accident data recorders, flight data recorders, cockpit and/or inter-com recorders.

4. Boards of Inquiry

4.1 Composition. The means adopted in all three Services and in MoD(PE) for the investigation of serious accidents are broadly the same, namely by Boards of Inquiry. However there are significant differences in the procedure each Service follows (see detailed comparison of the current procedures in Annex B).

Usually the president of the Board is of the rank of Commander, Lieutenant-Colonel or Wing Commander, though occasionally he may be one or two ranks lower. In addition there must be at least two other Board members, one of whom is a pilot drawn from an active squadron or unit equipped with aircraft of the same type as that involved in the accident, while the other is an engineer acquainted with the aircraft type. Sometimes a fourth member such as a medical or other specialist officer is appointed to the Board. Although a Group or Command Flight Safety Officer (in the RAF) may be available to assist the Board from the position of being 'in attendance', I have seen no record of the appointment of any person expert in the techniques of accident investigation or the analysis of flight recorded data being appointed as members of the Board. On most occasions, however, an aircraft engineer from the RN Aircraft Accident Investigation Unit (RNAAIU), Royal Electrical and Mechanical Engineers (REME), or the Accidents Investigation Board of the Department of Transport (AIB), who is expert in accident investigation work, is nominated 'in attendance' to the Board. The members of the Board receive no formal training in aircraft accident investigation and seldom have any previous experience of this type of work; at best a member may have served on one previous Board of Inquiry. A matter of some difficulty with the system is the substantial period that Board members must be absent from their primary duties. This can last for a month and sometimes more; occasionally when a report from a manufacturer or AIB is awaited, the Board is adjourned and subsequently reconvened. This constitutes a further distraction from the normal duties of Board members. The effect is most damaging to the Services in respect of Board presidents who are normally drawn from the small group of squadron commanders actively engaged in flying the same type as the crashed aircraft. Squadron commanders represent the vital link between Command and the fighting formations. This is particularly applicable in Germany where the squadrons have such an important operational role. To deprive an effective squadron of its commander for such a period is to inflict a deliberate deficiency upon the effectiveness of an entire unit.

The same principle applies to the engineering member of the Board whose primary responsibilities for the efficient maintenance of aircraft in operational units can be substantial. This is a serious impediment to the defence capability of the country which should be avoided if at all possible.

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4.2 Technical Support.

4.2.1 Royal Navy. In those cases where there is a suspected technical fault of some complexity, a naval Board may refer the matter to the R N A A I U at Lee-on-Solent. The reports of the Unit are usually comprehensive in technical content but, not surprisingly, limited in operational matters. This is not unintentional and reflects the staffing of the Unit which comprises four Engineer Officers and four Chief Petty Officers, the Commanding Officer being the only one with operational experience. Their reports are compiled in the standard format adopted by the International Civil Aviation Organisation for use throughout the world by civil aircraft accident investigators. The Unit has been in existence since 1946 and has acquired an enviable reputation for the quality of its work and reports.

4.2.2 Army. A specialist accident investigator and flight safety officer (ATFSO), who is a Lieutenant Colonel aircraft engineer in R E M E , together with his assistant accident investigator and flight safety Warrant Officer, provide technical assistance to Boards of Inquiry in those cases where there appears to be:-

- a. structural failure in the air not due to collision.
- b. fire or explosion in the air,
- c. fire or explosion after impact,
- d. a serious technical defect,
- e. unusual or obscure features of a technical nature,
- f. defects which have become epidemic.

The AIFSO may request further assistance from the AIB if he considers it necessary.

A behavioural scientist from the Human Factors Unit A A C is available to examine all the events preceding or relevant to an accident. The behavioural scientist has independent access to witnesses; interviews with her are in confidence and not under oath, but she presents a written report to the Board under oath.

4.2.3 RAF. The AIB acts in the capacity of consultant to R A F Boards of Inquiry concerned with accidents which appear to have been due to any of the following causes:-

- a. structural failure in the air,
- b. fire or explosion in the air,
- c. serious technical defect,
- d. unusual or obscure features of a technical nature,
- e. defects which have become epidemic.

AIB participation is confined to engineering matters (and occasionally interpretation of cockpit voice recordings). AIB evidence is submitted to the Board in written reports. They are highly valued by the AF and the aircraft industry.

4.2.4 MoD(PE). Whenever it is appropriate, members of MoD(PE) Boards of Inquiry may be drawn from MoD(PE) civilian personnel. In addition, advice may be sought from AIB, RAB or other MoD(PE) Establishments, the Quality Assurance Directorate or the RNA AIU.

4.2.5 General. The involvement of RNA AIU, AIFFSO and AIB has clearly come about to fill an inadequacy in the Board of Inquiry system notwithstanding the regular participation of an engineering member of the Board. Although each Service has adopted a different means of compensating for the inadequacy, in practice, the units concerned perform the same function. They are able to maintain the necessary high standard required as a result of their full-time professional occupation with this work. It therefore seems obvious that it would be more economic and efficient for a single organisation to provide this service.

4.3 Board Procedure. The manner in which Boards of Inquiry are conducted is largely dominated by the formalities written into the Board of Inquiry Rules, which are Statutory Instruments, and by procedures laid down in various Service instructions. The result is the Boards tend to be excessively legalistic and a significant proportion of the time and effort of the Board is devoted to satisfying the requirements of the Rules and instructions. This must necessarily be the case so long as the present Rules and instructions pertain. The more important work of the Board, namely the resolving of the cause of the accident thereby assumes a secondary place to be attended to only when the formalities have been observed. It is true that some of the formalities constitute a necessary part of the investigation process such as taking evidence from witnesses and producing documents and exhibits. However, the formalised way in which this has to be carried out is time-wasting and not particularly conducive to the ready flow of pertinent information. For example, the requirement that a witness may only give evidence orally, and in the presence of all members of the Board, has no practical benefit. On the contrary it means that evidence of a strictly technical or engineering character cannot be taken separately, on site, by the engineering member of the Board in a written statement to be signed by the witness, while the pilot members take statements of an operational nature at the same time from others. This is the method adopted by members of AIB investigating teams in civil aircraft accident investigations. It has the advantage of being more efficient and less time consuming.

4.4 Purpose of the Inquiry. It is important in my view that there should be a clear understanding and a statement in unambiguous terms of the purpose of the inquiry. In the Naval instructions there is reference to the primary purpose of a Board of Inquiry without mention of any secondary or other purpose, (see Annex B, 2.1 etc). Army instructions are concerned with "flight safety reporting" whilst the RAF and MoD(PE) instructions convey the generally recognised purpose in different statements.

I recommend that any future Rules, Regulations or instructions relating to the investigation of aircraft accidents in the Armed Forces be preceded by the following statement:-

"The purpose of investigating accidents under these Rules (Regulations or instructions, as appropriate) is to investigate and report the circumstances and

identify the cause or causes of the accident with a view to making recommendations for the preservation of life and the avoidance of accidents in the future;."

4.5 Terms of reference. In the examples of the terms of reference given in Appendix B, (3.1, 3.2, 3.3 and 3.4) it will be seen that Boards of Inquiry have been asked routinely whether Service personnel involved in the accident were on duty, and to ascertain the damage to public property and to civilian property. They have also been asked to ascertain the degree of injury suffered by persons both Service and civilian. To comply with this requirement, a Board of Inquiry must take evidence from the specialists concerned. Whether or not a person was on duty depends on the evidence of somebody with a sound knowledge of administrative matters if there is any doubt at all. Similarly on the question of damage to public and civilian property the PSA Regional Estate Surveyor must be consulted. Only a Medical Officer or a qualified medical practitioner can assess the degree of injury suffered by Service or civilian personnel. The Board of Inquiry is not as well qualified to make such assessments as the specialists themselves. It therefore appears altogether unnecessary to put these questions to the Board when the information can be obtained directly in a signed statement from the specialist. The further requirements to ascertain if all relevant orders and instructions were complied with, establish whether the aircrew escape and survival facilities were fully utilized and determine what was the damage to the aircraft, are relevant to the circumstances of the accident and are required to be reported in any case by the first of the terms of reference listed by all three Services. This can also be said for questions about the competency of the crew, suitability of the weather and serviceability of the aircraft, (naval questions), or damage to removable equipment, all relevant crash survival aspects and "any other points relevant to the inquiry", (army questions). One can only speculate why such features as fire in the air or structural failure are omitted, to mention but two more.

In practice, the list of questions relevant to any particular aircraft accident is almost invariably unique to that accident, and it is not possible to have a 'standard* list of terms of reference that is applicable in all, or even most, accidents. To specify such a list in Regulations, manuals etc. merely tends to limit the matters upon which the investigating body concentrates its efforts. A competent investigator will report on all relevant aspects if given the general instruction to investigate the accident in depth, and the temptation to be too specific with instructions to the Board should be resisted.

In reality, all the terms of reference mentioned above are covered by the single requirement to report the circumstances of the accident. This in turn is already covered by the suggested statement of the purpose of the inquiry, ie "to investigate and report the circumstances. There remains, therefore, no reason to give any terms of reference at all except for the question of responsibility for the accident' (Navy), 'negligence' (Army) 'or human failings' (RAF).

4.6 Negligence. Of all the features of the Board of Inquiry system, the one concerned with the identification of the person who was responsible for the accident; and the assessment of whether he was guilty of culpable or mitigated negligence, was the subject of more adverse criticism than any other I received in the representations that were made to me. The assessment of negligence is made by Boards of Inquiry in response to terms of reference demanding it in one form of wording or another, whether it be a requirement to:-

- a. "ascertain if all relevant orders and instructions were complied with." (RAF).

- b. "indicate responsibility" (Navy) or
- c. "ascertain whether any person or persons failed in their duty. If such failing constitutes negligence, identify the factors, mitigating or otherwise." (Army)

The only justification for putting such questions to Boards of Inquiry is to advise the administrative or executive authority whether to consider disciplinary action. This practice has the appearance of passing the responsibility for the decision to a collective body that can be seen to be judging its peers. A less generous interpretation is that it is a case of the administrative authority retaining the power to award punishment without accepting the responsibility for the decision to do so.

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An assessment of negligence makes no contribution to the establishment of the cause of an accident or the remedial measures necessary to prevent it. Evidence from D/Flying MoD (PE) was that Boards had a better chance of getting to the truth when they are interested only in establishing the cause of the accident (and not in apportioning blame). Air Commodore Hine in his report of the Working Party on Boards of Inquiry Regulations said that witnesses warned under QR 1269 "may tend to become more guarded in subsequent examination" though he added that in many cases witnesses remained frank and honest. "He went on to add: "The subject is emotive. The Working Party found a general unease throughout the RAF on this question" also "The word (negligence) is offensive to professional pride and to adjudge an RAF pilot negligent can be a far more serious punishment to him than loss of pay or seniority." The searching inquiry Air Commodore Hine conducted is more comprehensive on the subject of negligence than this study can ever be with its wider scope, but it merits re-examination in order to convey a true appreciation of all the factors involved.

Since this matter is so sensitive it is pertinent to inquire why the question of negligence is always put to Boards of inquiry for an answer. It goes without saying that a fighting force must maintain discipline and, rightly or wrongly, aircraft accidents have traditionally been associated with breaches of discipline. In my view this is a mistaken notion. There is no evidence that strict compliance with every rule and regulation will ensure that accidents will not happen.

The threat of punishment for breaking a rule that is assumed to have resulted in an accident is far less of a deterrent than the very real threat of a sudden and violent death. Furthermore, the loss of esteem in the eyes of his colleagues for having an accident can be more important to most pilots than condemnation by a system which is seen to be obsessed with attributing blame. The Hine report (para 41) states:

"Pride is a very essential ingredient of the fighting spirit and one bad decision on negligence can do much harm to a unit's morale and undermine its trust in the 'system' and authority."

If punishment is not a means of preventing accidents (and punishment in this context usually comprises a formal ticking-off by the AOC or Station Commander) there is no purpose in requiring the Board of Inquiry to determine whether negligence was a feature. The only logical conclusion is, therefore, that the time-consuming process of assessing negligence (Air

Commodore Hine concluded that it took between 11% and 25% of the total duration of a Board's deliberations) is totally futile.

However, in order to ensure that disobedience of orders or instructions does not go undetected, bearing in mind that inquiries must retain the right to impound evidence, an obligation on the part of the investigating body to notify the appropriate authorities when it appears to them that a breach of discipline may have taken place, will ensure that the organisation responsible for investigating the accident will not be required to make any judgements relating to negligence or wilful disobedience. This is not to imply that there should be a duty to seek out breaches of discipline, but merely to report such cases when they are brought to light in the course of investigation. At the same time, it ensures that any disciplinary action that results is taken by the proper administrative authorities, consistent with the maintenance of good order and discipline in the Services. This procedure is very similar to that which obtains at the present time in connection with the obligation of the Accidents Investigation Branch of the Department of Transport to notify the C A A of breaches of civil air law.

I therefore recommend that no terms of reference are given to future inquiries into aircraft accidents other than to implement the proposed purpose of the inquiry indicated in 4.4 above, but with the addition of the following words:-

"...it is not the purpose to apportion blame or responsibility"

5. Principles of Investigation

5.1 Basic Principles. The purpose of investigating aircraft accidents is to investigate and report the circumstances and identify the cause or causes with a view to making recommendations for the preservation of life and the avoidance of accidents in the future.

The investigating authority must be totally objective and impartial, and the integrity of its personnel must be beyond question. Its independence from outside influence is therefore fundamental. Personnel involved in the conduct of investigations should possess the highest possible degree of technical competence in this field of aviation.

Since no human being may be considered to be infallible, provision should be made for the review of the findings of an investigation. Also, if new and significant evidence comes to light, the investigation should be re-opened.

5.2 Other Important Considerations. It is not particularly important who, or what authority, orders an investigation to be carried out provided it is within the capacity of the investigating organisation to implement the order. However it is very important who, or what authority, decides that an investigation will not take place, so that there is no question of anyone with any responsibility for the manner in which the flight was conducted being able to prevent its investigation. For this reason it is necessary for some disinterested party in a senior position, who is in receipt of accident notification messages, to have overriding authority to order an investigation to be carried out.

The authority to whom the accident report is submitted should be senior to any interested party or Command which had responsibility for the manner in which the accident flight was

carried out. This is to ensure that the recommendations for the correction of any shortcomings in administration or procedures are not suppressed by means of the superior rank of the authority receiving the report over that of the investigating authority. •

Since the ultimate purpose of investigating an accident is to avoid accidents in the future, it is obvious that no time should be lost in identifying the cause. However, the urgency to complete the investigation should not detract from the need to investigate the accident in depth and permit the necessary component strips and any other researches to be carried out thoroughly before the final report is compiled. If a faulty component or procedure is identified before the investigation phase is completed, the investigating authority should immediately inform the appropriate organisation of the details of the fault and of the need to take corrective measures, whilst the investigation should proceed until all aspects of the accident have been properly examined.

6. System of Aircraft Accident Investigation.

6.1 General. Boards of Inquiry have been the official means of investigating aircraft accidents since World War I and the system has changed little since 1956 when the current Rules were brought into effect. This is consistent with the practice in other N A T O countries (see Appendix C), though many have a separate inquiry to allocate blame in addition to the inquiry into the cause of the accident. A few N A T O countries have standing presidents of Boards while one or two others employ permanent investigating teams in addition to the Board of Inquiry. Roughly half of the countries carry out joint Servxe investigations.

I have not had the time or resources to read all the complete accident reports that have been raised in recent years, but I have read about 40 of them covering the period 1980-1986, and I have attended some of the sittings of one R A F Board of Inquiry. My overall impression is of the diligent application of Board members to their task, but on the whole with somewhat variable results.

In some cases the inquiry covered all the aspects adequately, but in many the underlying causes had not been investigated in depth. Failure to recognise contributory factors was common. In a few cases the wrong primary cause was cited.

Some of the accidents which I believe require penetrating investigation are those which are concerned with:-

- a. excessive pilot work-load, particularly in single-seat aircraft at low level.
- b. ergonomic factors relating particularly to cockpit layout and the exclusion of auto-pilot facilities (probably for financial reasons).
- c. the level of blood-sugar in relation to optimum pilot performance.
- d. the relationship, if any, of excessive ground engine running to the amount of foreign object damage that ultimately leads to engine disintegration or other failure.
- e. the lack of pilot confidence in attitude indicating systems in Jaguar aircraft in the event of failure of one system.

f. recognition of somatogravic disorientation and the need to disengage the pilot from the control-loop during low level abort manoeuvres.

g. the need for continuing research into the intractable problem of bird ingestion.

An excessive preoccupation with the assessment of negligence is apparent throughout most inquiries. A disturbing feature is the influence which senior officers seek to exert on the investigation process, particularly in the RAF. Presidents of Boards are conscious of a 'hovering presence' in the background which in reality is nothing more sinister than an anxiety to implement corrective measures as soon as they are identified. On the other hand this may be manifest as a constant demand to be updated with the latest evidence as it comes to light.

6.2 Comments on Royal Navy Procedure. Boards of Inquiry in the Royal Navy are usually completed much more quickly than in the other Services and their reports are available to the convening authority within 14 days, otherwise a report must be made giving reasons for requiring more time. However, if the accident is concerned with a technical failure, the Board sometimes reports that it has referred the investigation of that aspect to the RNA AIU. In due course, sometimes six months or so later, the RNA ARJ will issue a comprehensive technical report. In such cases the value of the Board of Inquiry report would seem to be very limited.

Instructions contained in JSP 318 (0406) are somewhat conflicting insofar as para 4 states that the aim of the inquiry is to ascertain the facts so that the convening authority may arrive at conclusions, while para 5 describes one of the tasks of the inquiry as being to draw conclusions (sub-para d).

The contradictory nature of these instructions as to who, or what authority should draw conclusions is confusing. If a superior authority to the Board is required to draw the conclusions, the Board merely becomes a fact finding source. In that event the job could be done by investigating officers and the entire paraphernalia of a Board of Inquiry becomes unnecessary. The real question is what justification is there for the administrative authority, which, by the way, decides upon the terms of reference, to draw conclusions? The same authority that asks the questions is in this case providing the answers. This is not consistent with the recognised tenets of impartial inquiry. The process of inquiry must necessarily include drawing conclusions on a basis of the evidence before it, and the only proper course of action in these circumstances is that it must be the Board that draws the conclusions.

Reporting instructions are further confused by the strange assertion that the findings of a Board of Inquiry are to be in the form of a letter to the convening authority [JSP 318 (0408)]. I believe that the proper place for the findings of a Board of Inquiry is in its report.

6.3 Comments on Army Procedure.

Some of the Army reports indicate a reluctance of Boards of Inquiry to accept the evidence of technical experts or even to seek their views when it appears necessary to do so. In two of the cases examined, expert evidence was likely to show that organisational and operational

orders in force were inappropriate. They were, however, altogether relevant to the causes of the accidents and in my view should have been reported as such. '

6.4 Comments on RAP Procedure. The pervasive nature of the involvement of some Station Commanders. AOC's senior staff officers and even Commanders-in-Chief, is an unwelcome intrusion upon what should be the complete independence of the Board of Inquiry. To some extent it is the product of official procedure which calls for Station Commanders to 'brief the president of the Board soon after it has convened, and the presence of the Group Flight Safety Officer or engineering or other technical staff officers 'in attendance' to assist the Board. Presidents usually welcome the advice given by Group or Command Flight Safety Officers because they are familiar with the investigating procedure and are very helpful, whilst all the members of the Board can be complete novices. However, the opportunities for staff officers to influence the Board's interpretation of evidence, or even their findings, must throw some doubt on the complete freedom of the Board to draw its own conclusions. In some cases Station Commanders or AOC's have changed the findings made by Boards of Inquiry when the report is submitted to them. Not unusually this is in connection with the degree of negligence involved, but occasionally different conclusions have been drawn on technical matters on a basis of the evidence recorded by the Board and the advice of staff officers. It must, of course, always be possible to have reservations about the findings of an inquiry, but to assume superior insight on a basis of rank must be more doubtful. Furthermore, since it is frequently the AOC who convenes the Board and decides on the terms of reference, it should not be the AOC who provides the answers to the terms of reference (see 6.2 above in respect of the Royal Navy). The claim that collectively the officers on the AOC's staff have a wider diversity of expertise than the members of the Board of Inquiry and are thereby better able to draw conclusions on a basis of the evidence in the report, is an indication of the inadequacy of the Board of Inquiry system.

However, even the staff officers have no training in aircraft accident investigation, nor are they in a totally impartial position. Since these matters relate to one of the basic principles of aircraft accident investigation; namely the complete independence of the investigating authority, I suggest that it should be avoided in the future.

6.5 Comments on MoD(PE) Procedure.

Of the comparatively small number of accidents within the administration of MoD(PE) it appears to be unnecessary to involve the expense and effort necessary to convene Boards of Inquiry into accidents to historic aircraft which are altogether obsolete. This has taken place in strict observance of the relevant written requirements, but to hold such wasteful inquiries is not consistent with the basic purpose of an inquiry namely to prevent similar accidents in the future. It should be possible for a senior officer or official to exercise a discretion and decide that such an inquiry is not appropriate.

6.6 Representations. In the representations that have been made to me, a frequently mentioned shortcoming of the present Board of Inquiry system is the lack of professionalism in investigating techniques. This is in no way a criticism of the members of Boards since they receive no training and usually have no previous experience of accident investigation. References to the work of the NAAIU, the Army AIFSO and the AIB on the other hand have been in unqualified acknowledgement of the effectiveness and professionalism they have displayed, and an appreciation of the practical manner in which they get to grips with the task

of finding the root cause of a technical failure. This view is also shared enthusiastically by the aircraft manufacturing industry in this country. It is interesting, however, that the only criticism against them is that they take too long to produce their detailed reports. The observation that investigation in depth necessarily takes time does not seem to have impressed the critics.

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The following are extracts from letters I have received in response to my invitation to Service personnel to comment on the present system of accident investigation which, in the interests of brevity, must admittedly be taken out of their direct context. The message, however, is unmistakable:

From a Commonwealth exchange officer who spent a number of years in the UK working with accident investigation personnel:-

"The establishment of a unit similar to the RNAIU comprising all three Services co-located at Farnborough would provide a sound basis for improving the quality of investigations into accidents to military aircraft."

From a serving senior officer with specialist knowledge related to flight safety:-

"The overwhelming impressions of Boards of Inquiry that I have kept are that they were comprised of amateurs (in the sense of accident investigation), and that they seem to require indecent haste from all concerned so that they could arrive at an early conclusion and that the members almost always had no previous experience of similar Boards. The comparison with the painstaking professionalism of the AIB served to heighten these impressions."

From a retired UK officer more experienced than most in aircraft accident investigation:-

"I cannot see either the Army or Navy rejecting the conclusions of their professional investigators in the same way as I have heard of AOC's rejecting the findings of their amateur, in the investigation sense, Boards of Inquiry".

From another serving officer:-

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"The value of a unit, devoted to the investigations of military aviation accidents, which has a close liaison with AIB is, to my mind obvious. However, if it is not staffed by professionals who have had the proper training, then nothing of value will accrue".

At Appendix D are copies of letters which I have received from the chief executives of British Aerospace, Rolls-Royce and Westlands which are also relevant in part of these matters.

I have received no representations which express a view which is contrary to the general theme of the above statements.

Summing up, I must conclude that the mediocre standards of investigation displayed by Boards of Inquiry generally are not consistent with the high professional level of attainment

that is apparent in almost all other fields of activity in the Services: The reason for this poor performance is that the Board of Inquiry system, by its very nature, ensures that in all but the unusual cases when an officer is appointed to a Board on more than one occasion in his career, the investigation is conducted by complete novices. There is no opportunity to accumulate knowledge in the techniques of accident investigation, nor is there any continuity of effort. It is inherent in the system that every Board of Inquiry must necessarily start from scratch at the bottom of the learning curve. This was particularly well illustrated to me when I attended a recent inquiry in which the Board members had accumulated the relevant evidence, but did not appreciate its significance. They had neither the means of knowing nor the obligation to have accumulated the knowledge that was necessary to recognise the symptoms of the lethal situation that was revealed when the evidence was before them. Subsequent checking showed that similar accidents had occurred on two previous occasions within the period under review. I had the advantage of encountering the phenomenon for the first time 21 years earlier. Accidents occur in such widely differing circumstances that it is as difficult to instruct investigators in what should be done in a manual as it is to learn to fly by reading a book on the subject by a professor of aeronautics. The problem of identifying the root cause of an accident requires a wide ranging appreciation of the significance of particular features that can be organisational, mechanical, aerodynamic or medical and psychological in character. I find it rather insidious to call attention to what I see as the particular deficiencies of some specific accident reports that I have examined, but I have had the opportunity of discussing the shortcomings of a few of them with the presidents of the Boards concerned. Modern highly sophisticated aircraft with their complex systems, also the exacting manner in which they have to be operated, require the most thorough scrutiny when things go wrong. Only the specialist investigator with a sound background of training, knowledge and experience in the field will achieve the professional standard that is expected, and act infrequently exceeded, in other Service activities. It will inevitably take time to work up to that standard but I believe it can be done without disrupting the present arrangements in the interim.

I recommend that a unit comprising a number of trained professional investigators, experienced and qualified in the operation of current Service aircraft should take over the duty of investigating all serious aircraft accidents in the three Services and MoD(PE).

7. The Investigators

7.1 Joint Service Unit.

Strong representations have been made to me from the Navy, Army and MoD(PE) that a joint Service investigation unit would not be in their best interests. The Royal Navy contends that investigators from another Service would not appreciate the particular requirements and limitations of shipborne aircraft and operations at sea, also the administration and traditions of the Service would be foreign to them. The Army has similar reservations regarding its particular type of operations in support of ground forces. MoD(PE) is concerned that a joint Services unit would not understand the particular environment in which test-pilots operate.

I have considered these objections carefully in relation to the primary task of identifying the cause of accidents. The evidence of other joint Service activities does not support these contentions. The Empire Test Pilot's School (STPS) and the Joint Handling Squadron at Boscombe Down have been manned by RAF, Naval and Army pilots over a period of many

years and both units have been commended by Naval as well as R A F officers. Similarly, when the Falklands operation took place, R A F pilots were integrated with Naval pilots operating Harriers from aircraft carriers in hostile conditions. The investigators in AIB include one former Army helicopter pilot and one former Army engineering officer, besides a number of former Naval pilots (not excluding myself), and many former R A F officers in AIB are graduates of ETPS, including the present Chief Inspector. Many AIB engineering investigators have had no Service experience at all, yet they are seen to be most effective investigators.

I therefore reject the objections to a joint Service unit as special pleading, based upon a suspicion that the interests of the Service may be swamped by the greater numbers of the others. It is my experience that the different backgrounds of investigators services to stimulate thought and discussion and creates a cross fertilisation of ideas in an activity which requires critical examination of entrenched concepts. The quality of the individual is far more relevant than his origins in my view, though his previous experience in aviation is important. In this connection there should be a preference for pilot investigators who are ETPS and Staff College graduates, also for those who have experience in the promotion of air safety. The advantages of a joint Service unit are certainly chiefly economic, but also involve a greater breadth of experience and knowledge relating to the cause of accidents, leading in time to a more professional approach to each accident.

7.2 Recruitment.

The practical problem of setting up a joint Services unit must take into account the personnel that are currently suitable and available. In the interests of economy it must also involve employing the least number of investigators that is consistent with the demand upon their services balanced against efficient and effective fulfilment of their task. Experience in AIB over the last 40 years has shown that an efficient aircraft accident investigation organisation should comprise both experienced pilots and graduate aeronautical engineers in roughly equal numbers.

I recommend that the engineer officers currently appointed to the RNAAIU form the nucleus of the engineering section of the joint Services unit. Bearing in mind that the current establishment of AIB includes two or three engineering investigators to cover its commitment to assist with Service accidents, it may be possible to supplement the engineering investigators of the joint Service unit with two experienced Inspectors of Accidents from AIB, provided, of course, that AIB is relieved of its commitment to the Services. With regard to the pilot intake, it will be necessary to train them over a sustained period before they become fully effective. They should be recruited from each of the three Services in numbers proportionate to the numbers of aircraft in each Service. (It should be noted that the Army has made a very strong plea that the AIFSO should not be incorporated into any joint Services unit because he has duties other than those connected with aircraft accident investigation).

7.3 Service or Civilian Unit

There are arguments either way as to whether the unit should be manned by serving officers or civilians. There is even a case for a mix of both, indeed this may prove unavoidable in the first instance. There is one most important feature that must be recognised in respect of

employing serving officers in the joint Services unit. The normal appointment of an officer to a post for about three years is entirely unsuitable for aircraft accident investigators who must acquire several years experience to attain the professional proficiency that is one of the main objectives of bringing this fundamental change about. If serving officers are to be employed in the unit, it is desirable that they regard it as a career activity and this should be made clear to them before they are recruited. In order to make the unit sufficiently attractive to the best possible candidates, I suggest they be offered special conditions of service similar to those applicable to RAP Specialist Aircrew. This would encourage them to remain with the unit for sustained periods, with promotion prospects confined within the unit.

Alternatively they could be engaged as Retired Officers. It has been suggested that if the unit were manned entirely by civilians, it would have the psychological effect upon members of the Services of being a 'technical investigating body' rather than one seeking to find fault and lay blame. It may well be that the capitation relating to such a scheme would result in a smaller drain on the public purse. In a civilian scheme, however, the pilot-investigators could only be recruited from the ranks of former Service pilots, recently current in flying first-line aircraft. Like their colleagues in ALB they would need to continue to fly representative aircraft and simulators sufficiently often to remain familiar with current operational techniques. Whether they be civilians or serving officers, pilot or engineering investigators, they should all complete the longer course in aircraft accident investigation at the College of Aeronautics at Cranfield at the earliest stage of their training. Thereafter the engineers, with an experienced nucleus, can provide their own 'on the job' training under supervision, but the pilots will have to lean heavily on the experienced AIB Operations Inspectors to help build their experience. This has a bearing on the desirability of co-locating the unit with AIB at Farnborough and the goodwill of the Department of Transport.

8. Evidence on Oath.

Currently Boards of Inquiry in the Army and the RAF hear evidence on oath while the Royal Navy and MoD(PE) [with civilian and foreign pilots] Boards do not. There is no evidence whatsoever that the evidence taken by the Navy and MoD(PE) is any less reliable than that which is taken on oath.

This fact alone is sufficient to justify suspending the practice, but when considered with the contention that civilians and a few of the lower ranks in the Services are less forthcoming with evidence when it has to be sworn, it becomes more important to discontinue the practice altogether. In any case, if the Board of Inquiry is replaced with a joint investigation unit which would take evidence by way of signed statements, the need for taking evidence on oath no longer applies. Even if Boards of Inquiry are to continue, I see no useful purpose in continuing to require evidence to be sworn.

I therefore recommend that evidence in future aircraft accident investigation procedures in the Services be taken by means of signed statements and evidence on oath be no longer required.

9. Urgency to Report.

The instructions in all three Services place considerable emphasis upon the timely completion of inquiries. In the Royal Navy the Board of Inquiry report is required to be submitted within fourteen days, in the Army it is three weeks and the RAF instruction (AP 3207, Chapter 8,

para 27) states that a period of about two weeks should suffice. Although there are provisions for taking more time in each case, the periods stated are quite unrealistic if complete investigations in depth are to be carried out. There is little point in drawing up a report just to meet an arbitrary deadline when it does not include the results of significant component examinations, the cause of engine or structural failures or flight recorder analysis which necessarily take time to complete. It is counter-productive for the investigating body to have to break into the continuity of its work to produce an interim report, which could be invalidated by the results of the detailed work, purely to satisfy an unreasonable requirement. While these deadlines may have been practicable in the days of piston-engined or simple turbine driven aircraft, they are not appropriate to modern conditions or equipment. The reason for the pressure to report quickly is said to be based on concern to implement remedial action before a similar accident occurs, but I suspect that there is a degree of impatience involved as well. The simple act of giving an order to be quick contributes little to air safety, indeed the contrary is nearer the truth because the investigators have to divert their energies to producing an uninformative interim report while they should be concentrating all their efforts on resolving the cause of the accident. The proposed procedure for a professional joint investigation unit to notify the appropriate authorities of any need for urgent preventive or corrective action as soon as it is identified will relieve senior officers of the responsibility for doing so. Nonetheless there is benefit in releasing factual information about accidents together with any indications of the lines of inquiry being pursued, within about two weeks of the accident, in order to inform the Services what aspects can be eliminated as likely causes. This is consistent with the well received ABB Bulletins in the civil procedure. However the current requirements to express an opinion as to the cause of the accident at such an early stage cannot be much more than speculation in many cases. In legal terms it might be seen to be prejudicial to the ultimate findings. While it is important to resist unreasonable pressure to complete an investigation within a predetermined time period, the investigating body should carry out its work expeditiously. The current time taken in civil investigations is not appropriate in the Services.

10. Accident Reports.

The current instructions in the Royal Navy to present the report of the Board of Inquiry in the form of minutes of the proceedings, while the findings are in the form of a letter, are further confused by the requirement that the convening authority should draw the conclusions. The Army, the RAF and MoD(PE) practice of placing the accident report amongst the record of work of a Board of Inquiry on Form 412 is also unsatisfactory, and the format of the reports is poor to say the least. The reports of the RNA AIU on the other hand, which are based on the format of the International Civil Aviation Organisation, are clear and straightforward.

11. Flight Recorders.

11.1 General.

Experience in civil aircraft application since 1964 when their carriage was made mandatory, has shown that flight data and cockpit voice recorders are very important tools for the accident investigator when utilized properly by experienced personnel. They are not a substitute for an investigator. They can bring about a much more detailed understanding of the cause of accidents thus providing a greater probability of revealing the manner in which accidents can be avoided. Their initial and maintenance costs are not high in relation to their

effectiveness if they are incorporated into an original aircraft design, but if they are retrospectively fitted they are liable to be expensive and their effectiveness is usually compromised. The primary function of the data recorder is to provide the investigator with:-

- a. a reconstruction of the flight path in three dimensions,
- b. a comprehensive record of the attitude of the aircraft during its attainment of that flight path, and
- c. an indication of the forces and influences acting on the aircraft and the functioning of systems which create the forces and influences.

The cockpit voice recorder (CVR) provides the investigator with:

- a. an accurate means of synchronising the time of flight data and cockpit voice information with ground communication equipment, and
- b. in multi-seat aircraft an indication of how the aircrew are interpreting their flight situation.

In helicopters the CVR, a comparatively simple and relatively cheap device, can be modified to record main rotor rpm from which engine and gearbox malfunction may be detected. Modern pulse code modulated data recorders are capable of recording in digital form, more than 60 parameters per second, (though some have twice this capacity) for the usual duration of flight, while others can retain the recorded information of the previous flight also. This provides the investigator with a useful performance comparison. The recording medium, usually mylar tape, is heavily protected against the forces of crash impact and intense fire.

11.2 Current Service Installations.

Except for aircraft engaged in special research projects or weapons trials, no flight recorders, wither data or voice, are fitted as normal equipment to aircraft operated by the Royal Navy or the Army. In the RAF accident data recorders (ADR's) are fitted to the following aircraft:

- Tornado
- Hawk
- Nimrod
- Andover
- VC-10
- Tristar
- BAe 146 (Queen's Flight)

In addition the Harrier GR 5 and the Tucano will be fitted with an ADR and the specification for the ADR in the European Fighter Aircraft has been drafted. Of the remaining principal operational aircraft, the following are not fitted with ADR's:

- Harrier (all types other than GR 5)
- Jaguar
- Buccaneer

Phantom
Lightning
Hercules
All types of helicopter

Sonar Locator Beacons are fitted to the majority of RAF aircraft, and those which are fitted with ADR's and fly routinely over the sea have an additional beacon bolted to the ADR.

11.3 ADR and CVR Read-out.

When an accident occurs to an ADR equipped aircraft, the protected tape cassette is recovered from the wreckage site and impounded by the Board of Inquiry. Official advice to Board presidents is to send the cassette to A&AEE Boscombe Down in the first instance for retrieval of the data. The assumption is that the Board of Inquiry will itself analyse the data, but assistance is said to be available from A&AEE or RAE Structure Department at Farnborough. Alternatively this can be done by AIB when its resources permit.

Cockpit voice recordings are normally re-spooled by A&AEE or AIB so that Boards may hear them on standard tape recorders. Official advice is that AIB have experience and can help with damaged tapes.

Full analysis of data recordings requires a considerable degree of expertise. False results can arise from drawing conclusions from the raw data of a recorder read-out. Instrument, calibration, acceleration and hysteresis errors must be corrected from parameters which measure physical quantities, and position errors relating to pitot/static information at the high angles of attack in modern swept wing aircraft can be substantial. Shock waves can also distort these readings in critical flight conditions, and accidents occur in critical flight conditions. As to the analysis itself, knowledge and experience is necessary to interpret such things as total energy calculations and to gain the full benefit of making a double integration of acceleration records without being misled by their limitations.

If the CVR includes an "area microphone" in the cockpit, many significant noises will be recorded such as the operation of flap or undercarriage selectors and some of the more noisy switches, aural warnings of all kinds and noise made by the slipstream with configuration changes.

11.4 Flight Recorder Policy.

To expect untrained and inexperienced members of Boards of Inquiry to take flight recorder read-out in their stride and carry out an accurate analysis is not realistic. The result is that the full benefit of flight recorders is lost and some information about accidents remains obscure.

Defence Standard 00-970 which specifies the general design and airworthiness requirements for ADR's and CVR's in both aeroplanes and rotorcraft does not call for any particular standard of accuracy in recording each parameter nor its sampling rate. Neither are the crash protection or fire resistance standards defined. The Defence Standard does not indicate that engraved foil, photographic or frequency modulated electronic flight data recorders are unacceptable although these types were not permitted to be fitted to newly registered civil aircraft several years ago. There appears to be an assumption that a pulse code modulated i.e.

a digital flight data recorder will be used, but the Standard does not say so. There are no requirements for read-out equipment to be compatible with existing equipment, which could save considerable sums of money, (A & A E E skilfully devised a system of utilizing part of some existing equipment to read-out one newer type of recorder, with a notable saving of money). Similarly there is no policy guidance designed to achieve any degree of commonality in recorder systems or circuits used in the Services. The flight recorder specification for a new aircraft type seems to be decided by the MoD(PE) project director for that particular aircraft without any reference to the accident investigator who is the ultimate user. This is probably because there are no identifiable accident investigators as such in the RAF while, paradoxically, there are specialist accident investigators in the Royal Navy and the Army, but up to the present time, they have no flight recorders.

Flight recorder policy generally in the Ministry of Defence seems to be drifting like a ship without a rudder; it is perhaps as well, therefore, that there is now an opportunity to correct the situation before the Royal Navy and the Army are committed to fit flight recorders to their aircraft.

11.5 Conclusions on Flight Recorders.

In order to derive the maximum benefit from flight recorders, specialists must be involved from the specification stage to the final read-out. They should be very closely associated with full-time accident investigators. I therefore recommend that a group of specialists (not more than two or three people) be trained to oversee all aspects of flight recorders, both ADR and CVR in the Services, as a full-time activity.

They should be responsible primarily for the recovery, processing and analysis of all flight recordings and offer advice as to their design, protection and operation in the Services. They should be closely associated and co-located with accident investigation specialists, and be responsible to the person in charge of accident investigation.

12. New Helicopters.

I strongly recommend that the new helicopters for the Royal Navy and the Army should be equipped with flight recorders and that this should be made clear now before the design is frozen.

I would, however, advise against using Defence Standard 00-970 for Rotorcraft as the applicable specification. AIB who have experience with modified CVR's in helicopters and can give advice on this aspect from the point of view of the professional accident investigator (not that of a flight test or structural engineer who seems to have influenced the 00-970 Rotorcraft specification).

It is most important that when the Royal Navy and the Army do fit their aircraft with flight recorders, the equipment selected should be compatible with equipment already in use in the RAF. Compatible in this sense means that the recorders in all the services must be consistent with a joint Service flight recorder policy and it must be possible to read-out the recorders with a common read-out device. While it is acceptable and possibly necessary to record different parameters with different sampling rates and range scales, the temptation of each Service to fit an altogether different type of recorder must be strongly resisted.

Part II - Proposed Procedure

13. Joint Service Investigation Units.

13.1 General.

It is my considered view that Boards of Inquiry have outlived their usefulness as instruments of efficient aircraft accident investigation. In their place there should be a full-time accident investigation unit centrally located with a permanent base comprising a number of professional investigators, trained and experienced to work without formality as investigating teams. This will require substantial and significant amendment to existing Statutory Instrument's and Service instructions, and I recommend that new Joint Service Regulations be drawn up consistent with the guidelines contained in the succeeding paragraphs of this report.

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13.2 Objective.

A Joint Services Investigation Unit (referred to in the remainder of this report as JSIU) should be established with the responsibility of conducting investigations of Category 3, 4 and 5 accidents to aircraft in all the Armed Forces and MoD(PE). The Head of JSIU should, at his discretion, also investigate any other accident or incident that he considers to be appropriate.

13.3 Headquarters and Personnel.

JSIU permanent headquarters should be established at RAE Farnborough, though not as part of the Establishment. It should be located, insofar as it is practicable to do so, as close to the headquarters of AIB as possible, (if available the former offices and hangar of the Armaments Research Laboratories might be suitable). The headquarters should comprise hangars, workshops, FDR and CVR read-out laboratories, communications equipment, transport and a small administrative or secretarial staff. Investigating personnel should comprise approximately six pilot-investigators and six engineer-investigators, also two flight recorder specialists. It is also for consideration whether a behavioural scientist should be included amongst the personnel of the JSIU. In addition there should be an experienced investigator as Head of JSIU. If the four experienced engineer-investigator of RNAAIU, two engineers from AIB and the behavioural scientist currently attached to the AAC are recruited, this part of the complement will be met without any additional expense to public funds, but the pilot-investigators and Head of the organisation would be additional. Information provided for this study indicates that there have been approximately 30 Boards of Inquiry into Service accidents per year between January 1980 and December 1985 which averages at five investigations per team of one pilot and one engineer-investigator per year. This could be a reasonable starting point though more may be required in the light of experience.

13.4 The Head of JSIU.

The Head of JSIU should be appointed at Grade four level (in Civil Service grading) and he should be responsible directly to the Parliamentary Under-Secretary of State for the Armed Forces to whom he should submit all accident reports.

He should also be afforded direct access to the Parliamentary Under-Secretary in order to maintain his independent status and prevent interference or pressure from the Individual Services or senior officers. The Head of JSIU should maintain a close liaison with officers responsible for flight safety in the different Services and MoD(PE) and with the Chief Inspector of Accidents of the Department of Transport.

14. Initial Notification.

14.1 Common Signal Format.

A common system of notifying JSIU and other authorities, Command, MoD, etc of all accidents from Category 1 to Category 5 should be adopted by means of a single form of telephone message and reporting signal. Included in these communications should be information relating to the circumstances of the accident but there should not be a requirement to indicate the cause of the accident at this stage.

14.2 Request to Investigate.

The Initial Notification Signal should, in normal circumstances, also include a request for JSIU to investigate every accident which falls into Category 3, 4 or 5. The reason why this should be a request and not an instruction to investigate is that the newly reported accident might be of considerably less importance to flight safety at a time when JSIU is fully committed with other more important work. Nonetheless every effort should be made on the part of JSIU to investigate every accident in these categories but if that is not possible the accidents should then be investigated by means of Unit Inquiries.

14.3 Response Signal.

The JSIU should signal the unit concerned to confirm that JSIU will investigate the accident, naming the investigator in charge. If JSIU is unable to undertake the work, the signal should say so and indicate the reason for the refusal.

14.4 JSIU Intervention.

The Head of JSIU should, if he considers it expedient in the interests of flight safety to do so, investigate Category 1 or 2 accidents or any incident. That is why all accidents, including those in Categories 1 and 2 should be reported to JSIU, but in normal circumstances only those in Categories 3, 4 and 5 should be the subject of a JSIU investigation.

15. Investigation

15.1 Investigation Team Procedure.

There should be no requirement for any authority to designate where a JSIU investigation is to take place in the same way as the convening authority currently states where a Board of Inquiry will sit. Initially the JSIU investigating team should operate on, or near, the accident site and thereafter acquire evidence wherever it might be. Finally it should carry out most of its work at the HQ at Farnborough.

In all accidents involving death or serious injury, or where the use or failure of ejector seats is a feature, a consultant aviation, pathologist from the RAF Institute of Aviation Pathology, and Tropical Medicine should be included automatically in the investigating team. The Head of JSIU should have the right to co-opt the assistance of any specialist officer or agency, or the representative of any manufacturing organisation to assist in the investigation. There is no need for formal sittings of the team; statements should be taken by individual members of the team and signed by the witness and dated in the normal way, and the investigator concerned should also sign it to indicate that it was taken without coercion or duress. Witnesses should always be given a copy of their own statements. All evidence acquired by JSIU in an investigation should be privileged and should not be produced before a court-martial nor at a summary trial. Consultation within the team and with the Head of JSIU should be in private, and ultimately the report should be the responsibility of the investigator who was named to conduct the investigation, though parts of the report could be drafted by the engineering or flight recorder specialist members of the team under the supervision of the named investigator. The Head of JSIU must be responsible for the quality of investigations and reports, in which case every report should be signed by him as being approved. In the event of any disagreement between the named investigator and the Head of JSIU, the views of the Head of JSIU should prevail and be expressed in the report, but the named investigator should not be required to sign it. However in such a case the report should state that the named investigator did not sign the report.

15.2 Post Accident Procedures.

The principles of the post accident procedures contained in JSP 318 (Part 2, 0301 to 0320 for the Royal Navy and Part 3, 0401 to 0407 and Annex 4A for the Army) and in Chapter 6 of AP 3207 for the RAF should continue to be carried out, but with a gradual consolidation into a single procedure insofar as that is possible. In those cases where the Head of JSIU has indicated in the Response Signal that JSIU will be conducting the investigation, completion of Form A25 in the Royal Navy and the Interim Report in the Army and the RAF should no longer be required. However JSIU should issue (with appropriate distribution) a Factual Summary of the Accident, along the lines of the AIB Bulletin, within 14 days of the accident.

15.3 "Fire Brigade" Action.

If in the course of an investigation the JSIU identifies an inherent defect in an aircraft type or a faulty procedure, the Head of JSIU should have a duty to notify the appropriate authorities of the details of the feature without delay, together with any comments or recommendations for its correction.

15.4 Personal Jeopardy.

Since it is not the purpose of the investigation to apportion blame or responsibility and the accident report should not be produced before a court-martial nor at a summary trial as evidence, there should be no impediment to witnesses being forthcoming with frank and truthful statements.

If, however, the professional or personnel reputation of any person or the reputation of any organisation, is likely to be adversely affected by the report, that person, (or if he be deceased his personal representative), or the legal representative of that organisation should be informed of the detailed substance of the matter, before the report is submitted to the Parliamentary Under-Secretary of State for the Armed Forces. The person or organisation concerned should thereafter have the right to make a statement or written representations to the JSIU which must be considered by the named investigator, and any appropriate amendments made to the report before it is submitted. After the report is submitted the person or organisation concerned should be informed of any consequential amendments to the report that were made, and he should have the further right to request that the report be reviewed under the review procedure indicated in paragraph 17 below.

16. Accident reporting

16.1 JSIU Reports.

The accident report should be a comprehensive document that will stand on its own as a record of what happened, why it happened and what should be done to prevent it happening again. It should comprise facts, analysis, conclusions, recommendations and appendices. It has already been the practice of the RNAAIU to produce their reports in this manner for some time and they have been well received. JSIU reports, therefore, should follow the same practice but with a small number of changes incorporated. A suggested format, with the proposed amendments included, is attached at Appendix E.

16.2 Submission of Reports.

Every JSIU report should be signed on its completion by the named investigator and the Head of JSIU should also sign it to indicate his approval. The report should then be submitted by the Head of JSIU, or his nominated deputy, to the Parliamentary Under-Secretary of State for the Armed Forces with copies to the Command to which the aircraft concerned belonged. Copies should also be sent in every case to all of the following:

The Flight Safety Centre at HMS Heron in respect of the Royal Navy, and
The Aviation Standards Branch at HQ DAAC in respect of the Army, and
The Inspector of Flight Safety, RAF in respect of the Royal Air Force, and
The Director of Flying (PE) in respect of MoD(PE).

These authorities should be responsible for implementing the appropriate follow-up action in their respective Services, the necessary inter-Service co-ordination being the responsibility of the Service to which the aircraft concerned belonged. Recipients of copies should further pass copies of the report within their Service as they consider appropriate in the best interests of flight safety. The report should not be amended by any authority or officer, but the C in C

of the Command to which the aircraft belonged may request that the report be the subject of review.

17. Review of the Report.

Every report by JSIU should be liable to review, and the review procedure should be implemented if it is requested by any of the following:

- a. The flight deck crew of the aircraft concerned or, if they be deceased, their personal representative, or
- b. Any person whose professional or personal reputation has been impugned by the report, provided he has already taken advantage of his right to make a statement or representations as indicated in paragraph 15.4. above and he remains dissatisfied with the report as amended.
- c. The C in C of the Command to which the aircraft concerned belonged.

In order to prevent inappropriate review of reports for trivial reasons, requests for review should be submitted to the Judge Advocate for the Fleet or the Judge Advocate General for the Service of the person requesting the review, who should decide whether there are proper grounds for the review to take place. The review should be conducted in private by a Review Board comprising a president with a rank not less than Commander RN, Lieutenant-Colonel in the Army or Wing Commander RAF, and two other officers, one a pilot current on the type of aircraft concerned, and the other an engineer with an intimate knowledge of the aircraft. Members of the Review Board should, if possible, be selected one from each Service, and be appointed by the Parliamentary Under-Secretary of State for the Armed Forces. The Review Board should have the right to review the entire investigation, and all the evidence acquired by JSIU should be made available to the Board. The Board should also have the right to examine any additional evidence it considers to be relevant and any witness whether or not he gave evidence to JSIU. It should also have the right to order further researches to take place. Every person entitled to request a review should have the right to make a statement or representations to the Board and produce witnesses to give evidence. In the course the Review Board should make a report indicating the sections of the JSIU report with which it is in agreement and the sections with which it does not agree, and why. The Board should also report its own conclusions and opinion as to the cause of the accident. The report of the Review Board should be submitted to the Parliamentary Under-Secretary of State for the Armed Forces and copies should be passed to the authorities entitled to receive copies of the JSIU report and to the person(s) who requested the review.

18. Boards of Inquiry for Major Accidents

It is for consideration whether the existing Board of Inquiry procedure should be retained for those rare occasions when there is a major disaster such as the Vulcan accident at Heathrow (though that accident would now be dealt with under the "Combined" Military and Civil Regulations) or for example if a VC-10 full of troops collided with a refuelling tanker aircraft killing all occupants of both aircraft, or if a Tornado on a low level exercise crashed on a school killing many children. The public reaction to such accidents might be such that a JSIU investigation would be considered to be an attempt to 'cover up' with an investigation behind

closed doors. A Board of Inquiry in such circumstances would be similar to the provision in the civil Regulations for a Public Inquiry, the most recent of which was held into the Trident accident at Staines in 1972. If this procedure is retained, I suggest that it is only implemented on the order of the Secretary of State for Defence and that the president of such a Board should be an officer of Flag, General or Air rank.

It is further suggested that a member of JSIU should be appointed as a member of the Board of Inquiry in addition to such other officers as might be appropriate. The Secretary of State should also consider the possibility of publishing the report of the Board of Inquiry in such cases (with deletions of those matters affecting national security).

19. NATO and Foreign Involvement.

In those accidents involving NATO or foreign pilots or aircraft, the State concerned should be invited to appoint a liaison officer to participate in the JSIU investigation. Participation in this context should include the right to receive copies of all statements, reports and documents, (except those affecting national security) and the right of the liaison officer to make written representations to JSIU. The State concerned should be entitled to receive a copy of the JSIU report (with deletions of those matters affecting national security), and if the report is made the subject of review, the State concerned should be invited to appoint an officer, other than its liaison officer, to be a member of the Review Board (such an officer being asked to retire when matters affecting national security are considered).

20. Combined Military and Civil Air Accidents

In the event of a collision in the air between a military and a civil aircraft, or an accident to a military aircraft on a civil aerodrome or to a civil aircraft on a military aerodrome, and when there is some other combined military and civil element in an aircraft accident, the investigation is conducted under The Air Navigation (Investigation of Air Accidents involving Civil and Military Aircraft or Installations) 1986, SI 1986, 1953, referred to in this report as the "Combined" Regulations. Before this can commence the Secretaries of State for Defence and Transport, acting jointly, are required to direct that it is an accident to which the "Combined" Regulations apply. In that case the Chief Inspector of Accidents of the Department of Transport is responsible for the conduct of the investigation.

Hitherto, when these Regulations have been implemented, the Chief Inspector of Accidents has exercised his discretion under Regulation 8 (2) to request the appointment of a person (liaison officer) from the Service concerned to assist the Inspector of Accidents conducting the investigation, and the full powers of an Inspector of Accidents have been conferred on that person. However, parallel to the investigation under the "Combined" Regulations, the Services concerned have appointed a Board of Inquiry to investigate the Service element of the accident. In the light of the similarity between the proposed JSIU investigation and an Inspectors Investigation under the "Combined" Regulations, I see this practice as unnecessary duplication and introducing the possibility of conflicting findings. Furthermore, since the Board of Inquiry has no jurisdiction over the civil element of the accident, it cannot take into account relevant civil aspects, while the "Combined" Investigation has jurisdiction over both the military and the civil elements.

I therefore recommend that no separate JSIU or other Service investigation be conducted if an inquiry is ordered under the "Combined" Regulations, provided that the Department of Transport and the Ministry of Defence amend Regulation 8 (2) such that it is a requirement, not a matter of discretion on the part of the Chief Inspector of Accidents, to request the appointment of a liaison officer to assist the Inspector of Accidents with the conduct of the investigation. Similarly, if the Ministers of State order a Public Inquiry into a "combined" accident, one of the Assessors appointed by the Lord Chancellor to assist the Commissioner should be a senior officer from the Service concerned.

21. Reopening an Investigation

In the case of a JSIU investigation which has not been the subject of review and is already terminated, the Head of JSIU should order the investigation to be reopened if new and significant evidence comes to light. If the accident has been the subject of review, the Parliamentary Under-Secretary of State for the Armed Forces should direct the review to be reconvened if new and significant evidence comes to light. If Boards of Inquiry are to be retained for major accidents, the Secretary of State for Defence should direct that the inquiry be reopened if new and significant evidence comes to light. "Combined" Regulations already include provisions for reopening inquiries.

22. Introduction of New Procedures

Since it will necessarily take time to recruit and train JSIU staff and that the primary purpose of changing the investigation procedure is to introduce trained and experienced professional investigators into the system, it is suggested that after attending the full accident investigation course at the College of Aeronautics, Cranfield, JSIU investigators gain initial exposure to aircraft accident investigation practices as Board members under the existing Board of Inquiry system. After perhaps 12 months and several Boards in which to gain experience of investigation techniques, it is suggested that JSIU investigators are appointed as presidents of Boards of Inquiry for a further period of about a year to gain experience of deciding how the investigation should be supervised and having responsibility for writing accident reports. Thereafter the investigators should be sufficiently knowledgeable to conduct investigations under the new procedure.

23. Conclusions

23.1 Unit Inquiries.

I have made no recommendations for changing the present Unit Inquiries because, technically, these do not fall within my terms of reference, but also I do not see any pressing need to make drastic changes to the present system for the investigation of less serious accidents. There are, however, some features which might merit change. Firstly the purpose of conducting Unit Inquiries is no different from that of JSIU investigations. It would be logical, therefore, to require the president to investigate and report the circumstances, and identify the cause or causes of the accident rather than require him to respond to a list of terms of reference. Secondly the practice of hearing evidence on oath should be discontinued. The third matter may require more detailed consideration in order to achieve consistency with the spirit of the new proposed procedure.

I refer to some sort of review procedure preferably by a more senior officer than the one who conducted the Unit Inquiry and provisions to reopen a Unit Inquiry if new and significant evidence is brought to light.

23.2 RNAAIU.

It is to be anticipated that RNAAIU would no longer be effective if all the experienced engineer officers are transferred to the JSIU, but the unit at Lee-on-Solent would in any case be superfluous to requirements since its work would be done at Farnborough. It is for consideration whether the knowledge and experience of its Commanding Officer in establishing a successful organisation of this kind could also be beneficial to JSIU.

23.3 Observation.

I believe the changes I have advocated in the above report will result in a greater probability of identifying the true causes of aircraft accidents in the Armed Forces and a system that is fair and just to all concerned. I also hope and believe that in the long term it will lead to a decrease in loss of life and less cost to the nation.

J

W. H. Tench

January 1987

RECOMMENDATIONS

1.

4.4 (page 5). It is recommended that any future Rules, Regulations or instructions relating to the investigation of aircraft accidents in the Armed Forces be preceded by the following statement:

"The purpose of investigating accidents under these Rules (Regulations or instructions, as appropriate) is to investigate and report the circumstances and identify the cause or causes of the accident with a view to making recommendations for the preservation of life and the avoidance of accidents in the future,...."

2.

4.5 (page 5). It is recommended that no terms of reference are given to future inquiries into aircraft accidents other than to implement the proposed purpose of the inquiry indicated in 4.4 above, but with the addition of the following words:

"... it is not the purpose to apportion blame or responsibility"

3.

6.6 (page 13). It is recommended that a unit comprising a number of trained professional investigators, experienced and qualified in the operation of current Service aircraft should take over the duty of investigating all serious aircraft accidents in the three Services and MoD(PE).

4.

7.2 (page 14). It is recommended that the engineer officers currently appointed to the RNA AIU form the nucleus of the engineering section of the joint Services unit.

5.

8. (page 15). It is recommended that evidence in future aircraft accident investigation procedures in the Service be taken by means of signed statements and evidence on oath be no longer required.

6.

11.5 (page 18). It is recommended that a group of specialists (not more than two or three people) be trained to oversee all aspects of flight recorders, both ADR and CVR in the Services, as a full-time activity.

7.

12. (page 19). It is strongly recommended that the new helicopters for the Royal Navy and the Army should be equipped with flight recorders and that this should be made clear now before the design is frozen.

8.

13.1 (page 20). It is recommended that new Joint Service Regulations be drawn up consistent with the guidelines contained in the succeeding paragraphs of this report.

9.

20. (page 26). It is recommended that no separate JSIU or other investigation be conducted if an inquiry is ordered under the Air Navigation (Investigation of Air Accidents involving Civil and Military Aircraft or Installations) Regulations 1986, provided that the Department of Transport and the Ministry of Defence amend Regulation 8(2) such that it is a requirement, not a matter of discretion on the part of the Chief Inspector of Accidents, to request the appointment of a liaison officer to assist the Inspector of Accidents with the conduct of the investigation. Similarly, if the Ministers of State order a Public Inquiry into a "combined" accident, one of the Assessors appointed by the Lord Chancellor to assist the Commissioner should be a senior officer from the Service concerned.

APPENDIX A

AIRCRAFT DAMAGE CATEGORIES

- | | |
|--------------------------|--|
| <u>Category 1</u> | The damage is repairable on site by established first-line servicing personnel. |
| <u>Category 2</u> | The damage is repairable on site by established second-line servicing personnel. |
| <u>Category 3</u> | The damage is repairable on site but is beyond unit technical resources. Assistance from a repair and salvage unit or civilian contractor is required. |
| <u>Category 4</u> | The damage is not repairable on site. The aircraft must be removed to an established repair depot or civilian repair organisation. |
| <u>Category 5</u> | The aircraft is damaged beyond repair or is missing or, in accordance with current Ministry of Defence policy, is not worth repairing. |

APPENDIX B

BOARDS OF INQUIRY

1. Criteria for Boards of Inquiry

1.1 ROYAL NAVY

JSP 318 (0401) indicates that a board of inquiry should be held at the discretion of the administrative authority when:

I

- a. Any person is killed or injured.
- b. Neglect or default is suspected.
- c. There is doubt as to the cause of the accident.
- d. Considered in conjunction with previous occurrence the accident reveals a need for special investigation.
- e. The administrative authority considers it necessary.

1.2 ARMY

The convening authority is normally at Divisional or Brigade level. Army Regulations 0502 require a board of inquiry to be convened when:

- a. A person receives fatal or major injuries, or
- b. The cause has not been established beyond reasonable doubt, or
- c. Negligence or default is suspected, or
- d. In any other circumstances the convening authority, Theatre Command Aviation or DAAC considers it desirable.

1.3 ROYAL AIR FORCE

The AOC-in-C or AOC may convene a board of inquiry whenever he considers it desirable, but in the case of serious accidents, as for example when Category 3, 4 or 5 damage is sustained by the aircraft, or death or injury results, a board of inquiry is convened in every case.

1.4 MoD(PE)

A Service board of inquiry is convened by the appropriate military authority in the following circumstances:

- a. by the Royal Navy when 'PE' aircraft are operating from RN Ships or RN Establishments, or when requested by D/Flying (PE) if RN personnel are involved, or:
- b. by the Army when requested by D/Flying (PE) if Army personnel are involved; or
- c. by the RAF when RAF personnel or equipment are involved or when requested by D/Flying.

The procedures appropriate to the Service concerned will then be followed, including submission of the report to the respective convening authority. Accidents to aircraft flown by civilian or foreign pilots are generally investigated under the terms of MoD(PE) boards of inquiry convened by D/Flying (PE). The procedure for such inquiries is substantially the same as that followed in the RAF with the exception that:

- a. MoD(PE) boards of inquiry are not to apportion blame or to recommend disciplinary action, and
- b. evidence is not to be taken on oath, and
- c. witnesses may not be represented since MoD(PE) boards of inquiry do not apportion blame.

2. Purpose of the Inquiry

2.1 ROYAL NAVY

JSP 318 (0401) states:

"The primary purpose of a board of inquiry is to investigate the circumstances of the accident and to establish the cause and where the remedy may lie. It is not a judicial body and has no power to award punishment; it can only recommend."

2.2 ARMY

Army Regulation 0301 states under the heading of "Aim" as follows:

"The aim of flight safety reporting is to provide for the rapid identification of the causes of air and ground accidents and of the potential hazards associated with air and ground incidents, so that appropriate action can be taken to prevent any recurrence and minimize risk."

2.3 ROYAL AIR FORCE

3

The Royal Air Force Manual of Flight Safety (AP3027) states in the introduction to Chapter 7 as follows:

"Thorough investigation of aircraft accidents and incidents is essential if recurrence is to be avoided. Thus the primary purposes of a flight safety investigation are to:

- a. Determine the causes.
- b. Recommend appropriate remedial measures.
- c. Highlight any other lessons learned."

2.4 MoD(PE)

Av P 88 Chapter 704 states in the introduction at paragraph 1 as follows:

"The purpose of the MoD(PE) accident and incident reporting and investigation system is to provide, through the early examination of each reported occurrence, for the rapid identification of actual and potential flight safety hazards and this allow timely remedial and preventative action to be taken both in the immediate and longer term. etc. etc."

2.5 10 AO

The Convention on International Civil Aviation, Annex 13, paragraph 3.1. states as follows:

"The fundamental objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability."

2.6 UK CIVIL REGULATIONS

The Civil Aviation (Investigation of Accidents) Regulations, 1983, states in Regulation 4 as follows:

"The fundamental purpose of investigation accidents under these Regulations shall be to determine the circumstances and causes of the accident with a view to the preservation of life and the avoidance of accidents in the future: it is not the purpose to apportion blame or liability."

3. Terms of Reference

3.1 ROYAL NAVY

There are no fixed terms of reference for boards of inquiry into aircraft accidents in the Royal Navy but Annex 4 A of Section 6 of JSP 318 provides the following notes for the guidance of boards of inquiry:

- a. Investigate the circumstances of the accident.
- b. Determine the cause(s) and any contributory factors.
- c. Where the cause is obscure, the opinions of the board on any contributory causes.
- d. Indicate responsibility.
- e. Ascertain whether or not Service personnel involved were on duty.
- f. Whether or not the crew were competent to carry out the duty, that they were competently briefed and complied with the briefing.
- g. Whether or not all relevant orders and instructions were complied with.
- h. Whether or not the known and forecast weather conditions were suitable.
- i. Whether or not the aircraft was serviceable for the flight.
- j. Whether or not the aircraft escape facilities functioned correctly and were properly utilized.

In illustration of the flexible approach towards terms of reference maintained by Naval convening authorities, however, it is relevant to note that in connection with one accident to a Harrier T4N aircraft in 1985, the board of inquiry was merely required to conduct a:

"full and careful investigation into the circumstances attending accident".

3.2 ARMY

Army Regulations Section 5 Chapter 5 Annex B state that boards of inquiry are to report and express an opinion, where appropriate, on the following matters:

- a. The circumstances leading up to the accident and the circumstances of the accident.
- b. The cause or causes of the accident.

- c. The causes and degree of injury suffered by persons both Service and civilian.
- d. Whether Service personnel involved were on duty.
- e. Whether all relevant orders and instructions were complied with.
- f. The extent of damage to the aircraft.
- g. The extent of damage to aircraft removable role equipment and associated items.
- h. The extent of damage to Service and civilian property.
- j. Whether any person or persons failed in their duty. If any such failing constitutes negligence, identify the factors, mitigating or otherwise, affecting the act or omission deemed negligent.
- k. All relevant crash survival aspects.
- l. Any other points relevant to the inquiry.

The inquiry may make any recommendations it considers appropriate to prevent a recurrence.

3.3 ROYAL AIR FORCE

The terms of reference are determined by the convening authority. The following list is used in most causes but it may be expanded to meet the particular circumstances of the accident under consideration:

- a. Investigate the circumstances of the accident.
- b. Determine the cause or causes of the accident.
- c. Ascertain the degree of injury suffered by persons both Service and civilian.
- d. Ascertain if Service personnel involved were on duty.
- e. Ascertain if all relevant orders and instructions were complied with.
- f. Ascertain if aircrew escape and survival facilities were fully utilized and functioned correctly.
- g. Ascertain extent of damage to the aircraft, public property and civilian property.
- h. Assess any human failings.

- j. Make appropriate recommendations.

3.4 MoD(PE)

The terms of reference for MoD(PE) boards of inquiry are substantially the same as those promulgated in AP 3207 for the Royal Air Force.

3.5 UK CIVIL REGULATIONS

No terms of reference are given for the conduct of civil aircraft accident investigations.

4. Evidence on Oath

4.1 ROYAL NAVY

QRRN 2305 (2) states that a Naval board of inquiry has no power to examine witnesses on oath, but Appendix 38 (4) adds that witnesses suspected of lying should be warned that to do so is an offence under the Naval Discipline Act.

4.2 ARMY

Evidence at Army boards of inquiry is required to be taken on oath and any documentary evidence is to be produced on oath by a witness suitably qualified.

4.3 ROYAL AIR FORCE

Board of Inquiry (Air Force) Rules, 1956, Rule 13 requires that every witness before a board shall be examined on oath or after making a solemn affirmation.

4.4 MoD(PE)

Boards of inquiry investigating accidents into (PE) aircraft which are flown by civilian or foreign pilots do not take evidence on oath.

4.5 UK CIVIL REGULATIONS

AIB Inspectors do not take evidence on oath but witnesses are required to sign a declaration of the truth of the statements they made.

5. Personal Jeopardy

5.1 ROYAL NAVY

QRRN 2304 states that a person whose conduct may be in question and also may be in danger of subsequent disciplinary proceedings should be invited to attend the examination of

witnesses. He may be accompanied by a friend who may be allowed to address the Board and question witnesses.

5.2 ARMY

Army Regulation 0515 and Annex 5C indicate that any person whose character or professional reputation is likely to be affected by the findings is to be given the opportunity of being present or represented at the inquiry. He is entitled to bear all the evidence, give evidence himself and cross-examine any witness.

5.3 ROYAL AIR FORCE

If it appears to a Board that the inquiry will affect the character or professional reputation of any person, that person must be given notice of his rights under QR 1259. This entitles him to have all the relevant evidence up to that stage read to him, and to elect to be present, and represented at the remaining sittings of the board, (or at such times as the convening authority or president may specify). He may also cross-examine former and subsequent witnesses.

5.4 MoD(PE)

Boards of inquiry investigating accidents into (PE) aircraft which are flown by civilian or foreign pilots do not apportion blame, therefore there is no requirement for witnesses to have the right to be represented, hear the evidence or cross-examine any witness.

5.5 UK CIVIL REGULATIONS

Any person whose reputation is likely to be adversely affected is informed in writing of the proposed analysis of facts, conclusions and cause of the accident insofar as these might affect him, and he is given the opportunity to make representations to the Inspector which must be considered and, if in the opinion of the Inspector it is considered appropriate, the draft report must be amended before the report is submitted to the Secretary of State. The person is entitled to a copy of the amended report when it is submitted and if he remains dissatisfied he can require the report to be reviewed in public by a QC sitting formally with two assessors. The report of the review board is then submitted, with the Inspectors report, to the Secretary of State and it is published.

6. Reports of Boards of Inquiry

6.1 ROYAL NAVY

The report of a board of inquiry is in effect the minutes of the proceedings, (QRRN 2305) while the findings are in the form of a letter signed by the president and members of the board (JSP 318, 0408 para 2). Normally the letter should take the following form:

- Paragraph one A chronological narrative of events.
- Paragraph two Factual evidence.

- | | |
|-----------------|---|
| Paragraph three | Opinions of the board including a statement whether blame is attributable, to whom and to what extent, and whether due to negligence or inexperience. |
| Paragraph four | Conclusions, stating whether or not the board have seen the relevant AIU report. |
| Paragraph five | Recommendations, (recommendations about disciplinary action in individual cases should not be made unless specifically directed). |

The report of the board is submitted to the convening authority within fourteen days, otherwise the president is required to report the reasons for the delay and to give an estimate of the further time required (JSP 318, 0410 para 2). Any person who is held to blame is entitled to a copy of the minutes of evidence but not the other portions of the report of the board (QRRN 2304).

6.2 ARMY

The proceedings of an Army board of inquiry are recorded on R A F Form 412. The main headings are listed in the Army documentation as follows:

- a. Diary of action.
- b. Details of the aircraft engines etc.
- c. Material facts established.
- d. Narrative of events.
- e. Diagnosis of causes.
- f. Findings of the board including responses to the terms of reference and recommendations.

Army Regulations indicate that a normal period between convening the board and completion of the report (which is presented on R A F Form 412) is three weeks. On completion, the report is forwarded to the Commanding Officer of the unit for his comments. It is then passed to the Theatre Commander Aviation and on to the convening authority for their comments before submission to D A A C.

6.3 ROYAL AIR FORCE

The report of a board of inquiry is part of the documentation contained in R A F Form 412, the contents of which are as follows:

- Part 1. Details of the board of inquiry
- Part 2. Narrative of events, responses to terms of reference.

- Part 3. Remarks of the Station Commander or Commanding Officer.
- Part 4. Remarks of the Air Officer Commanding.
- Part 5. Remarks of the Commander-in-Chief.
- Part 6. Recorded evidence and statements of witnesses.
- Annexes
- Exhibits.

On completion of the report the president of the board submits it to the Station Commander who adds his comments and implements any remedial or disciplinary action appropriate to his responsibilities. It is then passed to Group, and then Command Headquarters for the comments of the AOC and AOC-in-C respectively. It is not unusual for these comments to amend or even reverse some of the findings of the board after detailed perusal of the report by Group or Command staff officers.

6.4 MoD(PE)

The reports of 'PE' boards of inquiry are prepared on RAF Form 412 and are submitted by D/Flying (PE) to the Deputy Controller of Aircraft "C" at MoD(PE). Special investigating and reporting procedures apply in relation to:

- a. accidents to Tornado aircraft, and
- b. accidents to military aircraft operated under joint Anglo-French development arrangements.

6.5 COMBINED MILITARY AND CIVIL AIR ACCIDENTS

Reports by the Accidents Investigation Branch of the Department of Transport into combined military and civil air accidents are submitted by the Chief Inspector of Accidents to the Secretary of State for Defence and to the Secretary of State for Transport.

6.6 UK CIVIL ACCIDENTS

Regulation 10 (7) of the Civil Aviation (Investigation of Accidents) Regulations, 1983, states as follows:

"The report to the Secretary of State shall state the facts relating to the accident followed by an analysis of the facts and conclusions as to the cause or causes of the accident, together with any recommendations which the Inspector thinks fit to make with a view to the preservation of life and the evidence of accidents in the future."

APPENDIX C

SUMMARY OF ACCIDENT INVESTIGATION PROCEDURES

	One Tier System (1)	Formal Inquiries All the Time	Standing Presidents	Permanent Investigation Teams	Joint Service Investigation
Germany	NO	YES	YES (2)	NO	YES
USA	NO	YES (2)	NO	NO	NO
Greece	YES	YES	NO	NO	NO
Belgium	NO	YES (2)	YES	YES	YES
France	NO	YES	YES	NO (3)	NO
Denmark	NO	YES	YES	NO (5)	YES
Canada	NO	YES (2)	NO	NO	YES
Netherlands	NO	YES	YES	YES	NO
Turkey	YES	YES	YES (3)	NO (3)	NO
Italy	YES	YES (4)	YES	NO	YES
Spain	NO	YES	NO	NO	NO

NOTES:

- (1) Investigate cause and allocate blame.
- (2) Not always for category 3/4.
- (3) However, teams are selected annually.
- (4) For major injury or maintenance requiring support from industry.
- (5) Some specialists from flight safety staff.

APPENDIX D

COPY

**From W H Tench C. B. E., C. Eng., F.RAe.S
Man S. (Org) 3, Room 657**

**H. P. Stewart Esq
Group Chief Executive
Westland Works
Yeovil
Somerset BA20 2YB**

BERW. 003

16th Oct 1986

The Parliamentary Under Secretary of State for the Armed Forces has asked me to conduct a study of aircraft accidents in the armed forces with the following terms of reference:

"To examine the reports and investigate the methods of conducting inquiries into military aircraft accidents in all three Services and MOD(PE) in order to establish whether alternative procedures, or any other features, would be more efficient or effective in determining the cause of accidents."

Since the basic purpose of investigating accidents is to prevent similar accidents in the future, I am necessarily concerned to establish whether the chain of follow-up and corrective action is working properly in those cases where Boards of Inquiry have recommended that modification action should be taken. I will be grateful, therefore, if you will inform me whether you are satisfied with the feed-back of information your staff receive about accidents to military helicopters which were manufactured, either partly or wholly, by Westland Helicopters Ltd.

I am aware that in many accidents members of your staff give technical assistance to Boards of Inquiry, carrying out component strips and producing detailed reports to Boards. However the information they impart has to negotiate many filters through the military Commands and MoD(PE) before the corrective action recommended by the Board of Inquiry reaches the manufacturer.

I would appreciate any assurance that you can give me that the present procedure is satisfactory from your point of view, or alternatively any criticism or suggestions you might wish to make. If there are serious shortcomings I am willing to visit Yeovil to discuss such matters with your staff. I must point out, however, that my terms of reference confine me to the general context of aircraft accident procedures, and I am not authorised to investigate other matters of procurement.

Westland pic

YEOVIL ENGLAND TELEPHONE: YEOVIL 75222 TELEX: 46277 WHL YEO G TELEGRAMS: AIRCRAFT TELEX YEOVIL

Fax: Kalle Infotec 6000 -
Plessev PDF

Yeovil 702131
Yeovil 702233

Our ref: CSDT/YABR/SW/2587
Ext no: 2016
Your ref: BERW.003
Date: 3rd November, 1986

Mr. W. H. Tench, OBE, C.Eng., FRAeS,
S (Org) 3,
Room 657,
Ministry of Defence,
Northumberland House,
Northumberland Avenue,
LONDON. WC2N5BR.

Dear Mr. Tench,

With reference to your letter of the 16th October, ref. BERW.003, to our Chief Executive, Mr. H. P. Stewart, and further to his reply of the 22nd October, following discussions with our Helicopter, Helicopter Customer Support, and Aerospace Divisions, I would comment as follows:

- I. With reference to your quoted terms of reference, e.g. "To examine the reports ... the cause of accidents", we have no reason to believe that these are not conducted in an efficient and effective manner. However, informally, you may be interested to know that we are aware of the benefits that accrue to the Accident Investigation Branch (AIB) - Civil, by having full-time staff undertaking this task. It could be that the Services would benefit from a multi-disciplinary (Army, Navy and Air Force) group rather than the current part-time individual Service's activity.
2. In connection with your side comments concerning the chain of follow-up and corrective action, I am sure you realise that while there are formal and informal procedures with which we interface to assist in accident investigations, which we consider function perfectly adequately, and although we are formally aware of the findings of the Accident Investigation Unit (ACU) - Navy, we are only informally aware of the AIU findings of the other Services.

A formal knowledge of the results of all of the AIU's would certainly assist us in deciding on the suitability of any modification we may wish to introduce to safeguard our own export customers and also similarly for us to advise on Service modification action.

We are not party to the results of your Boards of Inquiry. We accept that perhaps we do not have a need to know but this means that it is not possible for us to answer your question

concerned with whether significant airworthiness issues have been lost in the action chain since, as you say, the information that the Board imparts has to negotiate many filters through the military Commands before information reaches us. We have no reason to suppose that significant airworthiness matters are suppressed and we are usually informed/involved in the loop both formally and informally of follow-up action.

3. With reference to your request for assurance that the present procedures are satisfactory, we would confirm that they are within the concept of flight safety being preserved for minimum cost. This means that in some cases modification action that we would recommend (and consider essential for our overseas military customers) is not pursued by the Procurement Executive, but rather action which safeguards the situation through a greater involvement of qualified staff (a situation we cannot assume exists with our overseas military customers).

I am enclosing an example to support the above general comments supplied by G. Humphrey, Engineering Director of our Helicopter Customer Support Division. ,

From the above, I am sure you will see that we do not consider there are any serious shortcomings in the Services' conduct concerning accident investigations. However, I hope the above comments are useful to you and if you wish to discuss them in greater depth or receive further examples of the points we have raised, I am sure Geoff Humphrey will be pleased to discuss them with you.

Yours sincerely,

V. A. B. Rogers,
Corporate Staff Director-Technical.

Encl.

c.c. Mr. H. P. Stewart
Mr. G. J. Humphrey
Mr. R. I. Case
Mr. A. Weeks

WESTLAND HELICOPTERS LIMITED

G. J. Humphrey
Engineering Director

Ext: 2398

To: Mr. V. A. B. Rogers
Corporate Staff Director
Technical

Date:

Ref:

4th November, 1986

CSD/GJH/SBT/1612

FLIGHT SAFETY MODIFICATIONS

Further to our conversation regarding the above and particularly the letter from Mr. W. R. Tench,, I thought you might be interested in the following example:

In 1982 a disintegrating alternator generated a fire on the transmission deck of a Lynx helicopter. Our proposal for modification was to fit an outlet duct to the alternator such that in the event of a reoccurrence debris would be transported overboard. This modification has still not been adopted by M.O.D. The M.O.D., (as a short term measure?), called for inspection and greater cleanliness of the deck to prevent accumulation of pockets of spilt oil, and for a long term design improvement to the alternators. The Lynx will continue to operate for many years with the old standard of alternator, even after the new ones become available and, therefore, we feel the only sensible step to protect the whole fleet is to adopt the proposed duct and greater priority should be given by the M.O.D. to its introduction.

G. J. Humphrey
Engineering Director
Customer Support Division

ROLLS ROYCE pic
65 Buckingham Gate, London SW1E 6AT
Telephone: 01 222 9020 Telex: 918091

R H Robins Managing Director

5th November 1986

Mr. W. H. Tench, C.B.E., C.Eng., F.R.Ae.S.,
Ministry of Defence,
Northumberland House,
Northumberland Avenue,
LONDON WC2N 5BP

Dear Mr Tench,

Thank you for your letter of 16th October advising us of your study of aircraft accidents in the UK Armed Forces with respect to procedures used by the Services in determining the cause of accidents.

As requested, from experience and observation, we would comment as follows:

- a) The initial feedback of technical information is often sketchy and inaccurate due, we believe, to the complexity of various formalities.
- b) Due to the Navy and the Army each having its own dedicated service team who carry and the technical on-site and any subsequent investigation, good relationships and contacts exist with industry. However, with the RAF, for each accident a separate Board of Inquiry is convened which, due to inexperience, invariably takes longer to identify and instruct the priority tasks to be undertaken. As a consequence, only the RAF frequently enlist the services of the Department of Transport Accident Investigation Branch.
- c) When the need for modification action or other technical action such as STI/STO is identified during an investigation, the appropriate action is initiated and implemented without awaiting publication of any Board of Inquiry report.

Mr. W H Tench

5th November 1986

We trust that the above comments will help in your study and confirm that the Company welcomes all opportunities to assist and be involved in joint investigations.

We would equally welcome you for discussions on the above comments with the appropriate Company personnel responsible for accident and defect investigations.

Yours sincerely,

R. H. ROBINS

«

BRITISH AEROSPACE

DGE: BAMS

**BRITISH AEROSPACE
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5th December 1986

Further to my letter dated 23rd October 1986 I am sorry that it has taken longer than I anticipated to obtain the views of the two Aircraft Divisions on the points raised in your letter of 16 October. However, the comments from each Division have now been received and it may be most helpful to you if I enclose them virtually verbatim; you can then more easily determine whether you may wish to pursue any specific point with either of the Divisional Technical Directors concerned. Accordingly, I attach at Annex A and B respectively comments from the Military Aircraft and the Civil Aircraft Divisions.

Should you wish to discuss matters of future policy with British Aerospace, I would be grateful if you would inform me in advance. However, if you wish to pursue a particular point arising from either of the Divisional Technical Director's comments, I am quite content for you to contact them direct at either Weybridge or Hatfield. Meanwhile, I will not attempt to add to the views expressed.

However, you may be interested to know that a few months ago I presided over an internal Company Board of Inquiry into the loss of the Hawk 200 at Dunsfold in July; John Scott-Wilson was one of the five members of that Inquiry Board. In the light of my practical experience of both Service and Civil Accident Inquiry's, if I can be of any further assistance to you please do not hesitate to get in touch with me again. Meantime, good luck with your timely Review.

Enc.

REMARKS OF MILITARY AIRCRAFT DIVISION

H.Q.: WEYBRIDGE

TECHNICAL DIRECTOR Mr. B. YOUNG

Broadly we believe the Boards achieve what they are at present required to do but that there are points of principle in both their Terms of Reference and their methods of obtaining information which need examination. Feedback is not usually adequate for our purposes as Design Authority.

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1. Independence of the inquiry from the operator is not clearly established for military aircraft accidents. In fact the Board of Inquiry is convened by the Operating Commander who appoints the President.

Note that in Civil practice all accidents are investigated for Operational or Technical cause by an independent authority.

2. There is no requirement for independent expert evidence to be obtained. In many cases the aircraft manufacturer is asked questions and we are pleased to note the increasing use of the A.I.B. but neither is mandatory as with a Civil Enquiry and access to information may be limited.
3. Consideration of management factors i.e. organisation, compliance with instructions, human errors, is usually part of the terms of reference but not necessarily so. In Civil accidents the A.I.B. is required to do this as a matter of course and may call for further investigation by a specially convened Inquiry.
4. Results of Boards of Inquiry are generally available in the form of accident summaries provided by MoD (RAF) IFS but, in order to improve follow-up activity, we believe a more detailed technical analysis should be provided to the Design Authority.

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This and the points raised in 2) above could be covered by a requirement for a representative of the Design Authority to be co-opted onto the Board as a Technical Adviser.

These points are raised as a basis for possible further expansion should Mr. Tench require it. They are not intended as criticism of those involved in improving Flight Safety.

ANNEX B
to DGE:BAMS
5th Dec. 1986

REMARKS OF CIVH, AIRCRAFT DIVISION

H.Q.: HATFIELD

TECHNICAL DIRECTOR: Mr. J. SCOTT-WILSON

Civil Aircraft Division experience shows a marked difference in the degree of involvement of ourselves as a Design authority with Military aircraft accidents compared with Civil aircraft accidents.

In Civil accidents we are, in general, made aware of all cases where an enquiry is held into an aircraft accident. We have appointed Flight Safety Managers at our major sites to interface with the investigating body, providing any information it might require about the aircraft, and to feed back to our Design teams any findings that are causing concern and require action as far as all other operators of the type are concerned. The position of Flight Safety Manager was set up at each Site to handle this interface at the request of Sir Frederick Page when he was Chief Executive of Aircraft Group. It works well. We are kept aware of how our investigations are going which is important from both commercial liability and the technical points of view.

In comparison we are far less aware of proceedings of R A F Boards of Enquiry. It is accepted that procedures taken to prevent repetition are handled by the Service not by ourselves as is the case for Civil aircraft. It is also recognised that implementation of change is again the responsibility of the R A F and the Procurement Executive. However a more direct involvement of ourselves with an investigation would probably help the investigation forward and could also be beneficial in terms of suggesting subsequent preventative measures. In these days where export sales of Military aircraft are an important part of our business, the case for our having equal involvement in both Civil and Military accident investigations could be argued.

APPENDIX E

AIRCRAFT ACCIDENT REPORT No

AIRCRAFT	Type	SERVICE	Royal Navy
	Model		Army
	Number		Royal Air Force
			MoD(PE)

LOCATION OF ACCIDENT

	Lat	DAMAGE CATEGORY	
	Long		
DATE OF ACCIDENT		AIRCREW	Fatalities
			Injured
			Uninjured
TIME		OTHER	Fatalities/injuries

The report should commence with a summary indicating when the accident was notified to JSIU and by whom. This should be followed by the briefest description of the accident itself and the conclusion as to its cause.

Part I - FACTUAL INFORMATION

- 1.1 History at flight, (including preparation for the flight, intention etc).
- 1.2 Injuries to persons, (use standard table and include onlookers).
- 1.3 Damage to Aircraft, (in general terms, state damage Category).
- 1.4 Other Damage, (to buildings, crops, property etc).
- 1.5 Personnel Information, (qualifications and experience of aircrew and others).
- 1.6 Aircraft Information, (describe relevant systems, weight, c of g etc).
- 1.7 Meteorological Information, (forecast and aftercast, conditions of light).
- 1.8 Navigation Aids (describe only relevant features).
- 1.9 Communications frequencies and quality, transcripts should be in the Appendix.
- 1.10 Aerodrome Information, (relevant information only).
- 1.11 Flight Recorders, (types used, parameters etc, full read-outs in Appendix).

- 1.12 Examination of the Wreckage, (describe terrain and impact, detail damage).
- 1.13 Medical and Pathological Information, (cause of death source of injury).
- 1.14 Fire, (fuel load on impact, pre and post impact fire, source of ignition).
- 1.15 Escape and Survival, (ejector seat function, rescue organisation).
- 1.16 Tests, Research and Detailed Examination of Components, (indicate results).
- 1.17 Additional Factual Information, (catch-all if required).
- 1.18 Human Factors, (summarise relevant features).

PART U - ANALYSIS

- 2.1 Evaluate the evidence in Part I in detail using a separate paragraph 2.2, 2.3, etc., for each subject, so that the argument develops logically into explaining the reason why the accident occurred. Every aspect raised in the factual part of the report that might have a bearing on the accident should be discussed in a sequence that puts the least relevant (or possibly completely irrelevant) features first, and the most significant last

PART HI - CONCLUSIONS

- 3.1 The Findings.

The findings should provide the answers to the questions which the circumstances of the accident pose. Their primary purpose is to indicate in an unequivocal manner the area or areas in which the accident had its originating and contributory causes. It is also important to identify those aspects of the circumstances which came under suspicion of being related to the cause of the accident but on examination of the evidence were found to be unconnected with it.

- 3.2 The Cause of the Accident:

This should be a concise statement in two or three sentences of the cause, causes, or probable cause of the accident, also the contributory causes.

PART IV - RECOMMENDATIONS

- 4.1., 4.2.,

etc., It is important that the investigator should be severely practical when drawing up the recommendations. He should consider how the organisation to whom they are addressed is able to implement not only the spirit of his recommendations but the letter as well. It is preferable, therefore, for the wording to be in broad rather than specific terms if it is possible to retain its effectiveness when so doing. The temptation to make recommendations for their own sake should be resisted, bearing in mind that the flight safety authorities may generate improved practices from their own

reading of the investigator's report that are not associated with the recommendations in the report. At the same time, where it is established that the existing organisation is inadequate, there should be no hesitation in recommending corrective action.

PART V - APPENDICES

The Appendices should comprise those diagrams, photographs, charts and tabulated information, also complete specialist reports on particular subjects related to the accident, that are too detailed or specialised to be included in the body of the report.

Signature of Investor

Approval of Head/JSIU

Date