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AIR SAFETY: SELECTED REVIEW OF FAA PERFORMANCE

REPORT

BY THE

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

OF THE

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

HOUSE OF REPRESENTATIVES

NINETY-THIRD CONGRESS

SECOND SESSION

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FOREWORD

This report summarizes the results and findings of the Subcommittee's oversight review of a number of activities of the Federal Aviation Administration. The subject matter of the report is, of necessity, quite broad. But this merely reflects the scope and the importance of the varied responsibilities which the Congress has entrusted to the FAA. Unlike some other agencies of the Government, whose responsibilities center on economic regulation, the responsibilities of the FAA directly involve human life and safety.

For this reason, it is somewhat unfortunate that the task of the FAA has been traditionally described as two-fold: to foster aviation safety on the one hand, while promoting civil aviation itself, on the other. The Subcommittee has noted a tendency within the agency to view these responsibilities as if they were competing interests to be balanced off against each other. There have been instances when appropriate FAA actions in furtherance of air safety have been unreasonably delayed, or omitted entirely, because of an oversolicitous attitude on the part of some within the agency concerning the economic well-being of the aircraft industry or the air carriers.

The Subcommittee is not in favor of agency activity which imposes needless and unjustified burdens upon the aviation industry, But the Subcommittee does not view realistic and effective safety regulation as being inimical to the long-range economic health of the industry. Public acceptance and confidence in air travel has been based upon an underlying foundation of trust that the highest possible degree of safety is being required by the FAA and implemented by the air carriers. Recent developments, some of which are discussed in this report, have had the effect of calling into question these basic assumptions. Once lost, public confidence will not be quickly regained. Therefore, agency decisions which compromise safety in favor of apparent short-term economic factors affecting the industry apart from their threat to the public safety, do not serve the real economic interests of the aviation industry. The attempt to balance dollars against lives benefits no one.

It has been noted before that regulatory agencies, like people, sometimes suffer from hardening of the arteries with advancing age. Symptoms of such a process have been noted within the FAA. Administrative delay and inactivity is bad in any agency; in the case of the FAA, it may literally endanger human life. Instances of completely inappropriate bureaucratic slowness to act, and inaction, are noted throughout this report.

The Subcommittee found throughout its inquiry -- from the DC-10 crash to its most recent investigation into the feasibility of requiring Ground Proximity Warning Systems -- a tendency for the agency to avoid the role of leadership in advancing air safety which the Congress intended it to assume. This is manifested primarily by the FAA's willingness to let the industry engage in self-regulation when vital safety matters are concerned. In some instances, this abdication of responsibility has been coupled with an administrative lethargy -- a sluggishness which at times approaches an attitude of indifference to public safety. This must stop. In some instances, agency action was forthcoming only after public announcement by this Subcommittee that hearings would be held on the subject matter in question. This was the case with respect to the appointment of the eighteen full-time FAA specialists in hazardous air cargo matters. These positions had been authorized eight months prior to the Subcommittee's hearing on hazardous air cargo held on April 25 and 30, 1974. The positions remained unfilled by the agency until several days prior to the first hearing.

Again, in the case of the ground proximity warning system, an FAA period of inactivity extending over a year and a half was abruptly terminated immediately after Subcommittee hearings on the subject were announced. Within days after this announcement, an agency Notice of Proposed Rule Making was inserted in the Federal Register.

On December 10th, the Chairman of the Subcommittee was advised by telegram from Mr. Butterfield that the Administrator had personally flown to Seattle, Washington, and inspected the production facilities of the firm which manufacturers the only ground proximity warning system now commercially available. On the basis of this first-hand inspection and discussion with company officials, the Subcommittee was advised,through its Chairman, that immediate FAA action would be taken to require the installation of this life-saving device on all large commercial passenger aircraft by December 1st of next year.

The Subcommittee was initially very much encouraged by this action of the Administrator. But a review of the regulation which the FAA has now promulgated discloses that the agency does not propose to require that the ground proximity warning systems to be installed be equipped to give warnings when an aircraft deviates dangerously from the glide slope during landing. This type of accident comprises a significant number, perhaps as much as one-third, of all preventable crashes.

Based on statistics which the Subcommittee reviewed at its hearings in September,and which FAA witnesses did not dispute, it can be predicted that avoidable accidents resulting in loss of aircraft and human lives will occur because of the failure of FAA mandated equipment to provide warnings in cases of dangerous deviation from glide slope. To remove any doubt on this score, the Subcommittee calls attention to the report of the National Transportation Safety Board on the fatal crash of a Pan American Airlines plane attempting to land at the Page Pago Pago International Airport, American Samoa. Ninety-seven of the 101 occupants on board died as a result of the accident and the aircraft was destroyed by impact and fire. The Board's investigation, released on December 19, 1974, concludes that the probable cause of the accident was "the failure of the pilot to correct an excessive rate of descent after the aircraft had passed decision height." The Board concluded that the pilot failed to refer to the glide slope instruments immediately prior to the impact, and, furthermore, "the aircraft was <u>below the glide slope</u> and was descending too rapidly to complete the landing safely." (Emphasis added.)

Having taken so long to require the deployment of ground proximity warning systems, it is extremely regrettable that the FAA has now taken regulatory action which does not assure that the air traveling public will have the full benefit of presently available technology. This is perhaps the most pressing pending issue regarding air safety. The Administrator should, without delay, issue the necessary Notice of Proposed Rule Making and do all in his power to get the FAA's administrative machinery moving to upgrade the recently issued proximity warning requirement.

The FAA Administrator Alexander Butterfield has shown, both in his public statements and in some of his recent actions, an appreciation of the responsibilities entrusted to him and his agency. After the crash of the Turkish airliner in March of this year, Mr. Butterfield took action to issue appropriate Airworthiness Directives and to set up an ad hoc investigative committee to thoroughly review the regulatory issues surrounding the DC-10 cargo door problem. The Administrator's personal inspection of production facilities and capability, mentioned above, led to his revising the estimates provided by FAA staff as to the achievable effective date of the rule requiring installation of the ground proximity warning device. While the resulting rule itself is not adequate to provide the highest degree of attainable protection, this defect can be remedied by the Administrator taking the necessary steps to upgrade the rule.

On March 3, 1974, the worst disaster in the history of aviation took place when a fully loaded DC-10 aircraft operated by Turkish Airlines crashed outside Paris. The Subcommittee has given particular attention to the regulatory actions surrounding the certification of the DC-10, and the subsequent actions taken by the FAA when on June 12, 1972, one of these planes was involved in a nearly disastrous accident shortly after takeoff from Detroit Metropolitan Wayne County Airport. Since this incident occurred nearly two years prior to the Paris crash, it is imperative to analyze the agency's response to the first accident. The finding of the Subcommittee is that the agency's performance was completely unsatisfactory and involved non-regulatory expedients which must not be resorted to again in any future situation of similar import.

The setting up of the FAA Ad Hoc Investigative Committee immediately after the Paris DC-10 crash has already been mentioned above. The Committee's report (also known as the Bakke Report, after the Committee's Chairman) was submitted on April 19, 1974. It contains a number of findings and recommendations wnich would furnish the basis for additional oversight inquiries. It has not been practical for the Subcommittee to undertake these in the limited time available before the transfer of civil aviation jurisdiction provided for in the recent

reorganization of the House of Representatives (H. Res. 988). The Subcommittee has, however, noted these areas of concern at appropriate places in this report. The Subcommittee urges the Administrator to give top priority to the consideration and implementation of the recommendations contained in the report of the Ad Hoc Investigative Committee.

As noted elsewhere, the Subcommittee believes that the best interest of the public now requires that the report of the FAA's Ad Hoc Committee be made public. In the eight months since it was completed, the agency has had sufficient time to evaluate its contents. The report discusses issues of legitimate concern to the public and the Congress, and contains no material which constitutes an invasion of the privacy of any individual. While the official French investigation of the Paris air crash is still in progress, the Ad Hoc Committee's report does not address itself primarily to this subject. Insofar as it does discuss the background and causes of the Paris crash, the report does no more than reiterate information which has already been freely discussed publicly by a number of sources, including the FAA and the French Government. Its release at this time, therefore, will in no way compromise or preempt the work of the official investigative body looking into the Paris crash.

The Subcommittee emphasizes that surely air travel is one of the safest modes of transportation available today. There can be no rest or satisfaction, however, as long as preventable crashes continue to occur. Even greater safety is within easy reach and must be achieved as soon as possible.

References to Subcommittee hearings in this report refer to hearings held on the following topics on the indicated dates:

(1) DC-10, Problems with Cargo Doors
March 27 and April 9, 1974;

(2) Air Transport of Hazardous Materials
April 25 and 30, 1974;

(3) CF-6 Engine Problem Involving the DC-10
July 2 and 10, 1974;

(4) Ground Proximity Warning Systems
September 18, 1974

I. DC-10: PROBLEM WITH CARGO DOORS

A. Introduction

The advent of the so-called wide-body passenger jet aircraft has presented the FAA with some unique regulatory problems. The first of these aircraft to come into commercial use, the Boeing 747, was followed by the introduction of the McDonnell Douglas DC-10, the Lockheed L-1011 "Tristar," and the European A-300B "Airbus."

From the beginning, it was recognized that the loss of one of these immense transports, costing in the neighborhood of $20 to $25 million each, would take an enormous toll in human life. Such a dreadful event did in fact take place on March 3, 1974, when a fully loaded DC-10, operated by Turkish Airlines crashed outside Paris, France, shortly after takeoff. This was not the first instance of a crash by a wide-body aircraft. On December 29, 1972, a Lockheed L-1011 crashed into the Everglades while attempting to land at Miami International Airport; 99 lives were lost.1/ The DC-10 crash, however, was the worst disaster in aviation history; 335 passengers and 11 crew members perished.

The cause of the crash was the in-flight opening of the aircraft's aft bulk cargo door when the plane reached approximately 12,000 feet of altitude. The resulting explosive decompression caused the cabin floor to collapse, disrupting the aircraft's flight control cables routed beneath the floor. Examination of the wreckage confirmed that a crucial modification needed to secure the integrity of the door had not been installed.

The cause of this crash was, therefore, the same as the cause of a near-disastrous accident involving another DC-10 nearly two years previously. In that accident, which occurred on June 12, 1972, an American Airlines DC-10 lost its aft cargo door shortly after takeoff from Detroit Metropolitan Wayne County Airport, with resulting decompression, floor failure and disruption of controls. The plane was landed with considerable difficulty, and no lives were lost.

1/ The L-1011 accident is discussed in Section III of this report relating to Ground Proximity Warning Systems.

The National Transportation Safety Board (NTSB) investigated this accident, and found that the probable cause was the improper closing of the door prior to takeoff. It also found that the door was designed in such a way as to permit it to be apparently closed when it was not. The FAA, as the Federal agency primarily responsible for safety in the air, undertook certain steps to bring about modifications of the DC-10 cargo door system so that the near disaster of June 1972 might not be repeated. In addressing such safety problems, the FAA has available an instrument known as an Airworthiness Directive (AD). This is a legally binding directive addressed to those who manufacture and operate aircraft to require specified modifications or procedures deemed necessary in the interest of safety.

No AD was issued as a result of the nearly fatal accident of June 1972. After the fatal crash outside Paris two years later the FAA issued a telegraphic AD three days after the accident, and amended it approximately two weeks later to make it more comprehensive. The AD action required, among other things, the installation of modifications which had been available for periods of time ranging up to nearly two years prior to the crash.

Because of the obvious similarity between the 1972 American Airlines accident and the 1974 Turkish Airlines crash, it was announced on March 15 that the Subcommittee would conduct hearings to inquire into the background behind these accidents and the FAA's regulatory response. Specifically, the Subcommittee wanted to determine how it was that a huge transport plane filled with passengers could be lost because of the same type of failure which had almost cost a similar plane to be lost two years previously, despite the involvement of the Federal agency specifically set up by Congress to insure the highest degree of safety in the air.

The Subcommittee has determined that the crash outside Paris this year cast a long shadow before it. While responsibility rests with a number of persons and organizations, this Subcommittee's primary concern is with the FAA. In its response

to the opportunity presented by the frightening, but miraculously non-fatal, accident in June 1972, the FAA engaged in non-regulatory procedures which were totally ineffective and which must never again be resorted to.

The fault does not lie with the vast majority of the FAA's dedicated and competent staff. They moved speedily and effectively to prepare for the issuance of an immediate Airworthiness Directive which would have incorporated the requisite design corrections to the DC-10 cargo door problem as soon as they became available. On the day after this AD was to be promulgated, the Director of the FAA's Western Region office, the FAA officer authorized to issue such a document, was advised by the president of the Douglas Aircraft Company that a telephone conversation had taken place between him and the Administrator of the FAA during which a "Gentlemen's Agreement" had been reached which obviated the necessity of an AD. This surprising news was confirmed by FAA Headquarters in Washington. Thereafter, modifications designed to increase the safety of the DC-10 cargo door were the subject, not of mandatory AD's, but of "recommended" service bulletins issued by the manufacturer to the airlines. For the most part,they were treated accordingly.

As a result of this departure from the clear and proper regulatory response which the agency should have made, the lives of thousands of air passengers were needlessly and unjustifiably put at risk for almost two years. During this period, dozens of DC-10's were flying with their cargo door mechanisms in the same vulnerable condition as the Turkish plane which crashed earlier this year. While the potential for disaster was present, it was fortunately averted in the case of those aircraft and their passengers.

The central question which has occupied this Subcommittee and many other persons is whether the Turkish aircraft itself might have been saved had the FAA acted in accordance with its legislative mandate. The Subcommittee feels that the evidence available to it precludes a final judgment on that question.

The Subcommittee notes that the doomed airplane had not yet been released by the manufacturer, Douglas Aircraft, at the time of the Detroit accident. Furthermore, the Subcommittee has

examined company records purporting to show that the modifications needed to make the cargo door safe had in fact been installed on the plane. As indicated above, the modification had not, in fact, been made and the records indicating the contrary are erroneous. Since controversy has centered around whether or not the modification in question should have been the subject of an FAA Airworthiness Directive, it has been argued that this point is moot as to the Paris crash, inasmuch as the legal effect of an AD, even had one been issued, would not have prevented the inadvertent failure to install the modification, and the erroneous statement of the company's records would have prevented discovery of this fact.

But the Subcommittee cannot but consider that the existence of a legally binding order with respect to this modification might have raised its priority to the point where more careful verification of its completion might have been made by the company. It is also possible to expect that this same factor might have elicited a more thorough inspection of the plane by the FAA. But the agency spokesmen who testified before the Subcommittee denied that this would follow; this is in itself an indictment of present FAA regulations and procedures. Finally, a question remains as to whether the existence of an AD, which by rights should have been issued and which would have been the only one applicable to the DC-10 at the time of delivery, might not have prompted the Turkish authorities who accepted delivery of this $25 million airship to satisfy themselves that it had been complied with.

The Subcommittee is not prepared to state, on the basis of the evidence it has examined, that the Turkish airship would have been saved had the FAA acted more effectively after the 1972 Detroit accident. By the same token, the Subcommittee cannot degree with those witnesses who confidently testified before it that such would definitely not have been the case. This issue will have to be determined, if at all, before the appropriate judicial forum. Because of its actions, and lack of them, the FAA finds itself in the unaccustomed position of a defendant in a lawsuit brought by the survivors of the passengers aboard the destroyed plane.

The Subcommittee held two days of hearings on this subject, on March 27 and April 9, 1974. It has also had access to various memoranda and documents of the McDonnell Douglas Corporation, and the Convair Division of the General Dynamics Corporation, the subcontractor in charge of fabricating the DC-10 fuselage and doors.

In addition the Subcommittee has had reference to the report of the FAA's Ad Hoc Investigative Committee. On March 5, 1974, two days after the Paris crash, FAA Administrator, Alexander Butterfield, directed the Associate Administrator for Aviation Safety, Mr. Oscar Bakke, to organize and chair the Ad Hoc Committee. The committee's task was to review the pertinent certification history of the DC-10 airplane together with all investigative reports concerning accidents or incidents involving DC-10's which bore even slight similarities to the Turkish Airlines (Turk Hava Yollari, i.e., THY) DC-10 accident.

The resulting report of the Ad Hoc Committee (also known as the Bakke Report) is dated April 19, 1974. It has, as of the date of this Subcommittee's report, not been released by FAA. The Ad Hoc Investigative Committee's report has a bearing on issues of the greatest importance to the public and the Congress. Moreover, its findings raise additional questions which this Subcommittee will not have an opportunity to explore in view of the recent reorganization of the House of Representatives, which requires that aviation oversight jurisdiction be transferred to another Committee.

The Subcommittee feels that the FAA has had sufficient opportunity to consider and evaluate the Ad Hoc Committee's report during the eight months since it has been completed. It is now time for the public and the Congress to be apprised of its contents. The issues are of sufficient importance to merit public discussion; the recommendations of the report are worthy of serious Congressional scrutiny inasmuch as they are designed to realign the FAA's structure and priorities so as to provide for more effective and timely regulatory action in the public interest.

The report documents a number of "voluntary compliance" arrangements engaged in by the FAA with respect to serious safety defects. These are worthy of additional inquiry.

In view of the above considerations, the Subcommittee has determined that continued secrecy as to this report is no longer necessary or justified. The Subcommittee has, therefore, decided that it should be made available to the public. It will be found in Appendix A of this report.

B. Development and Certification Period

The Convair Division of General Dynamics was the subcontractor selected to manufacture the DC-10 fuselage, together with the cargo doors.

There are indications that the prime contractor, McDonnell Douglas, and the subcontractor, General Dynamics-Convair, were not in complete accord concerning the original design of the DC-10 cargo door and latching system and their subsequent modifications. An internal memorandum prepared by a Convair engineer refers to this subject. The memorandum is dated June 27, 1972, and was written three weeks after the near catastrophe involving a DC-10 over Windsor, Ontario (see below, page 21). That memorandum charged that the fundamental safety of the cargo door latching system had been "progressively degraded since the program began in 1968." The memorandum continued:

> "At the beginning of the DC-10 program it was Douglas' declared intention to design the DC-10 cargo doors and door latch systems much like the DC-8's and -9's. Documentation in April 1968 said that they would be hydraulically operated.
>
> "In October and November of 1968 they changed to electrical actuation which is fundamentally less positive. At that time we [i.e. Convair] discussed internally the wisdom of this change and recognized the degradation of safety, however, we also recognized that it was Douglas' prerogative to make such conceptual system design decisions whereas it was our responsibility as a subcontractor to carry out the detail design within the framework of their direction."

The calamitous chain of events which would ensue from the opening of a cargo door in flight was recognized by Convair early in the development of the door design. Convair's analysis on this point was made available to Douglas. The analysis was contained in what is known as a Failure Mode and Effect Analysis (FMEA). This type of analysis attempts to predict the initial and secondary effects of failure on the part of various components of a system.

The failure mode analysis of the DC-10 cargo door opening and closing mechanisms -- as they then existed -- was performed by a Convair engineer in May of 1969. It was done on McDonnell-Douglas forms and forwarded to McDonnell-Douglas on August 12, 1969. As noted, this document analyzes the consequences of failure of various elements in the door mechanism. The analysis was performed prior to the incorporation of the so-called vent door into the design (see below). It nevertheless identified several possible failures which might lead the crew to conclude that the door was safely locked when it was not.

The Convair analysis, moreover, was fairly explicit as to the consequences which could be expected should a DC-10 take off with the door not secure:

> "Door will fully open - resulting in sudden depressurization and possibly: Structural failure of floor. Also damage to empennage by expelled cargo and detached door."

While this report did not deal with the specific situation which was later to arise -- overpowering and forcing of the vent door handle -- it did clearly point out some of the possible end results of a failure of the door to completely close and latch. The report did not, however, specifically point out that the "structural failure of the floor" might in turn disrupt or immobilize the control cables to the tail, which in the DC-10 are routed through the floor.

As noted, this analysis was made known to the McDonnell-Douglas Corporation in August of 1969; two years before the first DC-10 was completed. The analysis was not, however, supplied to the FAA. The report of the FAA Ad Hoc Committee states:

> "The certificating office did not believe it to be a requirement that systems safety analyses, using probability procedures, fault mode analyses, and considering consequence of failures be submitted for certification acceptance of the Model DC-10 cargo doors latching, locking, or lock security warning systems; consequently, none were submitted at the time of original type certification." (Page 13.)

In the future, the FAA must adopt procedures which call for mandatory submission of all reports and analyses, whether prepared by the prime contractor or by a subcontractor, which bear directly upon the safety of the aircraft. The Subcommittee anticipates the objection that such information and data is likely to be voluminous, and that a requirement that FAA review it in detail may be unworkable. It is therefore necessary to make clear that the Subcommittee is not talking about the great mass of engineering, metalurgical, and production data which is involved in the design and production of aircraft. Rather, we have reference to documents such as the Convair FMEA report under discussion here. This was a report which directly analyzed the consequences of failure and found that the continued airworthiness of the plane would be threatened. The FAA should arrive at a realistic definition of the type of reports and data of this kind which should be brought to its attention, whether or not specifically asked for. Whatever the definition chosen, it should include the type of document prepared by Convair in May of 1969.

On May 29, 1970, a year after the completion of the Convair failure effect analysis on the DC-10 cargo door closing and latching mechanism, the conclusions of the analysis were dramatically confirmed. During a ground pressure test on DC-10 fuselage No. 1, improper latching caused the forward cargo door to blow open, resulting in explosive decompression and damage of the floor structure. 2/ As a result of this failure the cargo doors were redesigned to incorporate a small vent door, which will be discussed more fully below.

2/ The design of DC-10 cargo doors is essentially the same for all three doors. While the test failure involved the forward door, subsequent in-service accidents involved the aft cargo door.

The May 1970 pressurization test allegedly gave rise to another difference of opinion between the subcontractor and McDonnell Douglas. The Convair memorandum of June 27, 1972, already referred to, above, states:

> "We informally studied and discussed with Douglas alternative corrective actions including blow out panels in the cabin floor which would provide a predictable cabin floor failure mode which would accommodate the 'explosive' loss of cargo compartment pressure without loss of tail surface and center aft engine control. It seemed to us then prudent, that such a change was indicated since 'Murphy's law' being what it is, cargo doors will come open sometime during the twenty plus years of use ahead for the DC-10.
>
> "Douglas concurrently studied alternate corrective actions, in-house, and made a unilateral decision to incorporate vent doors in the cargo doors. This 'band-aid fix' not only failed to correct the inherent DC-10 catastrophic failure mode of cabin floor collapse but the detail design of the vent door change further degraded the safety of the original door latch system by replacing the direct, short coupled and stiff latch 'lock' indicator system with a complex and relatively flexible linkage."

The "band-aid fix" in the above quotation apparently refers to the vent door modification. It is important to understand the original theory behind the vent door modification. The vent door consists of a small rectangular opening located in the upper portion of the cargo door itself; literally, a door within a door. The linkage mechanism which closes the vent door is interconnected with the lock-pins which slide behind the cargo door's latching hooks. It was thought that, in a situation where the latching hooks were not fully engaged, the locking pins would strike the sides of the latching hooks rather than sliding behind them. This, theoretically, would immobilize the operating handle and, thus, prevent the vent door from closing as well.

At this point, there would be two readily apparent indicators to ground personnel that the cargo door was not properly closed and latched: (1) the door handle, which is approximately ten inches in length and hinged from the top, would remain at a perpendicular angle, sticking out horizontally from the side of the door rather than stowing flush with it; (2) the vent door itself, an opening approximately eight by ten inches, would remain open. Even if these two obvious indicators should somehow be overlooked, the plane could take off without disastrous consequences.

Should a plane become airborne with its cargo door improperly latched and the vent door open, the crew would find it impossible to pressurize the aircraft. Commercial aircraft are usually pressurized so as to provide a cabin pressure equivalent to 8,000 feet of altitude. The vent door, however, is of sufficient cross-section that pressurization would be impossible if it remained open. This being the case, the crew, noting the inability to pressurize the plane, would simply land again, whereupon the cause of the trouble would presumably be ascertained.

What was not foreseen was that the design of the linkage mechanism was of sufficient flexibility that it would be possible to overpower the system by exerting sufficient force on the vent door handle so as to force the handle in a closed position, thus closing the vent door, while the lock pins remained jammed against the sides of the partially opened latching hooks. This is what happened in the American Airlines DC-10 incident near Detroit on June 12, 1972, and what happened again in the case of the Turkish Airlines DC-10 which crashed near Paris on March 3, 1974.

Although it took place after the development and certification period presently under discussion, it should be noted that the near disaster over Windsor (see below, page 21), again raised the question of how to insure the safety of the cargo door latching system in the DC-10. Further modifications were designed in the door mechanism, but these too were characterized as "band-aids" in the June 1972 Convair memorandum:

> "Douglas has again studied alternative corrective actions and appears to be applying more 'band-aids.' So far they have directed us to install small one-inch diameter, transparent inspection windows through which you can view latch

'lock pin' position, they are revising the rigging instructions to increase 'lock pin' engagement and then plan to reinforce and stiffen the flexible linkage."

The scornful term "band-aid fix" has been encountered by the Subcommittee throughout its inquiry into this matter; its use is not limited to the particular memorandum under discussion.

The Subcommittee has not quoted from this memorandum in order to vouch for all of its conclusions. The author of the memorandum has not been put under oath before the Subcommittee, nor has it been practical for the Subcommittee to test the documentation for his statements. The memorandum was written in the aftermath of a narrowly averted disaster when mutual recrimination between the prime and subcontractor would not be a surprising development.

But the memorandum does show a serious disagreement between the two manufacturers; a disagreement over a matter of life and death, and a disagreement concerning which -- for all that appears in the FAA files -- the agency was entirely ignorant. As the government agency responsible for protecting the public, the FAA should have known of the controversy, and should have resolved it. If this memorandum, written almost two years before the DC-10 crash in Paris, presents even a generally accurate reflection of the sequence of events, it again points up the need for the FAA to avail itself of the expertise and information available from at least the major subcontractors. Such a dispute should not have been a matter solely within the corporate confines of General Dynamics' Convair Division and McDonnell Douglas. Mention has already been made of the massive litigation which has ensued in the wake of the Paris crash. The Convair memorandum which is presently under discussion has been brought to light in connection with this litigation, and will be tested in the judicial forum. The Subcommittee takes no position as to the respective legal liabilities of Convair and/or Douglas, if any. Rather, it confines itself to the implications of the fact that the FAA did not participate in the resolution of the conflicting approaches to safety.

In some of its statements, however, the memorandum was prophetic:

"It seems to me inevitable that, in the twenty years ahead of us, DC-10 cargo doors will come open and cargo compartments will experience decompression for other reasons and I would expect this to usually result in the loss of the airplane."

* * * * *

"It is recommended that overtures be made at the highest management level to persuade Douglas to immediately make a decision to incorporate changes in the DC-10 which will correct the fundamental cabin floor catastrophic failure mode.

"Correction will take a good bit of time, hopefully there is time before the National Transportation and [sic] Safety Board (NTSB) or the FAA ground the airplane which would have disastrous effects upon sales and production both near and long term. This corrective action becomes more expensive every day as production continues. However, it may well be less expensive than the cost of damages resulting from the loss of one plane load of people."

These conclusions were borne out with dreadful completeness on March 3, 1974, near Paris, France.

According to the Subcommittee's information, the contract between McDonnell Douglas and General Dynamics by implication at least, prohibited General Dynamics from contacting the FAA. Such provisions are, from what the Subcommittee staff has been told, not uncommon in contracts between sub- and prime contractors in the aircraft industry. They are based on the premise that it is preferable for a unified approach to be maintained with respect to approaches to the agency, and statements to the public. The Subcommittee must, however, question whether the public interest is served by such provisions. If they operate to insulate the FAA from the expertise available from the subcontractor -- as may have been the case in this matter -- they are contrary to the public interest and should be abandoned.

On July 29, 1971, the FAA issued Type Certificate No. A22WE, thereby approving the DC-10 for use. Scheduled service commenced on August 5, 1971, with a flight from Los Angeles to Chicago (American Airlines).

The FAA's certification procedure had allowed to stand a door latching mechanism which failed to provide for possible human error. The pressurization test of a year previously which resulted in a blown out door and structural damage to the floor had merely led to the incorporation of a back-up system -- the vent door arrangement -- which failed to deal with the primary problem, the incomplete closing of the latch hooks. Furthermore, the vent door mechanism, which one Convair engineer scornfully described as a "band-aid fix," was itself susceptible to human error.

The report of the FAA's Ad Hoc Investigative Committee properly calls into question the validity of agency regulations which can be satisfied by such means.

The ensuing service difficulties encountered with respect to the cargo doors, and the near disaster over Windsor, Ontario, on June 12, 1972, were to provide further opportunities to reassess the validity of the door closing and latching design, and correct its defects. These opportunities were wasted.

C. Initial Service Problems of DC-10 Cargo Doors

After the DC-10 aircraft commenced commercial service in August of 1971, service difficulties began to appear with respect to the cargo door mechanism. The DC-10 cargo door is hinged at the top and swings upward, away from the side of the plane. The closing and securing of the door can be thought of as a three step process. The initial step is the closing of the door itself; this is accomplished by an electric motor. The second step is the driving of the latch hooks into their "over-center," locked position. The latch hooks are also electrically driven. The final step in securing the cargo door is the manual operation of the vent door handle which moves the lock-pins behind the latching hooks, so as to prevent their releasing, and simultaneously closes the small vent in the cargo door.

Instances began to occur wherein the electrical motor driving the latching hooks did not drive them to their fully closed position. This necessitates a laborious hand-cranking operation causing substantial delay.

On May 30, 1972, Douglas issued DC-10 Service Bulletin 52-27. The bulletin noted that three of the four carriers then operating DC-10's had reported failure of the electrical latch actuators to latch and unlatch the cargo doors. Douglas attributed this difficulty to insufficient current reaching the latch actuator motor resulting in inadequate torque. The remedy called for by the service bulletin was to increase the wire guage leading to the actuator motor and, thus, to provide enough current for adequate torque to operate the latch hooks under all anticipated conditions. This modification was issued as a routine service bulletin.

The subject matter covered by Service Bulletin 52-27 is of great consequence in the entire scheme of the DC-10 door problem. The effect of cabin pressurization is to exert substantial outward force on the doors of an aircraft. The door locking mechanism on an outward opening door is, therefore, of critical importance; much more so than in the case of an inward opening, or plug type, door.

The design of the DC-10 latch hook mechanism is such that, if it is not driven to its "over-center" position, it cannot withstand the load imposed by the pressurization of the cabin. As the plane climbs into progressively thinner atmosphere, the pressure differential between the outside atmosphere and the cabin builds to the point where the partially closed latch hooks give way.3/ This is why the lock-pin device which secures the latch hooks in place, is essential.

There is evidence that the difficulties encountered in the service record of the DC-10 cargo doors were not made known to the FAA by McDonnell Douglas. Some of this information became known to the agency only after the near disaster of June 12, 1972, over Windsor. In a memorandum for the files dated June 20, 1972, Mr. Arvin Basnight, Director of the FAA's Western Region Office, noted a conversation he had had the previous Friday, June 16, 1972, with Mr. Richard Sliff, Chief of the Aircraft Engineering Division. The memorandum (the full text of which appears on page 57 of the Subcommittee's hearing), contains the following:

3/ In both the Windsor incident and the Paris crash, the cargo door came open as the plane reached about 12,000 feet.

> "Mr. Sliff also indicated that earlier in the week when FAA engineers contacted the Douglas Company, the Company people had not made available any reports indicating problems encountered by the operating airlines with the cargo doors. Mr. Sliff stated that he had raised a fuss because they had not produced the information and on the following day (which was about Wednesday) the Company had produced data showing that approximately 100 complaints had been received by the Company indicating that the airlines using the DC-10 had noted and reported to the Company mechanical problems in locking the bulk cargo doors. Mr. Sliff was disturbed by the Company's attitude and felt they had not performed well in that their cooperation with the FAA in considering this data had been unresponsive."

It is noted that these door closing problems were still being encountered at least as recently as last Spring. The report of the FAA Ad Hoc Investigative Committee contains the following:

> "Reports have been received to date from the FAA Certificate Holding Offices for American, Delta, National, Northwest and Overseas National Airways encompassing the time period September 1973 through March 15, 1974. A review of the reports reveals, in summary, that all five carriers have had repeated door closing latching problems, primarily in the electrical mode, and have had to manually close the doors many times. The latching discrepancies were due to actuator door seals and electrical door lock/unlock limit switches. The door seals lead the problem list." (page 31)

It should be emphasized that these difficulties, while they may cause schedule delays, do not constitute hazards so long as the vent door cannot be forced shut on an improperly latched cargo door. Nevertheless, these continuous service difficulties should be a matter of concern to FAA. Even the apparently foolproof linkage mechanism now installed in DC-10 cargo doors may prove susceptible to some as yet unknown circumvention or misalignment. In this connection, the Ad Hoc Committee report states:

"There still remains some question concerning the detail design of the Model DC-10 door latching mechanism. It appears that a central design deficiency may continue to exist. If latching action is, for some reason, terminated while the latch hooks are over the latch spools but before the mechanism has been driven to its 'over-center' position, any pressurization of the aircraft to 4.5/5.0 pounds-per-square-inch (i.e., approximately 11,000 to 13,000 ft. altitude) would cause latch loads to be passed through the latch actuation mechanism, and, in turn, would cause failure of the actuator attachment bolts. In the event of such failure, the latches would immediately release from the latch spools and the door would open. Only when latch actuation is terminated in the full 'over-center' position, does the design provide sufficient capability to withstand full fuselage pressurization. To compensate for this deficiency, a number of additional design add-on have been devised in order to insure that the objectives of the FARs are fully met. While there is no longer any doubt that it is safe, it is an inelegant design worthy of Rube Goldberg. Notwithstanding the lack of explicit regulatory prohibition, prudent design practice would suggest reconsideration of this arrangement." (page 33)

D. American Airlines Accident: Windsor, Ontario, June 12, 1972

American Airlines Flight 96, a DC-10, left Los Angeles the afternoon of June 12, 1972, for LaGuardia Airport, New York, with intermediate stops scheduled at Detroit and Buffalo. The Los Angeles to Detroit segment of the flight was uneventful. Shortly after takeoff from Detroit, however, the plane sustained severe damage when the aft cargo door separated in flight over Windsor, Ontario. As predicted by the Convair failure mode effect analysis of three years previously (see above, page 12), and demonstrated by the ground pressure test incident two years previously (see above, page 13), the loss of the cargo door in flight produced explosive decompression of the cargo compartment, bringing on collapse of the floor above it.

In its report on the accident, the National Transportation Safety Board described the effect of the decompression:

> "The decompression manifested itself to the passengers and flight attendants as a muffled explosive sound and a white-gray fog which formed throughout the cabin. The door to the cockpit and the door of the galley lift opened, and several ceiling panels in the center of the cabin fell down. A floor hatch in the aisle next to seat 4H flew up and struck a passenger in the face.
>
> "The chief flight attendant,who was standing in the forward service area, was thrown from this area. The two flight attendants seated at the two aft exits were thrown to the floor, which had partially collapsed into the baggage compartment below. The circular standup bar on this collapsed floor section was torn loose from the floor." (NTSB Report, p. 7.)

The Board found that the floor collapse had damaged and jammed a number of engine and flight control systems cables. In the DC-10 these cables, which run the length of the aircraft, are routed beneath the floor. The separated door itself caused minor damage to the fuselage and substantial damage to the leading edge and upper surface of the left horizontal stabilizer. The door was later recovered from a field several miles from the airport; the Board determined that the cargo door latches were not latched over-center and that this condition was the result of low voltage to the latching motor. Douglas Service Bulletin 52-27, which provided heavier guage wiring to increase the voltage (see above), had not been installed on the door.

Although the aircraft sustained substantial damage, the 56 passengers and 11 crew survived due to a combination of factors including the resourcefulness and skill of the American Airlines pilot. The NTSB concluded that the probable cause of the accident was the improper engagement of the latch hooks, as noted above. But, inasmuch as the latch hooks were not fully in position, the lock-pins could not be positioned behind them. This, theoretically, should have made it impossible to operate the vent door handle. This, in turn, should have caused the vent opening

in the cargo door to remain open. Even if the open vent and extended handle were, somehow, overlooked, the plane could not be pressurized with the vent open and the door would not give way.

But, as the Board noted, the vent handle was forced closed by the ramp service agent:

> "The ramp service agent who serviced the aft cargo compartment had difficulty closing the door. He stated that he closed the door electrically. He listened for the motor to stop running and then attempted to close the door handle. This handle is designed to close the small vent door which is located on the cargo door, to position a lockpin behind a cam on each of the four latches and to open the circuit to the cockpit warning lights.
>
> "The agent could not close the handle with normal force, so he applied additional force with his knee. This caused the handle to stow properly, but the vent door was closed in a slightly cocked position. The agent brought this to the attention of a mechanic who gave his approval for release of the aircraft. The flight departed the ramp at 1911 with the door in this condition. According to the flight engineer, the cargo door warning light on his panel never illuminated during the taxi-out, or at any time during the flight. This light was designed to illuminate when any cargo door is not properly secured for flight." (NTSB Report, pp. 1-2.)

The Board stated that the design characteristics of the door latching mechanism permitted the door to be apparently closed when, in fact, the latches were not fully engaged and the latch lock-pins were not in place. In view of this, and the danger caused by the collapse of the cabin floor, the NTSB issued the following two safety recommendations to the FAA on July 6, 1972:

(1) Recommendation A-72-97:

> "Require a modification to the DC-10 cargo door locking system to make it physically impossible to position the external locking handle and vent

door to their normal door locked positions unless the locking pins are fully engaged."

(2) Recommendation A-72-98:

"Require the installation of relief vents between the cabin and aft cargo compartment to minimize the pressure loading on the cabin flooring in the event of sudden depressurization of the cargo compartment."

These safety recommendations were duly acknowledged the following day by Mr. John Shaffer, FAA Administrator. His letter, dated July 7, 1972, to the Chairman of the NTSB, however, made no commitment with respect to compliance with the Board's recommendations:

"All operators of DC-10 airplanes are currently performing 100 hour functional checks on the cargo door system and will incorporate necessary modifications in accordance with McDonnell-Douglas Service Bulletins 52-27 and A52-35 within 300 hours. These modifications pertain to improvements in the inspection and operation of locking and vent mechanisms.

"Additional modifications to the cargo door locking and pressurization systems are being considered as part of a continued investigation effort. While a preliminary investigation indicates that it may not be feasible to provide complete venting between cabin and cargo compartments, your recommendations will be considered with respect to further action taken."

After the Paris crash (discussed below), the FAA took steps which effectively comply with the Safety Board's recommendation that the DC-10 cargo doors be fool-proof. The venting of the plane's floor so as to enable it to sustain sudden decompression without collapse remains a critical subject.

FAA regulations (FAR 25.365(e) and (f)) required that, for certification, the DC-10's floor be able to withstand sudden decompression brought on by loss of windows or doors, or by other

openings in the fuselage during flight unless such eventuality would be considered extremely remote. But in assessing the floor strength of the DC-10, the FAA assumed that the largest opening which need be considered was a hole having an area of nine-tenth of a square foot. The likelihood of larger openings appearing, such as from the loss of a door, was considered extremely remote.

The Detroit accident came at a time when the European A-300B "Airbus" was still in development. Design changes were made to increase cargo door latching reliability and to provide against floor collapse in the event of decompression brought on by unexpected openings in the fuselage. The A-300B can experience at least a 16 square foot hole in either of the two cargo compartments at an altitude of 38,000 feet without floor damage. (Ad Hoc Investigative Committee Report, page 28).

In November 1974, the McDonnell Douglas Company announced that venting and floor strengthening design changes would be incorporated into new production DC-10 aircraft. The FAA should explore the necessity for requiring all DC-10's and other wide-body aircraft as well, to be modified so as to be more resistent to structural floor collapse brought on by rapid decompression due to openings in the fuselage. 4/

E. FAA and Manufacturer Action After the American Airlines Accident

Immediately after the accident, FAA, NTSB, and Douglas personnel commenced an on-the-scene investigation. The day after the accident, it was known that the proximate cause was the separation of the cargo door in flight. The reason for the separation -- i.e., improper latching, followed by a jamming of the vent door handle -- was not immediately established.

On June 13, 1972, the day following the accident, Douglas transmitted to all DC-10 operators a message with instructions for a one-time precautionary functional check on all cargo door latching systems. The following day, the FAA in Washington issued a telegraphic General Notice (GENOT 8340.146) alerting FAA offices of the

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4/ The Chairman of the Subcommittee has already requested both the FAA and the National Transportation Safety Board to consider this question. The correspondence will be found in Appendix B.

apparent cause of the American Airlines accident. The GENOT was also sent to all DC-10 operators requesting them to perform a one-time inspection of all cargo doors before further flight and to correct any unsafe conditions.

Before considering further FAA action, including the divergent approaches arrived at by the agency's Western Region Office and the FAA Administrator, it will be helpful to break up the chronological sequence somewhat in order to consider the results of tests and analyses performed by Douglas' engineers, commencing immediately after the accident.

Douglas Service Bulletins A52-35, 52-37, 52-40, and 52-49.

Within a few days of the accident, Douglas engineers proposed the installation of a one-inch round viewing port in the lower part of the cargo door. This would permit the lock-pins to be viewed so as to ascertain if they were properly positioned. It was recognized that this did not present a final solution to the problem. Indeed, by providing a visual means of ascertaining whether the door was properly locked, the viewing port did nothing more than the vent door handle itself was supposed to have done. It was the vent door handle which was initially accepted by FAA as providing a visual confirmation of positive door locking.

At the time the DC-10 was certificated, the FAA already had a regulation having a direct bearing on the door-closing mechanism. FAR 25.783(e) reads as follows:

> "There must be a provision for direct visual inspection of the locking mechanism by crew members to determine whether external doors, for which the initial opening movement is outward (including passenger, crew, service, and cargo doors), are fully locked. In addition, there must be a visual means to signal to appropriate crew members when normally used external doors are closed and fully locked."

According to the report of the FAA's Ad Hoc Investigative Committee, the vent door itself, together with the vent door handle incorporated into each cargo door were accepted as satisfactory to provide the requisite visual indication of the locking mechanism position. In the words of the Ad Hoc Committee:

> "The rationale was that both the vent door and door latch safety system actuation handle are integral parts of locking mechanism referred to by the rule. It was thought that the vent door and handle would, by virtue of direct mechanical linkage, stay open if the corresponding door was not fully latched, thus providing a visual means of determining door latch security." (Page 12.)

One of the difficulties inherent in the inspection port as a safety measure is that the interior of the cargo compartment is not lighted. It is, therefore, sometimes difficult to ascertain the position of the lock-pins through the small one-inch window. This is especially true at night, even with the use of a flashlight.

Furthermore, the theory upon which the inspection window modification was based is that the ground crew, or individual baggage handler, responsible for closing the cargo door will invariably examine the lock-pin placement through the small one-inch window, and verify their proper placement before signifying that the door was secure. But, in the case of an improperly latched door, such a theory presupposes that, having once succumbed to human error by improperly jamming the vent door handle, the individual or individuals responsible would unerringly avoid making the second error of failing to properly verify correct lock-pin placement. This dubious theory was too slender a reed upon which to rest the lives of hundreds of passengers and the possible loss of a $25 million airplane.

In fact, the Turkish airliner which crashed outside Paris in March 1974 had the inspection port installed in the cargo door, and the door was closed in daylight, which should have made it easier to view the lock-pin placement.

The installation of the inspection window, or "peephole" as it has been referred to, was described in Douglas Alert Service Bulletin A52-35, issued on June 19, 1972. The circumstances behind this bulletin being issued as an "alert" bulletin will be discussed below.

The next step Douglas engineers undertook after developing Service Bulletin A52-35 was to conduct a ground test in which a DC-10 cargo door was deliberately left in the unlatched position.

Sufficient force was then applied to close the vent handle. This demonstrated that the vent door mechanism could be overpowered so as to make the cargo door appear to be properly closed. The information gained from this test was used to formulate a modification designed to increase the force necessary to overpower the mechanism to the point where it would, theoretically, be beyond the capacity of a human being. The solution settled upon, essentially, was to install lengthened lock-pins and a bracket. The purpose of the bracket was to stiffen one of the operating rods in the door-locking linkage so that it could not flex and permit sufficient distortion of the linkage so as to allow the vent door to close without the lock-pins being in place. The resulting modification was contained in Douglas Service Bulletin 52-37, issued on July 3, 1972, as a routine service bulletin.

It was estimated at the hearing that it would take about 450 pounds of pressure to overpower a DC-10 cargo door which had been modified in accordance with Service Bulletin 52-37. Prior to modification, the force required was 120 pounds (hearings, p. 112). The force required to close the door correctly is about 30 pounds.

Development of modifications to the cargo door continued. On October 27, 1972, Douglas Service Bulletin 52-40 was released. It specified that it was to be accomplished in conjunction with, or subsequent to, Service Bulletin 52-37. Service Bulletin 52-40 provided for the installation of a load-limiting spring in the door-locking mechanism. The spring was designed to give way after a sufficient amount of force was placed on the vent door handle. Thus, any attempt to improperly close the vent door by overpowering the handle would be frustrated by the flexing of the spring, which would not permit more than 50 pounds of pressure to be exerted. This would be adequate to close the door properly, but insufficient to force it closed improperly.

On October 25, 1973, Douglas Service Bulletin 52-49 was issued. It noted in its preamble that it superseded, but did not cancel, the requirements of Service Bulletins 52-37 and 52-40 (above). This was a more basic change than the two previous modifications just described. In the original design of the cargo door, the vent door handle simultaneously closed the vent door and operated the locking pins. Forcing the mechanism, in the case of an unlatched door, caused the vent door to close

while the lock-pins remained open. Service Bulletin 52-37 had sought to prevent this by raising the force necessary to overpower the system; Service Bulletin 52-40 introduced another safeguard by introducing a spring which would prevent more than 50 pounds of force from being applied. Service Bulletin 52-49, however, was a further improvement in that it allowed the vent door to close only after the lock-pins were in place. That is, the vent door handle operated only on the lock-pins; the movement of the lock-pins operated the vent door itself. This is the so-called "closed loop" system, and is incorporated into all present DC-10's.

Response of FAA's Western Region Office

Immediately after the American Airlines DC-10 accident near Windsor, FAA Western Region Aerospace Engineer Everett Pittman was instructed to prepare a telegraphic AD within 48 hours. The drafting of the AD presented certain difficulties. While the AD was to be sent out at once, its conclusions could only be partial as the reasons behind the door separation were not as yet known. The resulting draft AD, which was never sent, concluded with the following words:

> "This telegraphic A.D. is an interim action only and will be amended or superseded as further recommendations and design changes are forthcoming from the manufacturer."

Mr. Pittman, during the Subcommittee's hearing on March 27, was asked why the draft was termed an "interim action" (page 37):

> "Mr. PITTMAN. Because at that time the action that we had, in other words, the two service bulletins,5/ we did not feel solved the problem. They only gave us a short breathing spell until we could define the causes and the fixes.
>
> Mr. MANELLI. So the steps that you required in the proposed AD were the best available at that time to insure the continued safe operation of the DC-10; is that correct?
>
> Mr. PITTMAN. That is correct.

5/ I.e., Service Bulletins 52-27 and A52-35, described above.

Mr. MANELLI. But you also recognized, did you not, that the provisions in that AD would not represent a final solution to the problem?

Mr. PITTMAN. That is correct.

Mr. MANELLI. That would be true, would it not, because all you had provided for at this point was the peephole for the person to visually look and see if he had latched the cargo door correctly?

Mr. PITTMAN. Essentially that was the only substantial change, and the wiring change.

Mr. MANELLI. And the heavier wiring to make the door close more positively and latch?

Mr. PITTMAN. Yes, sir.

Mr. MANELLI. But it still did not solve the problem, at that point, of the person who would nevertheless close the door improperly and fail to recognize what he had done by looking through the peephole?

Mr. PITTMAN. That is correct.

Mr. MANELLI. As a matter of fact, while you knew that the door had come off the DC-10 in Detroit, at the time you were preparing this AD, you did not yet know the reason the door had not latched properly?

Mr. PITTMAN. The initial draft which I wrote, I did not know how the door had come off. I just knew it had come off. "

The draft AD was completed by Friday, June 16; the AD Review Board of the Western Region voted unanimously to issue it. It was forwarded to the Director of the Region office, Mr. Arvin Basnight, for approval and signature. Power to issue AD's on their own authority has been delegated to the Regional Directors by FAA regulations. Before discussing Mr. Basnight's actions, it will be helpful to consider the plan of action envisaged by the Western Region staff with respect to the DC-10 cargo safety problem.

The draft AD was, of necessity, devoid of a final solution to the cargo door problem. It required the performance of certain inspections, and the installation of Douglas Service Bulletins 52-27 (heavier guage wiring) and A52-35 (one-inch inspection window). It was, however, the intention of the Western Region staff to follow up, either by amending the original AD or by issuing new ones, and require incorporation of whatever further door modifications might be subsequently devised by the manufacturer.

Mr. Pittman testified, specifically, that he regarded the subsequently issued Douglas Service Bulletin 52-37 as more important than the service bulletin which provided for the inspection window (A52-35). He stated that it would have been his strong recommendation that Service Bulletin 52-37 be incorporated into an amended AD (hearings, page 38). He testified that he probably would have recommended similar AD treatment with respect to Douglas Service Bulletin 52-49 (issued on October 25, 1973). This is the bulletin which incorporates the so-called "closed loop" design into the door. The design provides a more foolproof locking mechanism, and is incorporated into all present DC-10 cargo doors.

The entirely unexpected and inexplicable decision not to issue the AD which had been drafted produced an understandably deflating effect on the Western Region staff. It was a clear signal that the regional office's autonomy had been overruled and that this matter was receiving special handling from FAA in Washington. This, in turn, had a deleterious effect upon the subsequent regulation of the cargo door problem. FAA Engineer Pittman was asked his opinion on this point (hearings, page 38):

> "Mr. MANELLI. Could you give the Subcommittee your views as to the effect that the killing of the AD had in the matter of the FAA meaningfully regulating the cargo door matter?
>
> Mr. PITTMAN. This is of course my opinion as I saw it at that time. When we found out that in fact the AD had been stopped, we were, I guess you could say, charged up. We were ready to go with getting this door fixed. To have it stopped at that time produced a natural reaction of something like if that is the way it is, let them take care of it.
>
> Unfortunately, that carried on and we were not even, I guess, inclined to try to later on issue an AD. If the first one had been stopped,then we were naturally inhibited from issuing an AD at a later time on the same subject."

As events turned out, neither Service Bulletin 52-37 nor 52-49 became the subject of an AD until after the Paris crash.

As already indicated, the draft AD forwarded to Mr. Basnight on Friday, June 16, would have required functional checks of the cargo door every 100 hours of service. Moreover, the wiring modi-

fications contained in Douglas Service Bulletin 52-27 were incorporated into the proposed AD along with additional modifications called for by Alert Service Bulletin A52-35. These changes were required to be accomplished within 300 hours after which the 100-hour functional checks could be discontinued. Although the contents of Service Bulletin A52-35 were already included in the draft AD of June 16, the bulletin itself was not issued by Douglas until the following Monday, June 19. Again, as previously noted, the proposed AD specifically stated that it was an interim action, and would be amended or superseded on the basis of further design changes from the manufacturer.

As Director of the Region which certificated the DC-10, Mr. Basnight had the authority to issue the AD by merely affixing his signature. This was not done and the Subcommittee's investigation and hearing attempted to determine the reason behind it.

Intervention by FAA Administrator:
"Gentlemen's Agreement" Safety Program

Mr. Basnight appeared as a witness before the Subcommittee on March 27, 1974. From his testimony, and that of other witnesses, it is clear that Mr. Basnight favored the issuance of an AD, and would have done so but for alternative arrangements which preempted his office's handling of the matter.

Early in the morning on Friday, June 16, 1972, Mr. Basnight received a telephone call from the president of Douglas Aircraft Company. Mr. Basnight's testimony before the Subcommittee was consistent with a file memorandum he prepared four days after in which he described the call as follows:

> "On Friday, 16 June 1972, at 8:50 AM, I received a phone call from Mr. Jack McGowan, President, Douglas Aircraft Company, who indicated that late on Thursday, 15 June, he had received a call from Mr. Shaffer [FAA Administrator] asking what the Company had found out about the problem about the cargo door that caused American Airlines to have an explosive decompression.
>
> "Mr. McGowan said he had reviewed with the Administrator the facts developed which included the need to beef up the electrical wiring and related factors that had been developed by the Douglas Company working with FAA.

> "He indicated that Mr. Shaffer had expressed pleasure in the finding of reasonable corrective actions and had told Mr. McGowan that the corrective measures could be undertaken as a product of a Gentleman's Agreement thereby not requiring the issuance of an FAA Airworthiness Directive."

The Subcommittee notes that there was nothing which could have furnished a basis for Mr. Shaffer to tell Mr. McGowen that an AD was not needed. The Airworthiness Directive (AD) is the appropriate medium used by the FAA to provide notice to aircraft operators and manufacturers that an unsafe condition exists which must be corrected. It has the effect of law, and compliance is required. Those involving matters of special urgency are issued telegraphically; the AD which Mr. Basnight and the FAA Western Region staff proposed to issue would have been of this type. Telegraphic AD's are described in the FAA's Handbook on "Airworthiness Directives" as follows:

> "Those [AD's] of an emergency nature requiring immediate compliance, which are issued in the Federal Register as immediate adopted rules and, if warranted, are issued initially by telegram directed to operators or their designated agents per Section 1005, Federal Aviation Act of 1958."

Furthermore, the telephone conversation between Mr. Shaffer and Mr. McGowen (on the evening of June 15, 1972) took place three days after the near-disaster over Windsor. At this point, the only official action taken by the FAA had been the issuance of the General Notice (GENOT) of June 14, which merely advised DC-10 operators to inspect the cargo doors and to correct any unsafe conditions found, pursuant to "applicable Douglas instructions." The cause of the American Airlines accident was not yet precisely determined. Moreover, the modification which the Douglas engineers were ultimately to devise in an attempt to make it impossible to overpower the vent door handle, was not yet available. As to the so-called "peephole" provided for in Service Bulletin A52-35, issued June 19, 1972, it was recognized, both at the FAA and at Douglas, for what it was -- a stopgap measure which, in the words of one FAA engineer, "only gave us a short breathing spell until we could define the causes and the fixes."

Mr. McGowen testified before the Subcommittee on March 27, 1974. He confirmed that he had had conversations, as indicated, with Mr. Shaffer and Mr. Basnight. As to his conversation with Mr. Shaffer, he stated (hearings, page 70):

> "Mr. McGOWEN. To the best of my recollection, Mr. Shaffer and I had several conversations concerning the incident at American. He was curious as to what we knew that he might not know of what had happened and this was a very fast moving moment, a lot of rumors and not enough facts for everybody to digest.
>
> We had a conversation and I don't remember the exact date, but I believe he called me and said in effect, 'Will you get those changes out and I will get the airlines to put them on.'
>
> I said, 'Absolutely.'
>
> He said, in some such words, 'I don't think we need an AD note if you can get those parts out quick and get those instructions out.'
>
> I would think within about 10 days from that conversation all the airplanes had been modified.
>
> Mr. MANELLI. When you are talking about modifications, you are talking about Service Bulletin 52-35?
>
> Mr. McGOWEN. Thirty-five, yes, sir.
>
> Mr. MANELLI. For the peephole?
>
> Mr. McGOWEN. Yes, 52-37 which has been discussed so much did not exist at that time. We knew nothing of what we were going to do later, but the peepholes were felt to assure absolute certainty of safe closure if used. I think they still do provide that assurance."

Mr. Shaffer confirmed that he had been in contact with many people in the wake of the American Airlines accident. He also testified, however, that he had not called Mr. Basnight or anyone at the Western Region Office. He acknowledged that it was his decision that "the best way to campaign [i.e. modify] the DC-10 fleet was through the Service Bulletin route, and the person-to-person contact with the few operators to get those few airplanes fixed as soon as possible because the fix Mr. McGowen and I discussed was a simple thing relatively speaking, easy to accomplish, which could be done right away." (Hearings, page 89.)

As indicated above, Mr. McGowen and Mr. Shaffer could not possibly have had any sort of realistic discussion on June 15th as to how the cargo doors were to be "fixed." The method of fixing the doors, which was later to be embodied in Douglas Service Bulletin 52-37, issued July 3, 1972, had not as yet been devised. The only modification which could have been the subject of a discussion between Mr. McGowen and Mr. Shaffer on June 15 was the installation of the one-inch inspection window. No person acquainted with the facts as they existed on June 15, 1972, could have concluded that the implementation of this make-shift response was all that was needed to protect the traveling public from a recurrence of the DC-10 accident over Windsor, Ontario.

In any event, after hearing from Mr. McGowen at 8:50 Friday morning, Mr. Basnight called FAA Headquarters in Washington seeking some sort of explanation or confirmation of Mr. McGowen's statement that the FAA Administrator had deemed an AD unnecessary. At this point, the Western Region's AD Review Board was putting the finishing touches on the draft AD prior to forwarding it to Mr. Basnight for signature.

Mr. Basnight talked to Mr. James Rudolph, the Director of Flight Standards Service, and expressed his concern inasmuch as his staff was then preparing an AD and in Mr. Basnight's opinion it should be issued. He told Mr. Rudolph of the call he had received from Mr. McGowen. Mr. Rudolph advised Mr. Basnight to proceed with the preparation of the AD. In the meantime, he, Mr. Rudolph, would attempt to verify the situation with either Mr. Shaffer, the Administrator, or his Deputy, Mr. Kenneth Smith. Since Mr. Shaffer was absent, Mr. Rudolph's discussions were with Deputy FAA Administrator Smith.

Mr. Rudolph told the Subcommittee that he, too, felt that the issuance of an AD was indicated under the circumstances, and so indicated to Deputy Administrator Smith (Hearings, page 134).

When he appeared before the Subcommittee as a witness, however, Mr. Smith did not recall Mr. Rudolph telling him that he favored issuing an AD in this case (Hearings, page 150). Nor was he aware that any telephone calls had taken place between FAA Administrator Shaffer and Douglas President McGowen.

The question now focuses on who it was who reached the specific decision that an Airworthiness Directive would not be issued. Both Mr. Basnight and Mr. Rudolph favored AD procedure. After hearing from Mr. McGowen that a "gentlemen's agreement" had been settled upon as an alternative to the AD, Mr. Basnight sought guidance from Mr. Rudolph. Mr. Rudolph in turn, sought guidance from Mr. Smith. What was Mr. Smith's position as Deputy Administrator of the FAA? According to Mr. Basnight's recollection of the events of June 16, as stated in his file memorandum, he received a telephone call from Mr. Smith, who advised him as follows:

> "Mr. Smith indicated that he concurred with our judgment that an airworthiness directive should be issued and that he would consult with the Administrator." (Hearings, page 58.)

In his testimony, Mr. Smith stated that the Basnight memorandum, so far as he could recall, accurately reflected his conversation in this regard. (Hearings, page 148.)

But did the Deputy Administrator also convey his preference for the issuance of an AD to Mr. Rudolph when the matter was originally raised with him? Mr. Rudolph could not recall. (Hearings, page 134.) As events unfolded that day, however, Mr. Rudolph came to understand that a decision had been made not to issue an AD; he did not know whether it was FAA Administrator Shaffer or his Deputy, Mr. Smith, who had made the decision.

Mr. Smith recalled that Mr. Rudolph had advised him of his conversation with Mr. Basnight regarding the proposed AD. But despite the above-quoted excerpt from Mr. Basnight's memorandum, which Mr. Smith confirmed as accurate, Mr. Smith, nevertheless, told the Subcommittee that he could not recall there being any particular concern as to whether an AD was to issue. He did recall having conversations with FAA Administrator Shaffer, but did not recall that the basic question of whether or not the FAA would issue an Airworthiness Directive ever came up. His testimony on this point was as follows:

> "Mr. MANELLI. Mr. Basnight prepared a memorandum for the files describing the communications he received, or some of them; this is part of the record of these hearings already.
>
> Have you seen a copy of Mr. Basnight's memorandum?

Mr. SMITH. Yes; I have.

Mr. MANELLI. Insofar as it pertains to your communications with him, is it accurate so far as you can see?

Mr. SMITH. As far as my portion of it, yes; I believe it is accurate. I have no knowledge of the telephone conversations or at least let me say I cannot recall being made aware of the telephone conversation between Mr. McGowen and Mr. Basnight, but I do not see any errors in there to the extent of my recollection of it.

Mr. MANELLI. Did you also have any conversations with Mr. Shaffer, then Administrator of the FAA, concerning this DC-10 incident?

Mr. SMITH. I have had a number of conversations with Mr. Shaffer on the DC-10 incident. The action was being taken by Flight Standards and the Western Region, we had nothing but complete cooperation by McDonnell. He was kept apprised of developments.

I do not recall any subsequent conversations with him whether this was to be a Service Bulletin or an AD. I may have had, but I do not recall in all sincerity, but I guess one of the reasons I have not recalled that conversation is it made no difference to me whether it was an AD or Service Bulletin.

I have a little different view on that point than Mr. Rudolph has.

Mr. MANELLI. So your discussions with Mr. Shaffer that you said did take place, they did not go into the question of whether or not an AD ought to issue?

Mr. SMITH. No; they did not, to the best of my recollection.

Mr. MANELLI. There was no discussion about the fact that the Western Region had an AD in preparation?

Mr. SMITH. No; nor do I recall anyone objecting to the fact that it came out as a Service Bulletin.

Mr. MANELLI. As a Service Bulletin?

Mr. SMITH. As a Service Bulletin.

Mr. MANELLI. Apart from not discussing the specific fact that the Western Region was considering an AD,you have already testified, I take it, that the question of whether an AD should issue, just in the abstract, never came up between you and Mr. Shaffer?

Mr. SMITH. That is correct.

Mr. MANELLI. Who, then, was it that decided an AD would not issue in this case?

Mr. SMITH. I don't recall any specific point of a decision. A point of action that we agreed to in earlier meetings in my office was the necessity to inform the chief operating officers, the chief executive officers of the four airlines then concerned to be certain they were aware of (a) what happened on the American Airlines aircraft, the incident; (b) the action taken at that time with the manufacturer and the FAA; and (c) that these things must be complied with immediately.

Mr. MANELLI. I think that goes a little beyond my question. Just so the record is clear: Mr. Basnight testified to the effect that his office was preparing an AD, that he was under the impression -- I am summarizing or paraphrasing the context of what he told the Subcommittee -- that he wanted to issue an AD and his decision in that regard was countermanded.

Mr. Rudolph has just testified, as I understand it, that he agreed with Mr. Basnight for the reasons he described a few minutes ago; that a decision was made either by yourself or Mr. Shaffer that an AD would not issue. He said he was unable to tell which of you made the decision, and he learned of it from you. He learned the decision was made and either would be sufficient.

Now, my question is who decided it would not be issued from the region?

Mr. SMITH. I don't recall whether it would be an AD or Service Bulletin." (Hearings, pages 148-149.)

Mr. Shaffer testified, however, that it was his decision to use the Service Bulletin (hearings, page 107.) Mr. Smith, either on his own initiative or acting on Mr. Shaffer's instructions, called the presidents of the four domestic airlines then operating DC-10's to discuss the situation. The same day a telegram signed by Mr. Smith as Deputy Administrator was sent to these airlines; it referred to the telephone conversations, and stated Mr. Smith's expectation that certain inspections and other actions would be taken with respect to the DC-10 cargo doors. The expected actions included the various inspections of the door previously specified by the initial FAA and Douglas telegrams the day after the crash. (See above, page 25.)

In addition, Douglas Service Bulletin 52-27 (providing for heavier guage wiring to the latch actuator motor), was to be installed, and a placard warning against applying more than fifty pounds of force to the vent door handle was to be affixed to the cargo door.

Upon reading this telegram, and realizing that this was to be the FAA's response to the American Airlines accident rather than the issuance of an Airworthiness Directive, Mr. Basnight was concerned that no mention was made of the installation of the inspection window in the cargo door.

He telephoned Mr. Rudolph to ask if it would be possible to include this provision. Mr. Rudolph indicated that it was then after office hours in Washington, but that the matter would be taken up the following Monday. On Monday, June 19, a new wire was sent out to the same addressees which incorporated into the list of expected airline actions, the accomplishment of Douglas Service Bulletin A52-35, the installation of the inspection window. Both the June 16 and June 19 telegrams concluded with the following:

> "This telegram is an interim action only and will be superseded or augmented as further recommendation and design changes are forthcoming from the manufacturer."

Notwithstanding these references to "interim action", however, these telegrams constituted the last communications or instructions sent to the carriers by the agency concerning this problem. This was despite the fact that additional vital door improvements were developed by Douglas.

Douglas Service Bulletin A52-35 was issued to the DC-10 operators as an "alert" service bulletin. This type of bulletin is printed on blue paper and designates a high priority modification affecting safety. It is, therefore, distinguished from the routine service bulletin, which is printed on white paper, and which may pertain to a myriad of items (e.g., curtain rods, washroom towel dispensers, etc.) completely unrelated to safety. 6/

6/ The official definitions of FAA Airworthiness Directives and the various types of manufacturer's service bulletins will be found on pages 87-88 of the Subcommittee hearings.

Within two weeks of the Windsor incident, all existing DC-10's were modified in accord with Douglas' "alert" Service Bulletin A52-35. Aside from its blue alert status -- itself sufficient to signify unusual priority and urgency -- this bulletin was preceded by the above described personal telephone calls from the FAA's Deputy Director to the presidents of the operating airlines. Thus, while the installation of the small inspection port did not take place under the mandate of the FAA's AD procedure, rapid installation was effectuated throughout the DC-10 fleet.

But the inspection port was totally inadequate as a means of correcting the basic problem. The cargo doors could still be forced closed; the inspection port could not prevent this, and did not prevent it from happening on the Turkish Airlines DC-10 which crashed outside of Paris.

When, on July 3, 1972, Service Bulletin 52-37 was issued (designed to prevent forcing of the vent door) the means were at hand to commence a direct remedy to the problem. Yet, this vital modification was issued in the form of a routine service bulletin. From the testimony of Mr. Brizendine, President of Douglas Aircraft Company, it appears that the alternative of issuing it as an alert bulletin was not given serious consideration at Douglas (hearings, page 120):

> "Mr. MANELLI. Who is it that makes the determination whether a Service Bulletin is an alert as opposed to a standard bulletin?
>
> Mr. BRIZENDINE. Our group of people in our company so designated as the alert board or alert committee.
>
> Mr. MANELLI. In this case, of course, the alert board was never convened so they didn't make any decision at all on this, did they?
>
> Mr. BRIZENDINE. No.
>
> Mr. MANELLI. Who decided that the alert board would not be convened on this question? How was this machinery supposed to go into operation to decide if there was going to be an alert board?
>
> Mr. BRIZENDINE. There are a number of various organizational functions in our company, obviously that work very close with each other. One is engineering, one is what we call product support dealing with customers ---

Mr. MANELLI. I don't want to interrupt if you want to complete that, but I think you are going beyond my question. I was asking just who would have determined that the alert board was not going to be activated.

Mr. BRIZENDINE. I will get to the answer. I am on my way to your answer.

Engineering product support, program management office, a flight development, flight operations organization -- these agencies are represented on the alert service, the alert committee, among others, quality and so on. These people work very closely together, all the time, and they know, they feel, they sense the state of the work. They are all aware of the problems. They have the common feeling and view for the need for service action.

It would be my speculation and it is strictly speculation that this group of people in their daily working together had determined that this bulletin -- talked it over among themselves and determined that 37 would not need to be an alert or they would not need to call an alert committee because the alert also has a connotation of more imminent hazard that had to be dealt with and we dealt with the imminent situation with the window.

The results of this completely inappropriate handling of such a vital safety matter speak for themselves. In sharp contrast to the two-week period during which the stopgap "peephole" modification was completed, the modification designed to prevent the forcing of the door handle was installed at a deadly slow pace (with the exception of United Airlines). The schedule of modification of DC-10 cargo doors was as follows:

Manufacturer's Fuselage No.	Date Completed
American Airlines	
7	November 14, 1972
12	January 11, 1973
21	January 23, 1973
9	February 17, 1973
22	March 5, 1973
5	March 15, 1973
23	March 18, 1973
20	April 12, 1973
31	May 2, 1973
3	May 11, 1973
24	May 23, 1973
37	May 24, 1973
13	June 2, 1973
30	June 18, 1973
Continental Airlines	
34	February 2, 1973
41	March 28, 1973
40	May 7, 1973
43	May 14, 1973
44	May 29, 1973
National Airlines	
18	November 2, 1972
19	November 9, 1972
38	December 2, 1972
16	December 6, 1972
14	March 6, 1974
United Airlines	
35	August 1, 1972
45	August 12, 1972
42	August 14, 1972
15	September 18, 1972
11	October 2, 1972
32	October 6, 1972
17	October 9,1972
8	October 11, 1972
10	October 15, 1972
27	October 16, 1972
6	October 17, 1972
39	October 20, 1972
4	October 24, 1972
25	October 30, 1972
26	November 9,1972

In most instances, long periods of time elapsed and millions of passenger miles were flown before the modifications called for in Service Bulletin 52-37 were completed. Only five of the total of 39 aircraft were modified within 90 days of the issuance of the bulletin. Eighteen were not modified until 1973, with some of these not completed until June, eleven months after issuance of the bulletin. One plane was not modified until March 6, 1974, twenty months after the issuance of the bulletin, and three days after the Paris crash.

Yet primary blame cannot be assigned to the carriers in this instance. Some explanation for their slowness is suggested in a letter of March 22, 1974 from a National Airlines official to the National Transportation Safety Board. By way of explanation of the fact that one of National's DC-10's was found, after the Paris crash, with its cargo doors still unmodified, he stated:

> "NAL wishes to emphasize that the inclusion of Alert Service Bulletin 52-35 and Service Bulletin 52-27 were preceded by various alert notices which continually emphasized the need for compliance. In view of this, both Bulletins were completed on five aircraft, N60NA through N64NA, by 7-13-72. In regard to Service Bulletin 52-37, the Bulletin was received in a routine manner with a compliance statement of 'recommended' as opposed to 'alert' compliance requirement.
>
> "Since Alert Service Bulletin 52-35 had been complied with, assurance of positive door locking was provided by visual means through the inspection window." 7/

The Subcommittee, of course,cannot agree with the assertion that any sort of "assurance of positive door locking" was provided by the installation of the inspection window; the fact of the Paris crash is sufficient refutation to such statements. In its other observations, however, the letter underscores the completely unjustified contrast between Alert Service Bulletin 52-35 and the routine Service Bulletin 52-37. The fact that the carriers set their own priorities accordingly is not too surprising.

7/ The full text of the letter will be found on pages 95-96 of the Subcommittee's hearings.

The Subcommittee is not unmindful of Mr. Brizendine's testimony (hearings, page 110) that he wrote to the chief technical officers of each airline, advising them that Service Bulletin 52-37 was part of an "immediate action program." But the figures, reproduced above, speak for themselves; there was, in fact, no immediate action.

While the FAA had engaged in at least quasi-regulatory activity with respect to the telephone calls and telegrams regarding Service Bulletin A52-35, there was no such action regarding 52-37. On July 12, 1972, a letter was sent to Douglas by Mr. Sliff of the FAA's Western Region, asking that the agency be kept abreast of the progress of the modifications initiated since the Windsor, Ontario accident of June 12. In a reply dated August 7, Douglas advised that the modifications called for in Service Bulletins 52-27 and A52-35 were complete on all airplanes, but that none had been modified according to Bulletin 52-37. The letter concluded:

> "You will be provided periodic reports as this bulletin is accomplished."

A second letter, dated August 18, 1972, advised that United Airlines had completed the installation on one of its airplanes, and that "modifications of the entire fleet will now commence." The FAA asked for no further reports, and Douglas provided none.

During the many months that Service Bulletin 52-37 remained uncompleted, dozens of DC-10's were flying with cargo doors which were in the same status as that of the Turkish airliner which crashed near Paris. During this extensive period of time, these cargo doors were susceptible to being improperly closed, as had already occurred in Detroit in June 1972 and was to happen again in Paris in March 1974. No airline disaster took place because of the failure to effectuate prompt modification of the DC-10 doors; but, through regulatory nonfeasance, thousands of lives were unjustifiably put at risk.

The report of the FAA's Ad Hoc Investigative Committee states:

> "The agency was not effective in attaining adequate fleet-wide corrective action on a timely basis after problem areas were clearly indicated by the AAL accident of June 1972. Non-regulatory procedures and agreements were used in lieu of established regulatory (i.e., FAR 39) Airworthi-

> ness Directive (AD) procedure. The procedures used in lieu of AD action, in the long run, proved to be ineffective in correcting design deficiencies on a timely basis to prevent reoccurrence of the AAL accident. The last FAA message sent to the airlines and FAA Regional Offices on June 19, 1972, stated 'this telegram is an interim action only and will be superceded or augmented as further recommendation and design changes are forthcoming from the manufacturer.' Notwithstanding this statement, no follow-up action was taken, either by AD or by follow-on messages to the operators, as further design improvements were made available by McDonnell Douglas." (page 37.)

The Subcommittee concurs in this finding of the Ad Hoc Committee. Despite attempts to characterize the handling of this case as appropriate and in accord with proper regulatory practice, it is clear that the interruption of the AD procedures was unprecedented as well as unjustified. During the Subcommittee's hearing of March 27, the following testimony was received (page 52):

> "Mr. LENT. Mr. Pittman testified that he had prepared numerous AD's in his years with the FAA. Can you tell us of the AD's that you personally prepared and worked on how many of those were killed after they passed the AD Review Board stage?
>
> Mr. PITTMAN. None, sir.
>
> Mr. LENT. So this was a rather unusual circumstance as far as you were concerned?
>
> Mr. PITTMAN. For me personally, yes.
>
> Mr. LENT. Was there anything unusual, in Mr. Sliff's mind now, was there anything unusual about this particular action that was differentiated from the other occasions when the AD's had been approved at the Review Board level and then subsequently countermanded?
>
> Mr. SLIFF. Yes. This case was unusual from the standpoint that in other cases the decision not to go with an AD was made collectively by the people that were involved on the AD at the local area such as the Board, the project engineers and other people who would be in the process.
>
> In this particular case an order came from outside the region to not issue it.

> Mr. LENT. In all your years with the FAA this is the first time that some outside branch of the FAA had countermanded a regional AD?
> Mr. SLIFF. To my knowledge that is true."

Similarly, Mr. Basnight, Director of the Western Region could recall no previous occasion when he had been called by a company president regarding a pending AD (hearings, page 63); and Mr. Smith, former Deputy Administration of the FAA, stated:

> "It is a little unusual for an airframe manufacturing officer to explain to the FAA what processes are going to be used. I will certainly volunteer that fact." (Hearings, page 150.)

Despite Mr. Shaffer's testimony that he was constantly in telephone communication with various parties immediately after the Detroit incident, he did not include the FAA's Western Region Director, Arvin Basnight, in his conversations. Yet, as the FAA office certificating the DC-10, the Western Region had the most expertise in this aircraft; its staff of engineers were intimately familiar with the development of the cargo doors, and at least one of them took part in the investigation of the American Airlines accident.

There is no explanation or excuse for the conducting of these telephonic negotiations and arrangements between the Administrator and the manufacturer without involving the one FAA office having preeminent expertise in this matter. Furthermore, the preempting of the considered decision of the Western Region that an AD should issue, was taken on the basis of the most fragmentary information. The FAA's telegram of June 16 to the DC-10 operators was drafted without any reference to even the stopgap inspection window modification. It was only thanks to an evening telephone call from Mr. Basnight to Mr. Rudolph that a second revised telegram went out incorporating a reference to the inspection window.

A number of recommendations have arisen as a result of the events described in this section (See Section VIII, this report). The central theme which recurs throughout the events which followed the nearly disastrous incident over Windsor on June 12, 1972, was the desire to avoid the issuance of an FAA Airworthiness Directive.

Although some witnesses testified that the issuance or non-issuance of an AD was a matter of relative indifference to them, the facts suggest otherwise. AD's are viewed as "black marks" in the aircraft industry, a sign that a given airplane suffers from faulty design which must be corrected by government order. At the time of the American Airlines incident in June of 1972, there were no AD's outstanding against the DC-10 aircraft. The purpose of the telephone calls, voluntary agreements, and other non-regulatory expedients resorted to after the June 1972 DC-10 accident can only be understood in the light of this underlying motivation. That is, the existence of an AD can have an adverse impact on aircraft sales.

F. Turkish Airlines Accident: March 3, 1974

On March 3, 1974, a DC-10 operated by the Turkish Airlines (Turk Hava Yollari) took off from Orly Airport near Paris, France. As the aircraft reached approximately 12,000 feet, the aft bulk cargo door opened and separated from the plane. The resulting explosive decompression of the cargo compartment caused the cabin floor above it to collapse, disrupting the control cables routed beneath the floor.

The airplane crashed within two minutes. All 346 passengers and crew were killed; it was the worst disaster in aviation history.

Despite the fact that Douglas records reflected that the plane's cargo doors had been modified, so as to incorporate certain design changes intended to make it impossible to close the cargo door in an unsafe manner, subsequent investigation has disclosed that the modifications as described in Service Bulletin 52-37 were not, in fact, carried out.

The load limiting spring provided for in Douglas Service Bulletin 52-40 was also not installed on the aircraft. Douglas records reflected the fact that it was not installed (hearings, page 122, et seq.). The purpose of this design modification was to prevent excess force being exerted on the vent door handle (see above, page 28). The Subcommittee hearings did not produce a satisfactory answer to the question of why this modification was not incorporated into the aircraft's cargo doors. Nor is it

clear why its absence, which was reflected in Douglas' records, was not questioned by either the company itself or the FAA. Further, although the evidence on this point is fragmentary, it is difficult to see how the Paris crash could have occurred as it did had Service Bulletin 52-40 been installed and working satisfactorily. Finally, the installation of Service Bulletin 52-40 presumarly would have disclosed that Bulletin 52-37 had not been completed inasmuch as the preamble to Bulletin 52-40 specified that it was to be installed subsequent to, or in conjunction with, Bulletin 52-37 (hearings, page 126).

The one-inch inspection window, described in Douglas Alert Service Bulletin A52-35 was on the plane.

Based on information presently available, there is no question of sabotage being a causitive factor in the crash. Rather, the crash seems to have resulted from the improper latching and locking of the cargo door; i.e. the same cause which was found to have brought on the nearly disastrous accident to the American Airlines DC-10 over Windsor, Ontario.

G. FAA Response

On March 6, seventy-two hours after the crash, the FAA issued a telegraphic Airworthiness Directive to all operators of DC-10 aircraft. The AD directed them to perform the modifications on the cargo doors described in McDonnell Douglas Service Bulletins 52-27, A52-35, and 52-37. All of these bulletins had been in existence since shortly after the American Airlines accident 20 months previously.

On March 22, 1974, the FAA amended the March 6 AD to require the installation of the cargo door modifications described in McDonnell Douglas Service Bulletin 52-49, and three other Service Bulletins. Bulletin 52-49 incorporated the so-called "closed loop" system for locking the cargo doors; it represented an improvement over the modification contained in Bulletin 52-37, above. Bulletin 52-49 was issued as a routine service bulletin on October 25, 1973.

In addition to the above described AD actions, the Ad Hoc Investigative Committee, described elsewhere in this report, was set up. General Notices were issued to instruct FAA inspectors

to verify compliance with the AD, and to obtain a detailed review of the service history of the DC-10 cargo door. In addition, a survey of 130 DC-10 departures was taken to verify that the operators were using qualified personnel to ascertain cargo door security prior to takeoff; two instances were found where door closure was accomplished by questionably trained personnel (the survey was conducted over the weekend of March 16-17, 1974.)

II. DC-8 GROUND SPOILERS

This matter came to the Subcommittee's attention in the Spring of 1974. Information developed through investigation and review of FAA and NTSB documents reflect questionable handling of a critical safety problem.

A. Air Canada Accident: July 1970, Toronto, Canada

On July 5, 1970, Air Canada flight 621, a Douglas DC-8, was attempting to land at Toronto International Airport. This was to be an enroute landing on a scheduled flight from Montreal to Los Angeles. After a momentary touchdown, the plane crashed. All 109 persons aboard (3 flight crew, 6 cabin crew, and 100 passengers) were killed. Investigation by Canadian authorities disclosed the accident was caused by inadvertent deployment of the ground spoilers in flight.

Ground spoilers are flat plates hinged to the upper surfaces of each wing. They serve as an aerodynamic control device designed to spoil or disrupt the smooth flow of air around the wings with the object of reducing the lift of the aircraft. Ground spoilers are deployed at the moment of touchdown to help settle the full weight of the airplane firmly on the ground, thus overcoming any tendency of the plane to lift. They also serve as an initial groundspeed brake to decrease the length of the landing roll.

The ground spoilers in the DC-8 are activated by a lever on the right side of the throttle quadrant. In cruising flight, the spoilers are inoperative. At low airspeeds, the spoiler hydraulic system is automatically energized when the aircraft landing gear is extended. With the gear down, deployment of the ground spoilers may be accomplished in two ways: (1) manually, by pulling the lever aft to the "extend" position, and (2) by lifting the same lever to engage an electro-mechanical actuator. The latter action is called "arming" the spoilers and they will deploy automatically when a signal is provided by the landing gear following contact with the ground.

In the earlier "40" series of DC-8 aircraft, the force required on the lever to manually extend the ground spoilers is around 70 pounds. In the later "50" and "60" series of DC-8's

(including the Air Canada plane in question, a series 63), the force required is about 35 pounds. Also, in the earlier "40" series, "arming" of the lever engages a mechanical system which extends the ground spoilers when the nose landing gear is compressed by the weight of the aircraft, whereas in the "50" and "60" series, the "40" system is retained as a backup unit to a primary system which activates the ground spoilers upon spin-up of the main landing gear at a speed of approximately 700-800 rpm.

The Captain and First Officer of the fatal Air Canada flight had a technique for deploying the spoilers that had been agreed upon between them when they flew together on previous flights. The agreement was that when the Captain was flying the aircraft, the First Officer would cause the spoilers to be extended "on the ground," and when the First Officer was flying, the Captain would arm the spoilers "on the flare" (the leveling of the aircraft from its descent angle just prior to touchdown). Both of these techniques differed from the technique called for in the Air Canada operating manual which, in effect, called for arming the spoilers when the aircraft was approximately 1,000 feet above the ground.

On the day of the accident, the Captain and First Officer deviated from their previously agreed technique. The Captain was flying the plane, but was about 60 feet above the ground and in the flare position, the Captain said "OK" which was interpreted to mean that the First Officer was to arm the spoilers. Instead, the First Officer inadvertently pulled the lever aft to the extend position and the ground spoilers deployed. This caused the airplane to sink rapidly toward the ground at a rate of 24 feet per second. The Captain simultaneously called, "No, no, no" in alarm and took immediate action to attempt a missed approach and go around; that is, he applied full power to all four engines and pulled back on the control column to gain altitude. The First Officer, recognizing his mistake, said to the Captain, "Sorry - Oh! Sorry, Pete."

The immediate action taken by the Captain reduced the excessive sink rate of the aircraft from 24 feet per second to 18 feet per second; this, however, was not sufficient to prevent the airplane from striking the ground very hard. The aircraft bounced heavily on the runway with the right wing slightly low. The number four engine and pylon separated from the plane spewing high-pressure jet fuel, which ignited. The airplane then climbed away from the runway.

The flight crew, unaware that the number four engine and pylon were gone and that the right wing was on fire, elected to go around and attempt another landing. The aircraft climbed to 3,100 feet and, as it was starting to circle for another approach, a series of three explosions occurred and the plane, with a large portion of its right wing gone, plummeted to earth and was destroyed.

B. FAA and Manufacturer Action Following Air Canada Accident

On August 7, 1970, a month after the Air Canada accident, the Douglas Aircraft Company sent a cable to all operators of DC-8 aircraft cautioning that ground spoilers should not be deployed in flight. The wire made no mention of the Air Canada crash.

On November 3, 1970, the Airworthiness Directive Review Board of the FAA's Western Region office in Los Angeles met and decided to issue an AD relative to the ground spoiler problem. The project engineer, who was assigned to the matter in mid-October in the Western Region, recommended a three-part AD: (1) Change the Douglas Aviation Flight Manual (AFM) to add the phrase "Do Not Extend Ground Spoilers During Flight," (2) Change the placard mounted adjacent to the lever in the cockpit to read "Ground Spoilers" instead of "Spoilers," and (3) Conduct a check on the ground of the forces required to move the ground spoiler lever on each DC-8 aircraft to determine if they were properly rigged. The AD Review Board accepted the first two recommendations, with modifications, and rejected the third. Douglas representatives attended the AD Review Board meeting on November 3, 1970.

By letter dated November 12, 1970, Douglas advised the Western Region that Douglas did not know of a single instance of manual inadvertent extension of ground spoilers in flight. (It is noted that this statement was made with the apparent knowledge of the First Officer's comments, as contained in the Cockpit Voice Recorder, in the Air Canada crash.) Douglas also objected to the placard as an unwarranted burden on the operators and one which would serve no useful purpose. Accordingly, Douglas did not feel that an AD was warranted.

On November 9, 1970, the Air Transport Association (ATA) advised the Western Region that it objected to an AD on the ground spoilers because the placard and AFM limitation were unnecessary. ATA felt the matter should be accomplished by training, and suggested that the final approach checklist was the appropriate place for the item. The following day, ATA notified Western Region that Eastern Air Lines protested the placard change because it would be too expensive and too much work would be involved to permit compliance within the proposed 50 hours' time in service. EAL suggested that only the AFM be changed.

The AD Review Board again met on November 12 and 17, and, after further considering the objections raised by Douglas and ATA, decided to proceed with the AD. The AD was issued effective December 5, 1970. The AD was brief and in the copy distributed to all DC-8 operators through the FAA communications center at Oklahoma City, made no mention of the Air Canada accident, In fact, the words "ground spoilers" are not mentioned until the third paragraph of the AD. The initial paragraph indicates that the AD applies to all DC-8 airplanes certificated "in all categories equipped with Mark II and Mark III anti-skid system installation."

The AD required that within the next 50 hours' time in service after December 5, the following must be accomplished "to prevent misuse of ground spoilers": (1) add to the Limitations Section of the FAA approved AFM the following - "DO NOT EXTEND GROUND SPOILERS DURING FLIGHT" and (2) install a placard on the pedestal immediately below the word "spoiler" to read - "Deployment in Flight Prohibited," or an equivalent installation approved by Western Region.

On December 3, 1970, Douglas issued an Alert Service Bulletin to all operators of DC-8 airplanes to accomplish the requirements of the placard installation set forth in the AD. It is noted that the ATA defines an Alert Service Bulletin as one which "shall be issued on all matters requiring the urgent attention of the operator and shall generally be limited to items affecting safety." The Douglas Alert Service Bulletin made no mention of the Air Canada crash or of the safety ramifications involved.

C. Other Ground Spoiler Incidents (Foreign) - 1971 and 1972

On October 12, 1971, the International Air Transport Association (IATA), Montreal, Canada, issued a Safety Information Exchange bulletin regarding a ground spoiler extension in flight incident (date and place not given) involving a United Kingdom Airlines training flight in a DC-8-63 airplane. During the final checklist before landing, the Captain (occupying the co-pilot's seat) could not arm the spoiler lever (the lever could not be moved upwards) so he decided to extend the ground spoilers manually after touchdown. He kept his hand on the lever and moved it a small distance backwards. He did not consider this movement unsafe, as he knew that he would have to overcome some counterforce before the spoiler system operated. However, without having met any resistance the ground spoilers suddenly extended and the aircraft fell to the runway from an estimated height of 10 to 15 feet, resulting in some structural damage but no injuries to the flight crew.

This serious incident confirmed the validity of a previously issued IATA Safety Advisory Committee recommendation (May 1971) that future aircraft should be so constructed that it would not be possible to operate flight control surfaces in the air if they are intended solely for use on the ground.

On November 28, 1972, a Japan Air Lines (JAL) DC-8-62 crashed shortly after becoming airborne at Sheremet'yevo Airport, Moscow, Russia, on a flight to Tokyo, Japan. Sixty-one of the 76 persons aboard were killed; the surviving 15 were seriously injured. Investigation by the USSR Ministry of Civil Aviation determined that during takeoff, and after reaching safe velocity (V_2), the crew brought the aircraft into supercritical angles of attack which led to a loss of speed and elevation and eventually to the crash. While the cause of the accident was not absolutely determined, the Russian investigating authority strongly suspected that there had been an inadvertent deployment of the ground spoilers.

The inability of the Soviet investigators to establish positively the cause of the accident centered around a single unclear word on the Cockpit Voice Recorder. The word was spoken by a member of the flight crew just as the aircraft reached V_2 speed. Soviet and Japanese specialists listened to the recording many times and understood the meaning of the word to be either the

Japanese "oya" (What is that?) or the English "spoiler." Immediately thereafter, a member of the crew said, "Nanda soreva" (What is that?). Another member of the crew said, "Sumimasen" (Sorry) and the plane began to descend rapidly and crashed. In any event, the deployment of ground spoilers in flight, in this instance shortly after takeoff, remains a distinct possibility in this catastrophic accident.

D. Icelandic Airlines Accident: June 1973, New York

On June 23, 1973, a Loftleidir Icelandic Airlines DC-8-61 was involved in a landing accident at John F. Kennedy International Airport, Jamaica, New York. Of the 128 persons aboard, 38 were injured, eight seriously; there were no fatalities. The aircraft was damaged substantially.

Just before touchdown and when the aircraft was on the flare about 40 feet above the runway, the Captain called for the ground spoilers to be armed. During the arming process, the First Officer inadvertently pulled back the activating lever, which caused the spoilers to deploy fully. The aircraft's rate of descent promptly increased, and the airplane struck the runway, tail first, 20 feet short of the displaced runway threshold. From that point, the aircraft rolled out and stopped 6,048 feet farther down the runway. The number one engine separated from the aircraft 720 feet from the initial point of impact. Fire broke out in the number one engine pylon but was quickly extinguished by firefighting crews after the airplane came to a stop.

The Cockpit Voice Recorder transcript reveals that approximately eight minutes before impact, the Captain informed the First Officer that the spoilers would be armed at touchdown. Two minutes and 15 seconds before impact a discussion lasting 46 seconds occurred between the Captain, First Officer and Flight Engineer as to how ground spoilers could be deployed, what action would result from various methods of deployment, and when, during landing, they should be activated. Three and one-half seconds before impact, the Captain said, "Okay, arm them." Two seconds later, the Flight Engineer shouted, "No! No! No! No! No!" The aircraft then dropped and hit the ground tail first.

The NTSB determined that "the probable cause of the accident was the First Officer's inadvertent deployment of the ground spoilers in flight while he was attempting to arm the spoiler system. The Captain's decision to delay arming of the spoilers until just before touchdown was a contributing factor, because the timing varied from normal procedures and required the crewmembers to act quickly, without time for corrective action."

It is noted that the placard change (Deployment in Flight Prohibited) called for in the FAA's AD of December 5, 1970, was installed on the Icelandic aircraft at the time of the accident.

E. FAA and Manufacturer Action Following Icelandic Accident

Following the Icelandic Airlines accident of June 23, 1973, the FAA's Eastern Region office at New York, by letter dated August 6, 1973, made several recommendations to the Western Region: (1) reevaluate the design and operation of the ground spoiler system on DC-8 aircraft with consideration to the following modifications -- (a) a positive lock-out of ground spoiler operation in flight, or (b) remove the automatic spoiler deployment by nose gear compression, or (c) install a separate arming switch for ground spoilers with an associated "spoilers armed" light; and (2) change the placard on the cockpit pedestal to read - "Spoiler - Do not move lever rearward in flight as spoilers will deploy."

In its letter of reply on September 6, 1973, Western Region noted that the Icelandic accident was similar to the Air Canada accident in 1970, and that Eastern Region's proposed modifications to the ground spoiler system and placard were similar to those considered during Western Region's detailed evaluation of the system following the Air Canada accident. The letter further noted that, as a result of this previous evaluation, an AD was issued effective December 5, 1970. The letter concluded as follows:

> "We consider that limitation, warning and information contained in the cockpit placards and airplane flight manuals, as amended by the AD, are adequate for the safe operation of the ground spoiler system of the DC-8 aircraft.

"McDonnell Douglas has recently proposed, as an optional installation, an automatic lock to prevent deployment of the ground spoilers in flight. We are currently evaluating this device."

In early September 1973, Douglas advised Western Region that "at the request of several DC-8 operators" Douglas had been engaged in an extensive design study to make the ground spoiler system inoperative when the DC-8 is airborne. Douglas concluded its studies with the selection of a simple design modification as an optional installation, but on September 13, 1973, informed Western Region that it had decided to make the spoiler change available to all DC-8 operators at no charge.

An installation of the new spoiler lock-out mechanism was made on a United Airlines DC-8-61 and test flown in mid-September 1973 and approved by the Western Region. Thereafter, on October 5, 1973, Douglas issued Service Bulletin 27-251 to all DC-8 operators relative to the ground spoiler lock-out mechanism modification. This was a routine service bulletin, not an alert service bulletin as was the one issued on December 3, 1970 (see above), and made no mention of the Air Canada or Icelandic accidents. The modification was presented as a design improvement to the ground spoiler actuating mechanism, rather than a critical safety feature.

By memorandum dated October 19, 1973, the Chief of the Flight Operations Division, FAA Headquarters, Washington, D. C., advised the Chief of the Engineering and Manufacturing Division, FAA Headquarters, that the service bulletin provided a mechanical means to prevent in-flight spoiler deployment on DC-8 airplanes. He noted that in the past four years there had been four DC-8 accidents in which spoiler deployment in flight was a causal factor and, accordingly, expressed the desire that the service bulletin be upgraded to an AD.

This desire was made known to the Western Region and on November 5, 1973, a project engineer was assigned to evaluate the matter. On November 27, 1973, the project engineer sent an Advance Information Record notification to Douglas and ATA advising that AD action was being proposed.

On December 3, 1973, FAA Headquarters advised Western Region that NTSB had furnished advanced copies of recommendations relating to ground spoilers which would be made public on December 7. NTSB's recommendations were contained in a letter dated December 7,

1973, to the FAA Administrator. The Chairman of the NTSB advised that his Board's investigation of the Icelandic accident disclosed an aircraft design feature which did not provide optimum protection against human error; that inadvertent deployment of the ground spoilers in flight had caused both the Icelandic and Air Canada accidents; and noted that, as a result of the Air Canada accident, FAA cautioned pilots against in-flight operation of ground spoilers by requiring installation of a warning placard in the cockpit and the insertion of an additional operating limitation in the AFM.

NTSB further advised FAA that the Icelandic accident indicated that additional corrective action was necessary to prevent human error in the operation of DC-8 ground spoilers. The Board said it recognized that it might be necessary to retrofit the DC-8 fleet (approximately 500 aircraft); but stated that the hazard potential well justified such action.

Accordingly, NTSB made two recommendations: (1) require that a protective device be installed as a part of the activating lever mechanism of the ground spoiler system in Douglas DC-8 aircraft. Such a device should prevent the inadvertent deployment of ground spoilers in flight; (2) amend 14 CFR 25 to require that ground deceleration devices which directly affect the lift generated by the wings be designed so that they cannot be inadvertently operated in flight.

Western Region's AD Review Board met on December 6, 1973, and the project engineer discussed previous spoiler incidents and his conclusion that deployments were inadvertent. He proposed AD action to cancel the old AD and issue a new one requiring: (1) installation of the spoiler handle lock-out device per Douglas Service Bulletin 27-251; (2) incorporation of AFM Limitation whereby flight crews must arm the ground spoilers for landing at an altitude in excess of 1,500 feet above the terrain, and (3) periodic checks of DC-8 spoiler valve rigging. The Review Board asked that additional data (i.e. available parts, system rigging and in-flight load problems) be obtained from Douglas and the operators for presentation at a future Board meeting.

On January 9, 1974, Douglas advised Western Region that delivery of kits to accomplish the Service Bulletin had already begun and parts for fleet wide accomplishment would be available by September 30, 1974. Additional detailed data concerning rigging was also furnished to FAA.

On January 10, 1974, the AD Review Board decided to proceed with an adopted rule. On Janury 29, 1974, the AD was issued, effective February 15, 1974, calling for the spoiler lock-out modification in accordance with Service Bulletin 27-251 within the next 3,600 hours' time in service (approximately a year to a year and a half). It also required that, within 100 hours' time in service, the following limitation be added to the Aviation Flight Manual - "On those airplanes not modified by Service Bulletin 27-251, do not attempt to arm the ground spoilers below 1,000 feet above the terrain." Further requirements provided that, within 450 hours' time in service, certain inspections should be carried out if modifications under Service Bulletin 27-251 had not been performed. In addition, certain other rigging measurements were to be performed to insure that out-of-rigging could not occur even when the lock-out device is installed.

Following issuance of the second AD by Western Region, Canadian civil aviation authorities issued their own AD, consistent with Service Bulletin 27-251, but calling for compliance (installation of the lock-out device) by July 1, 1974.

F. Comment

(1) Following the Air Canada crash (July 5, 1970), FAA issued an AD effective December 5, 1970. The "fix," however, was a change in the flight manual plus installation of a placard in the cockpit reading, "Deployment in flight prohibited." The remedy was almost totally worthless because it in no way would prevent the inadvertent in-flight deployment of ground spoilers by the flight crew, which was the very cause of the Air Canada accident.

Pilots operating DC-8 aircraft were well aware, from training and instruction, that in-flight deployment of ground spoilers near the terrain could have catastrophic consequences. Indeed, the flight crews of the Air Canada and Icelandic flights immediately recognized their mistakes when the spoilers were deployed. Thus, it was not the deliberate deployment that was the problem, but the inadvertent action that endangered safety.

One Canadian air official termed the placard as "ridiculous" and stated the wording might just as well have read, "Do not crash this plane." An engineer in the Western Region advised that he

had never been impressed with solving mechanical problems with placards. In other words, the "fix" that FAA employed was nothing more than a written caution against the same human error that caused the Air Canada accident in the first place.

Proof of the ineffectiveness of the "fix" set forth in the December 1970 AD is the fact that two and a half years later, the Icelandic DC-8 flight crew duplicated the same mistake made by the Air Canada crew, despite the fact that the placard was affixed.

Thus, back in 1970, the FAA elected to correct a safety problem with a placard, rather than requiring the mechanical correction necessary to insure that a similar disaster would not occur in the future.

(2) The project engineer who worked on the initial AD in 1970 recommended to the Review Board that the AD include a requirement for a ground check of the forces required to move the ground spoiler lever on each DC-8 to determine if they were properly rigged. This was not approved by the Review Board, and one member of that Board has advised that Douglas had objected to the rigging check.

(3) Douglas issued an Alert Service Bulletin on December 3, 1970, relative to the placard installation. The bulletin made no mention of the Air Canada crash or the safety ramifications involved. And the FAA's AD of December 5, 1970, was no more informative. The FAA made no mention of the Air Canada crash in the AD summary furnished to all DC-8 operators. Only the preamble to the AD, which appears only in the Federal Register, contained a sentence alluding to the Air Canada disaster: "One accident has occurred in which the use of these spoilers during the approach to landing was a possible cause." The initial paragraph of the summary AD discussed anti-skid systems, and it was not until the third paragraph that the words "ground spoilers" were discussed.

As a matter of fact, the wording of this AD so well camouflaged and insulated it from the Air Canada crash, that the Secretary of the AD Review Board in the FAA's Western Region was unable to identify and locate the AD at the request of the Subcommittee staff. The document was finally located by a systematic digging back in the files by an FAA engineer.

(4) In August of 1973, following the Icelandic accident two months previously (June 1973), FAA's Eastern Region made several recommendations to the Western Region including a re-evaluation of the design and operation of the DC-8 ground spoiler system with consideration for a positive lock-out device to prevent the inadvertent deployment of the spoilers in flight. Western Region's reply of September 6, 1973, written by the project engineer who had authored the 1970 AD, stated, in part:

> "You propose certain modifications to the ground spoiler system and placard which are similar to those considered during the detailed evaluation of the system by our Engineering and Operations personnel following the Air Canada accident."

Contrary to the above language, there is no indication in Western Region files, nor did the Subcommittee staff receive any information through interviews with the engineers involved, that any consideration was given to interviews with the engineers involved, that any consideration was given to a lock-out feature back in 1970, or even to a reevaluation of the design and operation of the system. On the contrary, no thought was apparently given to redesign until after the Japan Air Lines accident in Moscow in November 1972.

Even more indefensible is the further statement in the Western Region's September 6, 1973 reply that the provisions of the 1970 AD "... are adequate for the safe operation of the ground spoiler system of the DC-8 aircraft." That such a statement could be made subsequent to the Icelandic accident says little for the agency's ability to learn by experience. The letter concluded by noting that Western Region was currently evaluating the Douglas proposed lock-out device.

(5) Fortunately, Douglas recognized that the placard specified by the FAA in 1970 was, in reality, no remedy for the situation and had set about, at the request of JAL and Air Canada, to develop a lock-out device. The Icelandic accident spurred the Douglas effort; by August-September 1973, Douglas had developed the mechanical modifications necessary to prevent duplication of the Air Canada accident, and the similar ones which followed. The modification was approved by FAA in September, and described in Douglas Service Bulletin 27-251 (October 5, 1973).

Although Western Region had advised Eastern Region on September 6, 1973, that Douglas was working on a lock-out device and Western Region was currently evaluating it, Western Region took no action to initiate an AD to require installation of the lock-out on DC-8's fleet-wide. It was not until early November 1973, following notification by FAA Headquarters that an AD was desired,that Western Region assigned this matter to a project engineer and set in motion the events which culminated with the issuance of the second AD in January 1974.

It is a matter of speculation as to whether or not the mechanical "fix" called for in the 1974 AD would have prevented the fatal JAL crash in Moscow in November 1972; the cause of that crash has never been positively determined. The fact remains, however, that a possible cause of that crash was the inadvertent in-flight deployment of ground spoilers. It is, similarly, difficult to determine whether appropriate FAA regulatory response in 1970, i.e., a requirement for a mechanically foolproof system rather than a useless placard, would have brought such a system into being soon enough to have been incorporated on the JAL plane which crashed. All that can be said for certain at this point is that a possible cause of that crash was the inadvertent deployment of ground spoilers, and that the FAA's previous action had not resulted in any sort of safeguard against such an occurrence. There is no doubt, however, that a mechanical lock-out system would have prevented the Icelandic accident in which 38 persons were injured, eight seriously.

(6) It is also noted that when the FAA project engineer assigned the second AD matter (November 1973) attempted to research the previous ground spoiler accidents, he was surprised to find that Western Region did not have a copy of either the Air Canada or JAL accident reports. Copies were finally obtained from FAA Headquarters in Washington.

It thus appears that FAA personnel in the Western Region who reviewed the ground spoiler problem from the time of the Icelandic accident in June 1973 until November 1973, when this particular project engineer was assigned to the case, did not have access to the critical data contained in reports of previous accidents of this kind. The Subcommittee feels it is impossible for the agency to make decisions in the best interests of safety without careful consideration and evaluation of such vital information.

(7) In summary, a pattern emerges from the Ground Spoiler matter which is not unlike that noted in the DC-10 cargo door problem. The Icelandic plane which was involved in a near disastrous accident had the placard warning "Deployment in Flight Prohibited" mounted on the instrument panel. The Turkish plane, which was involved in aviation's worst disaster, had the "Peephole" in the aft cargo door. Both provisions made no allowance for human error, and were manifestly inadequate.

III. GROUND PROXIMITY WARNING SYSTEMS

Preliminary investigation on this matter was conducted in August 1974 in connection with the Subcommittee's selected review of FAA regulatory performance. On September 5, 1974, the Subcommittee announced a hearing to determine whether ground proximity warning systems (GPWS) should be required on commercial aircraft to reduce the number of approach and landing accidents. The hearing was held on September 18, 1974.

Industry figures revealed that over half of all accidents occurring since 1972 resulted from controlled flight into terrain (CFIT) during approach and landing -- clearly the most dangerous phases of flight. It was estimated that in these accidents alone, over 1,200 persons died during the two years in question.

The Subcommittee also noted that the NTSB had recommended for a number of years that the FAA require installation of a ground proximity warning device to prevent such accidents. In rejecting such action, the FAA's position was that:

> "Present instrumentation and procedures provide for safe and adequate terrain clearance, as long as proper flight crew discipline is maintained and appropriate flight operations procedures are followed." 8/

On April 18, 1973, the FAA had issued an Advance Notice of Proposed Rule Making, asking for comment on ground proximity warning devices. The comments were to be received by July 24, 1973. The public record reflected no further FAA activity, however, until after the Subcommittee hearing was announced on September 5, 1974.

During the FAA's silence of almost a year and a half, the Boeing Company announced that it would install a ground proximity warning system as standard equipment on all passenger transport aircraft. Pan American World Airways also announced its intention to equip all of its airplanes with such a device; this has been

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8/ FAA's Advance Notice of Proposed Rule Making, published in the Federal Register, April 25, 1973.

partially accomplished. A number of foreign carriers have been using this equipment for several years.

In view of the apparent availability of technology to prevent many of these air crashes, the Subcommittee wanted to know why the FAA had failed to take action to require installation of the device on commercial aircraft.

A. Controlled Flight into Terrain Problem

Controlled flight into terrain (CFIT) accidents are those accidents which occur when an otherwise airworthy aircraft is inadvertently flown into the ground. According to NTSB, its accident investigators have shown that a variety of adverse circumstances can cause sufficient disruption to optimum crew procedures to produce a terrain impact accident. One witness in mentioning causes of CFIT accidents listed poor visibility, navigation error, instrument misreading, visual misconception, airways facilities, vertigo, distraction, confusion and inattention.

The Subcommittee received testimony and submissions for the record revealing the extent to which CFIT accidents occur. According to industry figures, 50 percent of commercial airline accidents and over 50 percent of all fatalities during the past twenty years involve CFIT. In 1972 and 1973, it was estimated that 56 percent of world-wide commercial accidents were attributable to CFIT. By comparison, loss of control during takeoff and landing accounted for only 28 percent of accidents; loss of control in flight caused 8 percent; cabin and cargo fires caused 4 percent; and, mid-air collisions and engine turbine bursts each contributed 2 percent.

Sundstrand Data Control, Inc. (Sundstrand), a developer of a ground proximity warning system (GPWS) has studied commercial accidents over the past 20 years and concluded that over 300 accidents involved inadvertent controlled flight into terrain. It established that more than 4,000 lives were lost and financial losses exceeding $400 million in hull and passenger liabilities were incurred.

Chairman Reed of the National Transportation Safety Board, supplied a list of CFIT accidents which in the Safety Board's judgment might have been prevented by a ground proximity warning system. These accidents, which cover a 5-year period, are as follows:

I. Accidents Investigated by NTSB

Date	Place	Carrier	Type Acft.	Brief	No. of Fatalities
10/25/68	Hanover, N.H.	Northeast Airlines	FH 227	Premature descent due naviation problems	29
11/22/68	San Francisco Bay, Cal.	Japan Air Lines	DC-8	Below glide slope on approach	0
12/24/68	Bradford, Pa.	Allegheny	CV 580	Descent through MDA impact 2.5 N.M. from runway	20
1/6/69	Bradford, Pa.	Allegheny	CV 440	Descent through MDA - possible altimetry - 4.7 N.M. from airport	11
1/13/69	Los Angeles	SAS	DC-8	Descent below MDA	15
3/5/69	San Juan Puerto Rico	Puerto Rico Air Taxi	DH 114	Acft vectored into mountainous terrain	19
11/14/70	Huntington, W. Va.	Southern Airways	DC-9	Descent below MDA struck rising terrain. Recommendation for GPWS	75
2/17/71	Gulfport, Miss.	Southern Airways	DC-9	Descent below MDA weather after visual contact. Recommendation for GPWS	0

Date	Place	Carrier	Type Acft.	Brief	No. of Fatalities
6/22/71	Martha's Vineyard, Mass.	Northeast Airlines	DC-9	Lack of altitude awareness - impact 3 m. short non-precision approach remained airborne	0
9/4/71	Juneau, Alaska	Alaska Airlines	B-727	Premature descent due naviation problems	111
10/24/71	Allentown, Pa.	Monmouth Airlines Air Taxi	Beech 99	Impact with rising terrain non adherence to approved approach	4
12/29/72	Miami, Florida	Eastern AirLines	L-1011	Descent unrecognized due crew preoccupation	99
7/32/73 [sic]	Boston, Mass.	Delta Air Lines	DC-9	Descent through ILS glide slope	90
9/8/73	King Cove, Alaska	World Airways	DC-8	Navigation problems - impact with rising terrain	6
9/27/73	Mena, Ar.	Texas International	CV 600	Navigation problems impact with rising terrain	11
			TOTAL		490

II. Accidents Investigated by Foreign Government

Date	Place	Carrier	No. of Fatalities
12/12/68	Caracas, Venezuela	Pan American	51
7/3/70	Les Angudes, Spain	Dan-Air	112
7/25/71	Mt. Kamunay, Phillipines	Pan American	4
1/7/72	Ibiza, Spain	Iberia	104
3/15/72	Dubai, Persian Gulf	Sterling	112
5/72	Palermo, Sicily	Alitalia	115
6/12/72	New Delhi, India	J A L	83
5/73	New Delhi, India	Indian Airlines	48
6/20/73	Puerto Vallarta	Aero Mexico	27
7/23/73	Tahiti	Pan American	78
4/23/74	Bali	Pan American	107
		TOTAL	841

Chairman Reed also listed other related accidents still under investigation by the Board:

Date	Place	Carrier	Type Acft.	Brief	No. of Fatalities
11/27/73	Chattanooga, Tenn.	Delta Air Lines	DC-9	Still Under Investigation	0
12/17/73	Boston, Mass.	Iberia Air Lines	DC-10	Still Under Investigation	0
1/6/74	Johnstown, Pa.	Air East Inc.	Beech 99	Still Under Investigation	12
1/30/74	Pago Pago, American Samoa	Pan American World Air-Ways	B-707	Still Under Investigation	97
9/11/74	Charlotte, N. C.	Eastern Air Lines	DC-9	Still Under Investigation	70
				TOTAL	179

A study of Western world accidents by Boeing for the years 1972 and 1973 revealed that CFIT accidents, which may have been prevented by a GPWS, accounted for 56 percent of the total accidents, and involved 19 carriers and 7 different model aircraft built by 5 manufacturers. These accidents resulted in loss of 1,120 lives and 20 aircraft. The Boeing data is set forth below:

747

FATAL CFIT ACCIDENTS - 1972

6-24-74
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DATE	LOCATION	AIRPLANE	AIRLINE	NATURE OF ACCIDENT	HULL LOSS	FATALITIES
1-7-72	SPAIN	CARAVELLE	IBERIA	HIT MOUNTAIN ON INITIAL APPROACH	YES	104/104
1-21-72	TURKEY	DC-9	TURKISH	IMPACT ON GO-AROUND 4 MILES OUT	YES	1/5
3-14-72	OMAN	CARAVELLE	STERLING	HIT HILL ON INTIAL APPROACH	YES	112/112
3-19-72	SO. YEMEN	DC-9	UNITED ARAB	HIT MOUNTAIN ON INITIAL APPROACH	YES	30/30
5-5-72	ITALY	DC-8	ALITALIA	HIT MOUNTAIN ON INITIAL APPROACH	YES	115/115
6-14-72	NEW DELHI	DC-8	JAPAN	HIT GROUND 13 MILES OUT IN DUST STORM	YES	81/87
7-6-72	CANARY IS.	DC-8	AVIACO	LET DOWN INTO SEA 15 MILES OUT	YES	10/10
12-8-72	CHICAGO	737	UNITED	HIGH SINK RATE ON APPROACH	YES	43/61
12-23-72	OSLO	F-28	BRAATHENS	HIT HILL 7 MILES OUT	YES	39/45
12-29-72	MIAMI	L-1011	EASTERN	LET DOWN INTO SWAMP ON GO-AROUND	YES	99/176
						634 FATALITIES

747

FATAL CFIT ACCIDENTS - 1973

5-8-74
TE 3232

DATE	LOCATION	AIRPLANE	AIRLINE	NATURE OF ACCIDENT	HULL LOSS	FATALITIES
1-2-73	EDMONTON	707	PAC. WEST	LANDED SHORT IN SNOWSTORM	YES	5/5
3-5-73	MADIERA IS.	CARAVELLE	AVIACO	CRASHED IN OCEAN, 6 MILES OUT	YES	3/3
5-31-73	NEW DELHI	737	INDIAN	CRASHED 3 MILES OUT IN DUST STORM	YES	48/65
6-9-73	RIO	707	VARIG	HIT POWER LINES 2,000 FT OUT - FOG	YES	2/4
6-20-73	PUERTO VELARTE	DC-9	AERO MEX	HIT MOUNTAIN 20 MILES OUT	YES	27/27
7-23-73	TAHITI	707	PAN AM	DESCENDED INTO BAY AFTER TAKEOFF	YES	78/79
7-31-73	BOSTON	DC-9	DELTA	HIT SEA WALL 3,000 FT OUT - FOG	YES	88/89
8-13-73	LACORUNA SP.	CARAVELLE	AVIACO	HIT HILL 1.8 MILES OUT ON GO-AROUND	YES	85/85
9-8-73	COLD BAY	DC-8	WORLD	HIT MOUNTAIN 18 MILES OUT	YES	6/6
9-11-73	TITOGRAD	CARAVELLE	YUGOSLAV	HIT MOUNTAIN 30 MILES OUT	YES	41/41
12-23-73	TANGIER	CARAVELLE	SABENA	HIT MOUNTAIN 20 MILES OUT	YES	105/105
						488 FATALITIES

The most recent in the series of accidents which appears to have involved CFIT occurred after the Subcommittee's hearing. Shortly after 11:00 a.m. on Sunday, December 1, 1974, a TWA Boeing 727 crashed into a foothill of the Blue Ridge Mountains while approaching Dulles Airport. All 92 persons aboard were killed in the worst U.S. air accident this year.

While the NTSB's inquiry is still in progress at the time of this writing, information available to the Subcommittee indicates another CFIT accident.

First, the aircraft was completely airworthy, with no indication of any mechanical difficulty.

Second, weather conditions were adverse, visibility was limited and the landing site had been changed from National to Dulles Airport.

Third, the plane had been in a controlled descent preparatory to landing at Dulles; there is no indication of any severe downdraft or turbulence which would have forced the plane to crash.

Fourth, the plane was generally in level flight, but approximately 1,700 feet below the appropriate altitude for crossing this peak. The plane's instruments seem to have been working normally.

Fifth, for unknown reasons, the flight crew was apparently unaware of its peril right up to the moment of impact.

A further discussion of this accident is contained at Comments 7, 8, and 9, beginning at page 111.

B. NTSB Recommendations

Chairman Reed testified before the Subcommittee on September 18, that since 1969, the NTSB has been concerned about the number of airworthy aircraft which have been inadvertently flown into terrain. In January of that year, the Board made a general recommendation to the FAA for expeditious development of a ground proximity warning system.

Thereafter, as a result of investigations of three accidents of this nature, the Board again recommended development of a ground proximity warning system. The accidents investigated, together with the Board's recommendation, are as follows:

(1) Gulfport, Mississippi, April 16, 1971, Southern Airways DC-9.

A 71-53 "Develop a ground proximity warning system for use during approach and landing."

(2) Martha's Vineyard, Massachusetts, June 22, 1971, Northeast Airlines DC-9.

A 72-19 "Develop a ground proximity warning system for use in the approach and landing phases of operation ..."

(3) Huntington, West Virginia, November 14, 1970, Southern Airways DC-9.

A 72-35 "Develop a ground proximity warning system for use in the approach and landing phases of operation ..."

In late 1972, the NTSB held a two-day Approach and Landing Accident Prevention Forum. In its report after the conference, the Board included the following recommendation for mandatory installation of ground proximity warning systems:

A 73-82 "Ground proximity warning system should be required for use in all commercial passengers flight operations, particularly during non-precision approaches."

A ground proximity warning system was developed by the Sundstrand Corporation, partially in reponse to indications of interest by certain foreign air carriers. There was no FAA participation in or support of this development.

In response to the FAA's April 18, 1973, Advance Notice of Proposed Rule Making (ANPRM) on "Ground Proximity Warning Devices," the NTSB filed comments. The Board again urged a mandatory requirement for such a device.

Finally, in its annual report to Congress for 1973, the NTSB said the following under a section entitled "Ground Proximity Warning":

> "The Safety Board repeatedly has recommended that FAA require use of ground proximity warning equipment in airline aircraft as the single most effective means of preventing approach and landing accidents. The Board's intent would have been achieved either by adaptation of cockpit instrumentation already aboard jet aircraft or by installation of new devices now available as options on new wide-body jets. The Board believes such equipment could have prevented more than a dozen major accidents since a United Air Lines 727, letting down for Chicago in 1965, descended into Lake Michigan in the darkness.
>
> "FAA's response to the Board's repeated recommendations was that with adequate cockpit discipline and proper use of existing instrumentation and approach procedures, ground proximity warning equipment was not needed. In April 1973, FAA issued an Advance Notice of Proposed Rulemaking on ground proximity warning devices. The notice said FAA 'has not yet determined that such a warning system or device is needed or, if it is needed, how it should be designed.' The deadline for comment was July 24, and FAA had made no further public comment at year's end." [Emphasis added.]

It was in view of this state of affairs that the Subcommittee determined that a Congressional oversight inquiry was essential.

C. Development of the GPWS

It appears from the Subcommittee's investigation as well as from testimony at the hearing that the Sundstrand device is the most sophisticated GPWS developed thus far. It is estimated by Boeing and Sundstrand, respectively, that the device in its present configuration will provide meaningful advance warning in 85 percent to over 90 percent of potential CFIT accidents. In the light of additional information that such accidents constitute 56 percent of the total, it appears that such devices could prevent half of all passenger aircraft crashes.

In connection with development of the GPWS, the manufacturer found in reviewing CFIT accidents over a 20 year period certain common characteristics or factors to these accidents.

(1) The aircraft and crew were completely airworthy.

(2) In virtually all, some form of pilot error was listed as the probable cause.

(3) The crew did not realize until too late that the terrain was there or that close.

(4) Two out of three occurred at night; the rest in clouds or fog.

(5) One out of five occurred during descent or approach in rain or snow, with the continuous suspicion of possible barometric errors.

(6) One out of five accidents involved sinking back into terrain just after takeoff or a missed approach. All of these were at night over unlit water or terrain. All accelerated back into terrain, usually just after flap retraction, yet were capable of climbing out at a proper climbing speed with no suspicion of stall or stall warning.

(7) In three out of four accidents, either excessive closure or sink rate with respect to the terrain was involved.

(8) In three out of four, the gear was not down at impact.

The GPWS was designed to give the pilot advance warning of hazardous conditions relative to the ground common to this kind of accident. The system produces both aural and visual warnings. The aural warning, heard through the flight deck speaker and earphones, is a loud "whooping" sound followed by the spoken command, "Pull Up." The visual warning is a red lighted panel that continuously flashes the words, "Pull Up" or "Terrain." These warnings cannot be cancelled by the crew except by taking corrective action or by exercising a circuit breaker.

43-720 O - 74 - 6

The five mode GPWS which is currently operational provides a warning when one or more of the following conditions exists:

(1) excessive sink rate;

(2) excessive terrain closure rate;

(3) negative climb after takeoff;

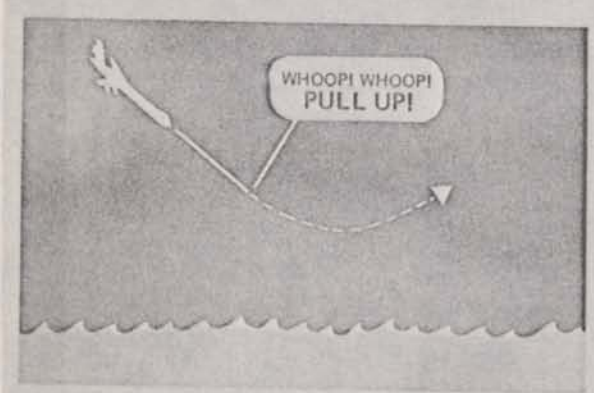
(4) inadvertent proximity to ground without gear or landing flaps; and

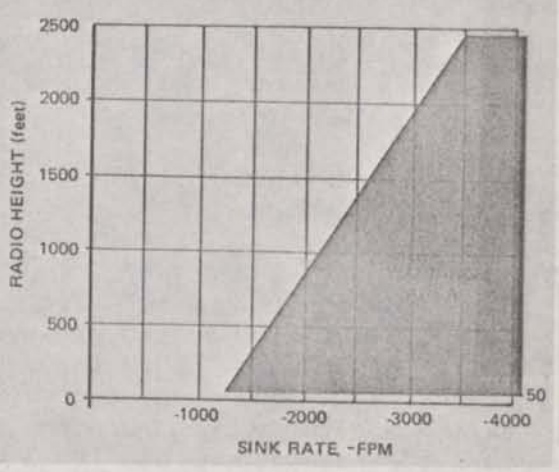
(5) inadvertent "duck-under" the glide slope.

EXHIBITS DEPICTING THE FIVE-MODE GPWS 9/

Mode 1 Excessive sink rate

A warning is given if the airplane has a sink rate that exceeds a value which linearly decreases from 3500 ft/min at a radio height of 2450 ft. to 1300 ft/min at 0 feet radio height.

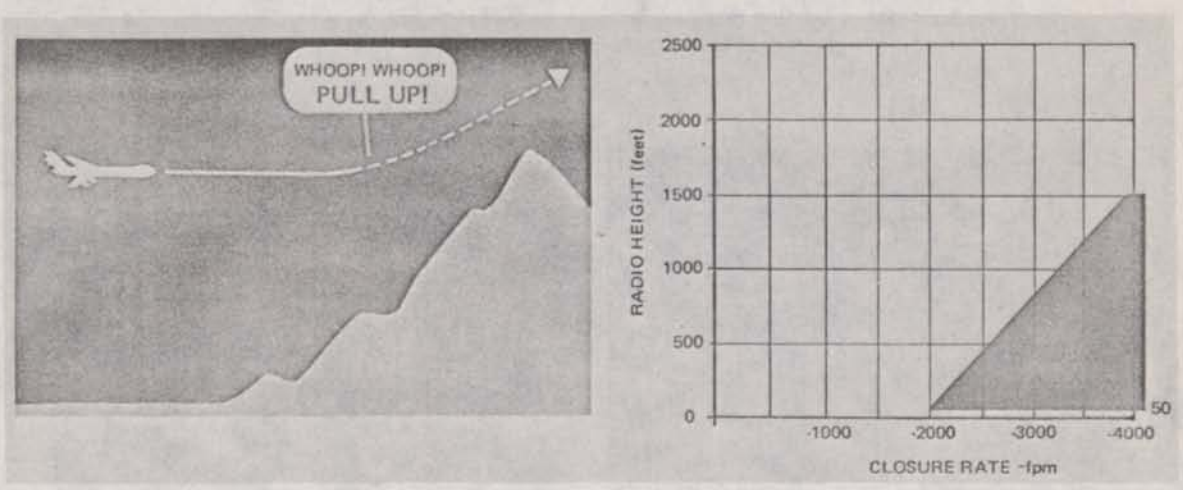




9/ Source: Sundstrand Corporation

Mode 2 Excessive terrain closure rate

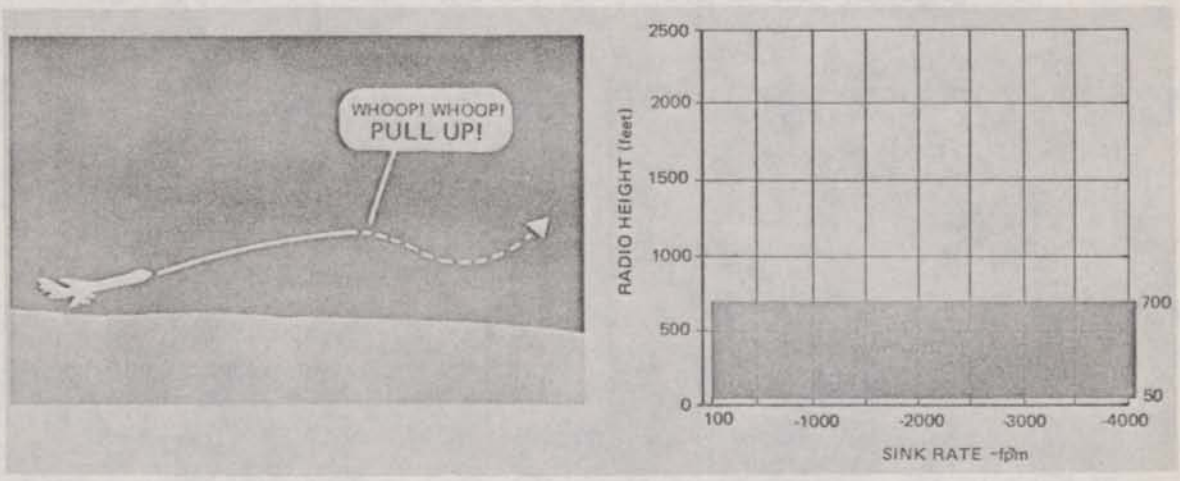
A computed terrain closure rate signal, derived from radio height rate and barometric altitude rate, will give a warning if this signal exceeds 3800 ft/min at a radio height of 1500 ft, to 2000 ft/min at 50 feet radio height.



Mode 3 Negative climb after takeoff

If a sink rate exceeding 100 ft/min is experienced after takeoff and below 700 feet radio height, a warning is given.

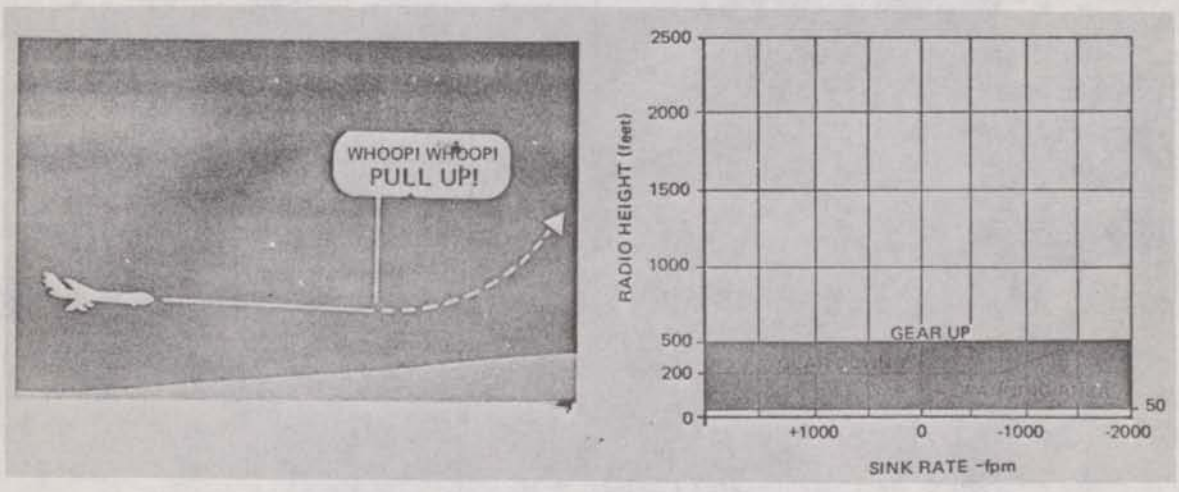
The system does not become active until clearing 50 feet radio altitude. This is to avoid nuisance warnings due to fluctuations in the static pressure while the airplane is accelerating in the ground effect region.



Mode 4 Inadvertent proximity to ground

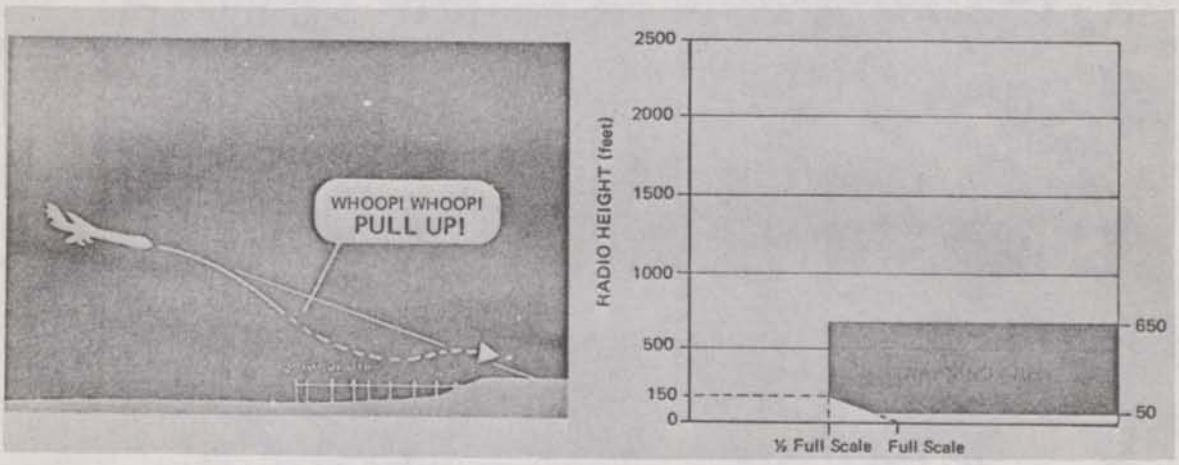
If the airplane flies below 500 feet radio height with gear up, a warning is given.

With the gear down, and the flaps not in landing position, a warning is given that varies linearly from 500 feet with sink rates greater than 1450 fpm down to 200 feet with sink rates less than 600 fpm.

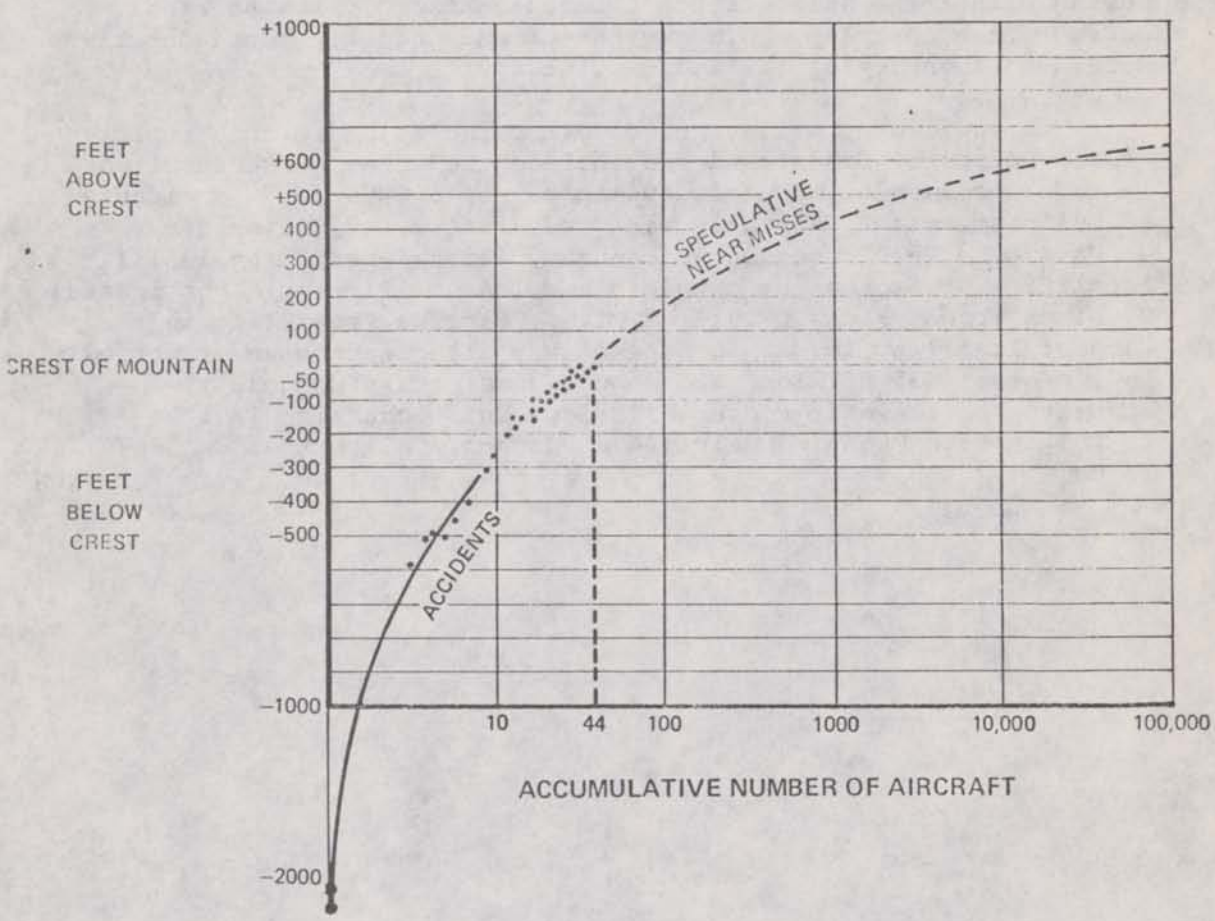


Mode 5 Inadvertent "duck-under" the glideslope

If the glideslope deviation is in excess of half full scale fly-up above 150 ft a warning is given. From 150 ft down to 50 ft a fixed deviation limit is established.



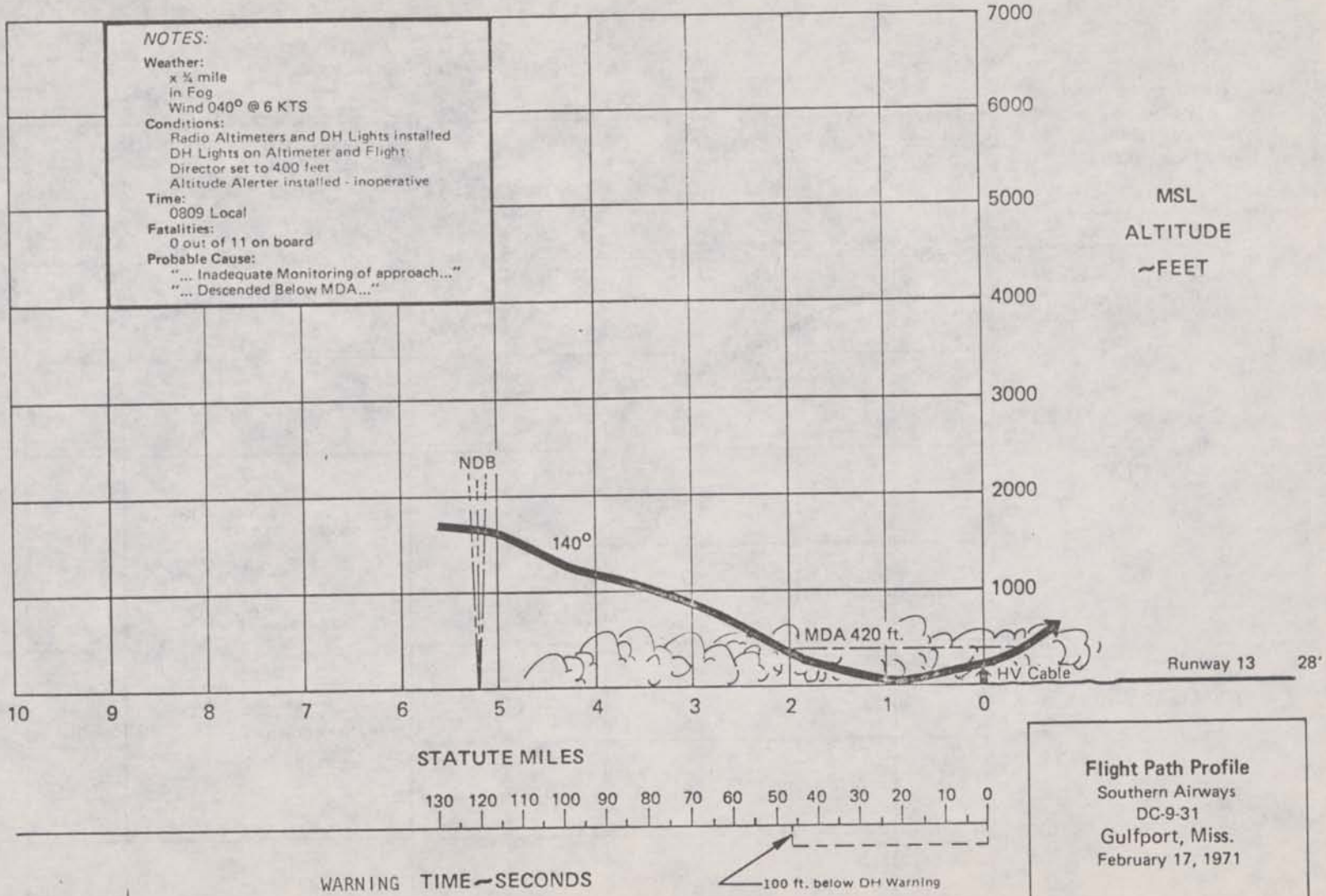
It should be noted, with reference to Mode 2, that the system uses input from the aircraft's downward looking radio altimeter. Hence, this mode will give no warning if the airplane if flown into a vertical cliff. According to the manufacturer, nature rarely presents shear walls in excess of 100 or 200 feet in height and, where they do exist, they are usually preambled by a 50 degree to 70 degree upward slope. It was determined that the additional height required to clear the high ground for the average accident of this kind is usually less than 200 feet and the GPWS would provide advance warning in most instances. A chart prepared by Sundstrand depicting the grouping of accidents just below the mountain crest and speculating near misses appears below:



In addition to the radio altimeter, the GPWS utilizes signals from existing systems on the aircraft. The air data system, glide slope receiver, flap position switch and landing gear handle switch all provide input into the GPWS computer.

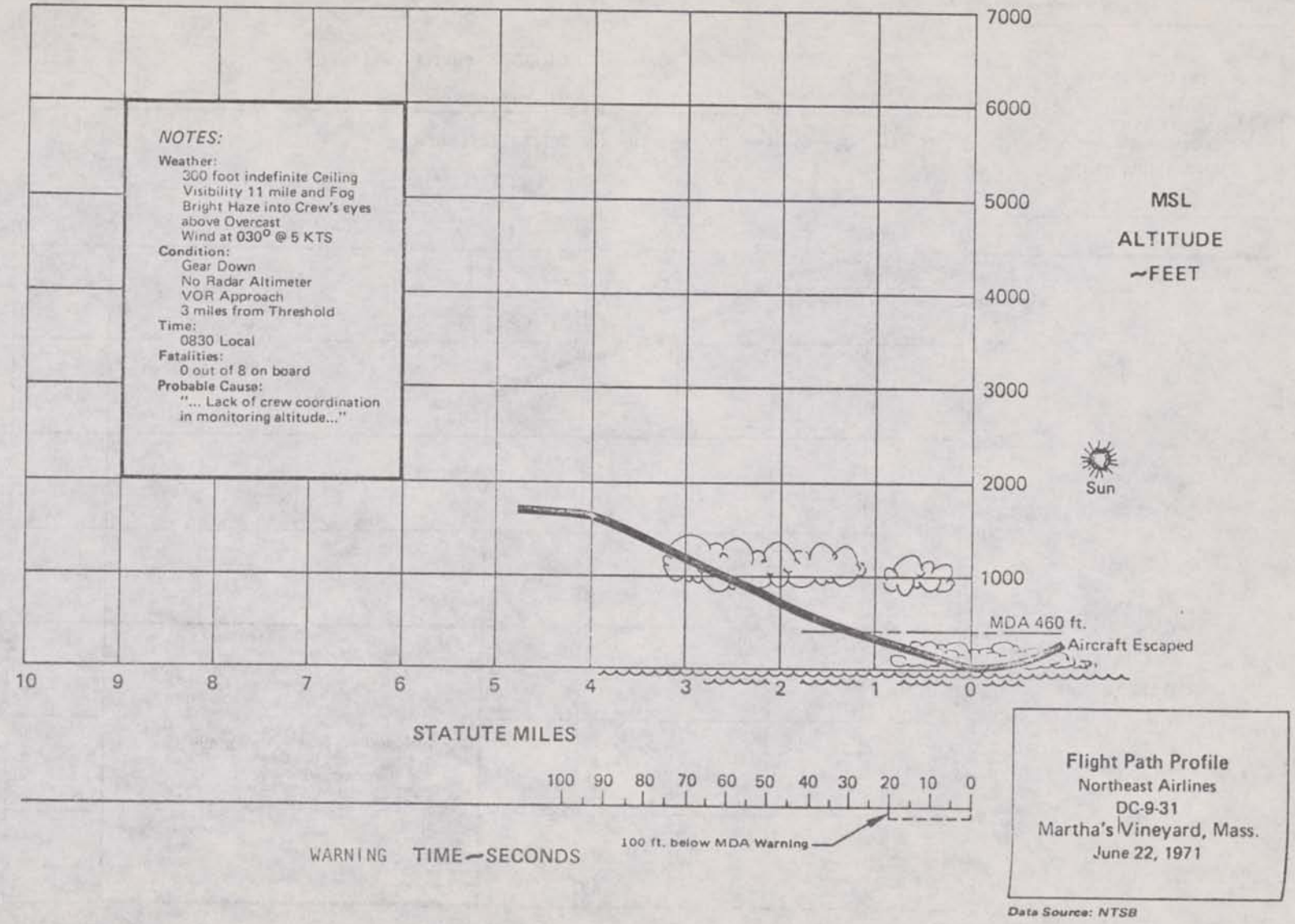
Reproduced on succeeding pages are selected flight path profiles of aircraft involving in CFIT accidents. These accidents were among the scores of accidents analyzed by the manufacturer in connection with development of its GPWS. In this manner, it was also determined whether the device would have provided a warning and, if so, the amount of warning time prior to impact. Sundstrand believes, on the basis of its review of 20 years of accidents, that its device would have given an average warning time of 20 seconds. It should be noted that no one challenged this accident analysis during either the Subcommittee's investigation or its hearing. Quite to the contrary, both government and industry representatives were complimentary of the accident study.

The accident profiles selected for inclusion in this report were prepared by Sundstrand and include the three which resulted in NTSB recommendations for development of a GPWS (DC-9 accidents at Gulfport, Miss., Martha's Vineyard, Mass., and Huntington, W. Va.); the B-727 accident at Juneau, Alaska, resulting in 111 fatalities, the greatest single plane loss of life in a continental U. S. air tragedy; the L-1011 at Miami, Florida, resulting in the largest liability losses to date of any air catastrophe (reportedly in excess of $35 million with some claims remaining unsettled) and three of the most recent CFIT accidents occurring in 1974 (B-707 at Pago Pago, Convair 440 at Bishop, California, and B-707 at Bali):



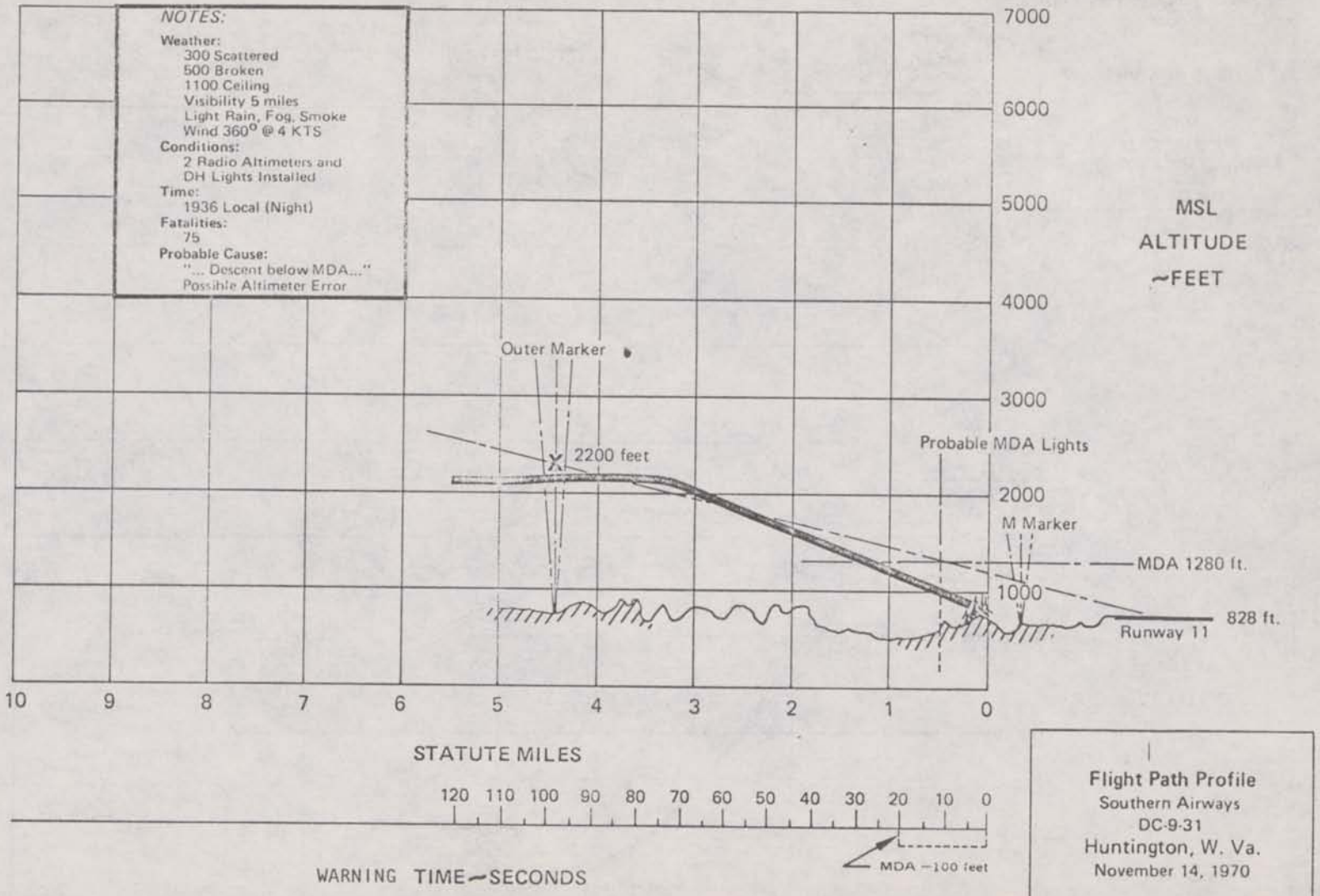
Flight Path Profile
Southern Airways
DC-9-31
Gulfport, Miss.
February 17, 1971

Data Source: NTSB



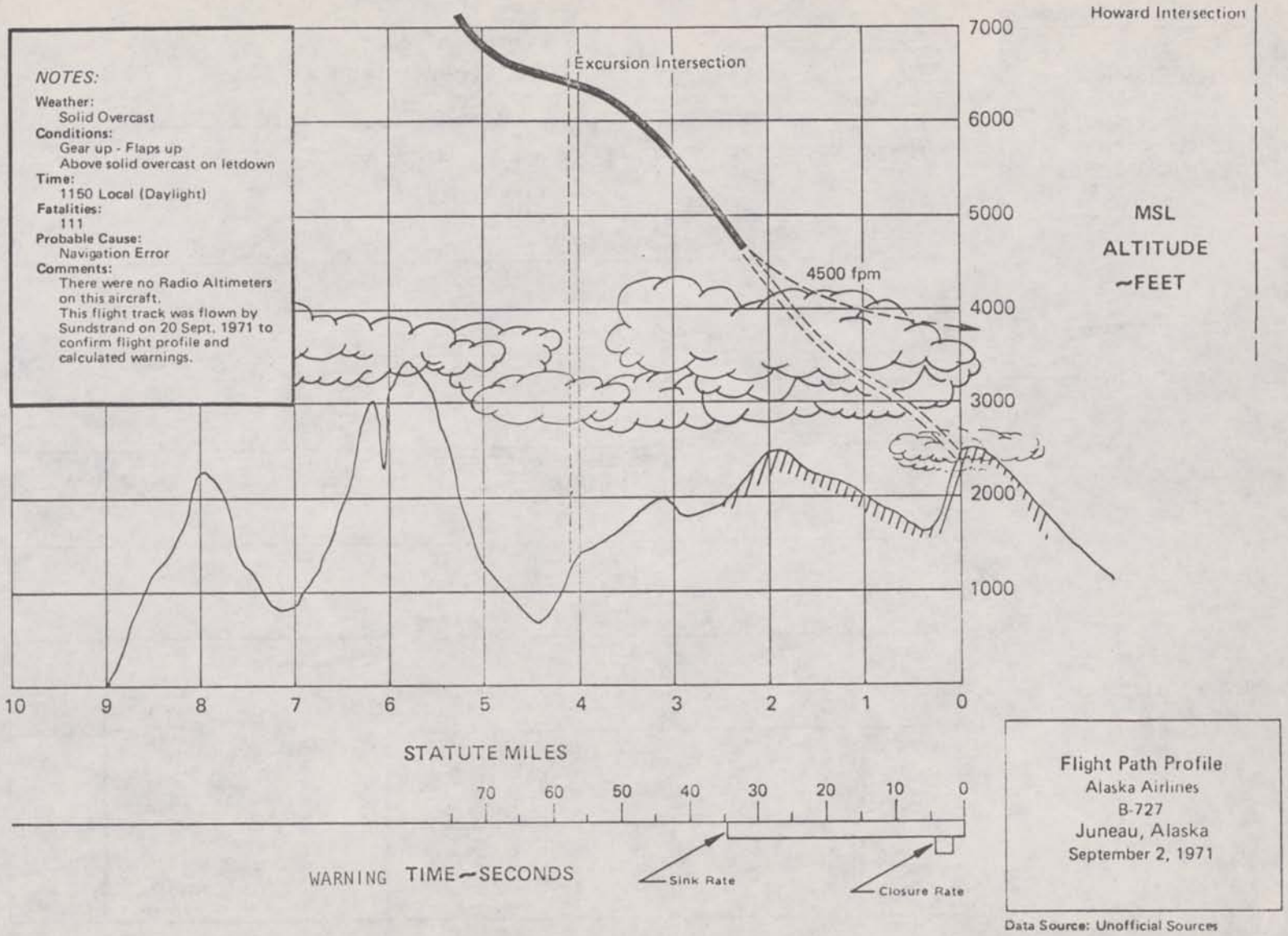
Flight Path Profile
Northeast Airlines
DC-9-31
Martha's Vineyard, Mass.
June 22, 1971

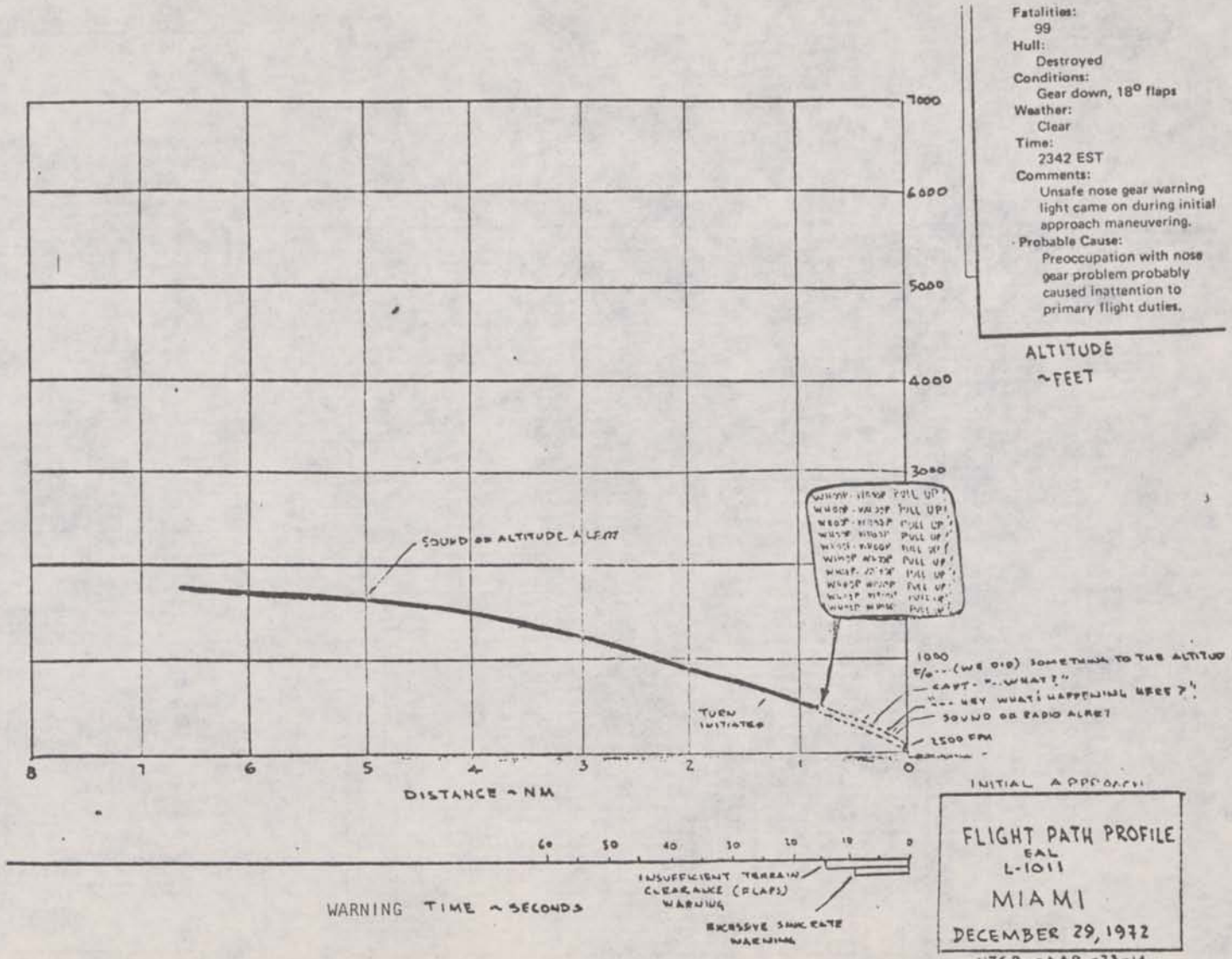
Data Source: NTSB

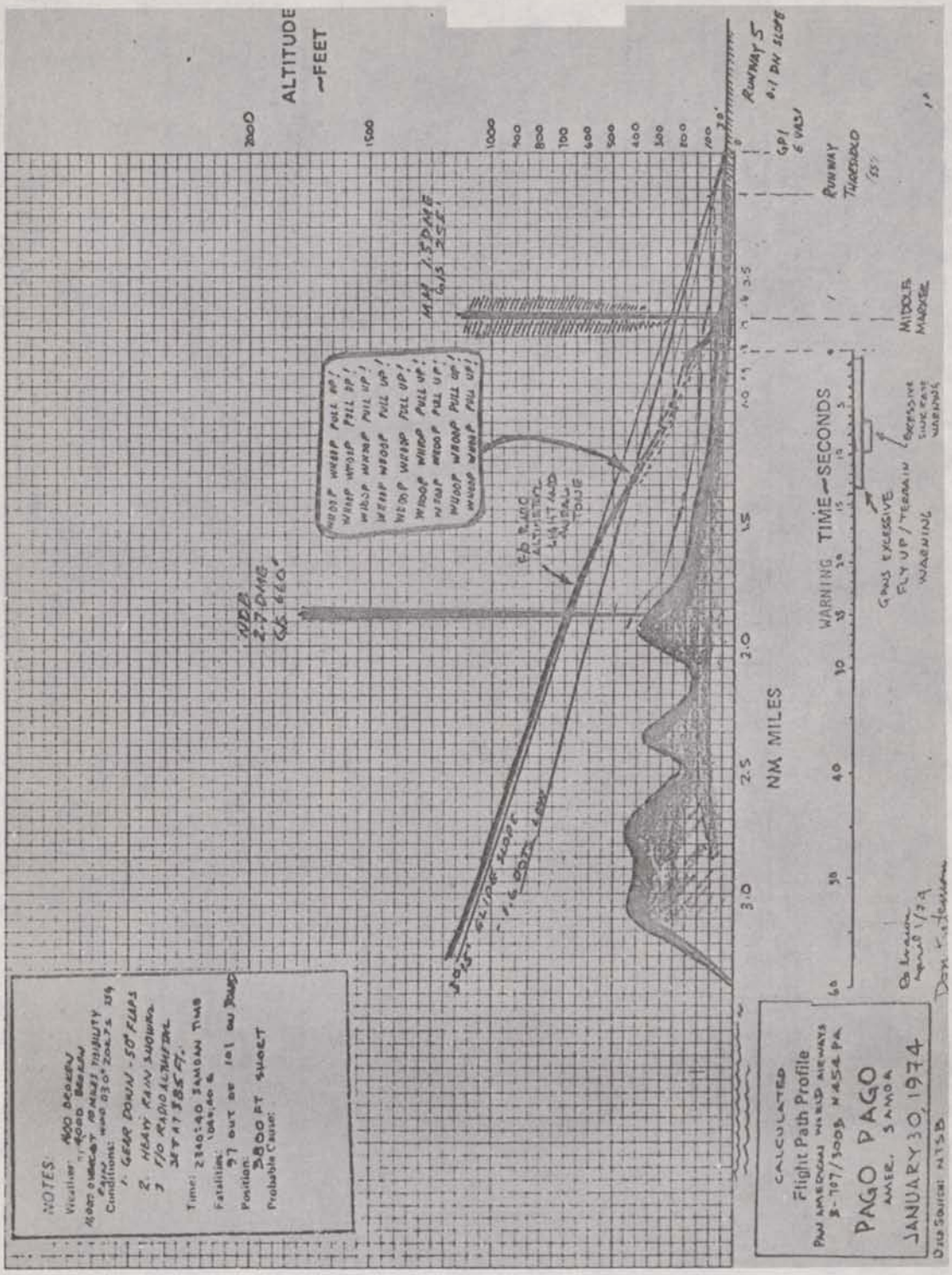


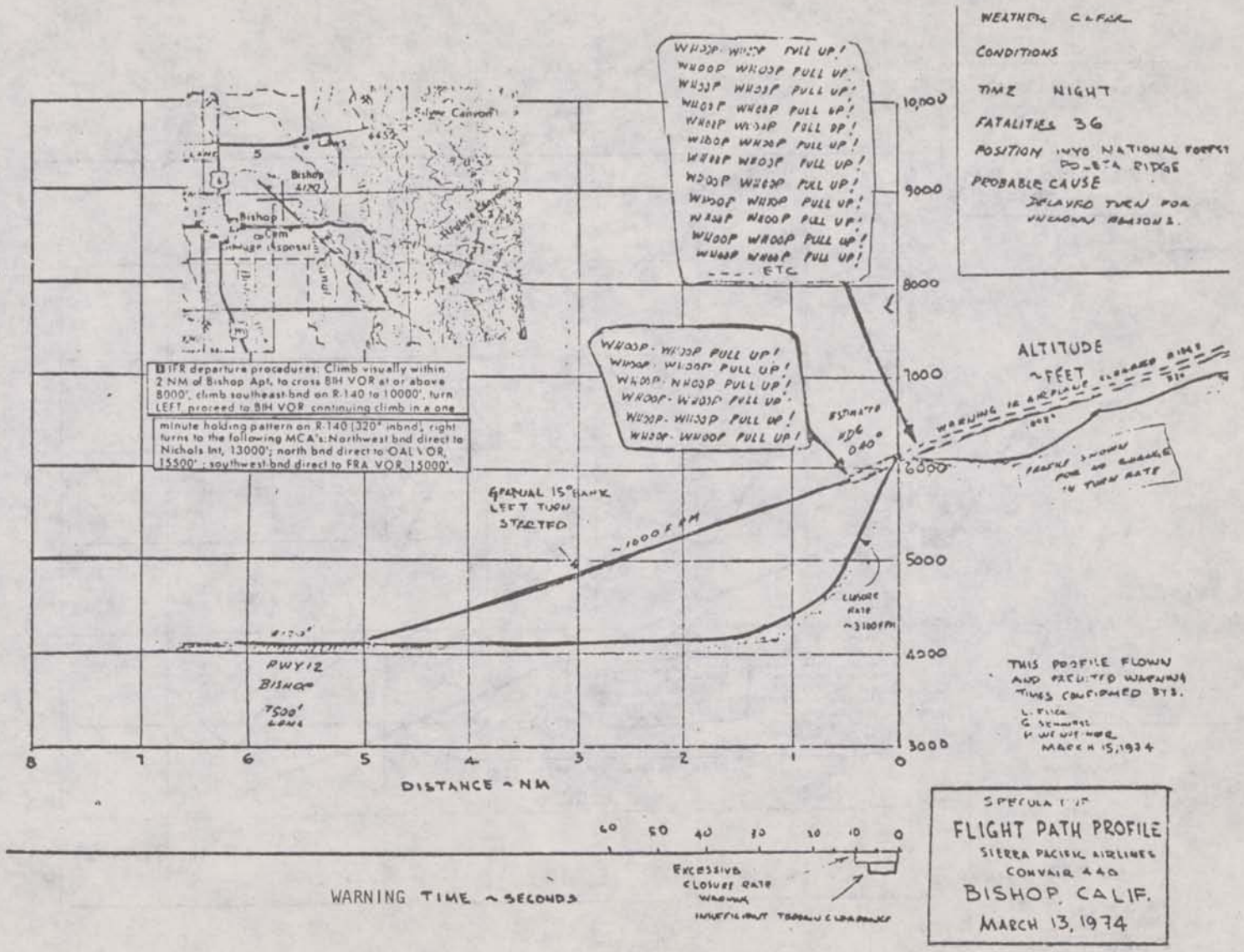
Flight Path Profile
Southern Airways
DC-9-31
Huntington, W. Va.
November 14, 1970

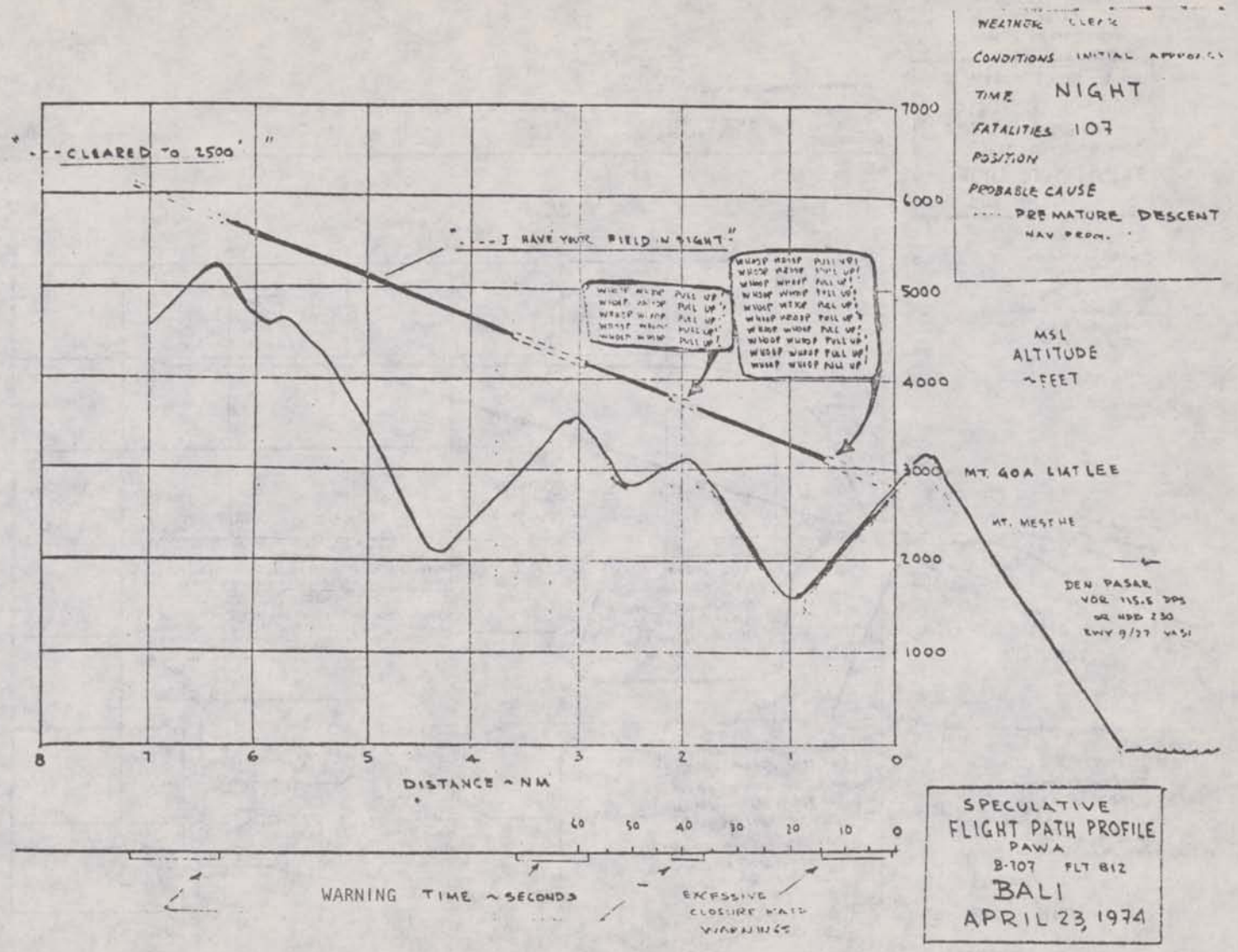
Data Source: NTSB AA Report


NOTES:
Weather:
Solid Overcast
Conditions:
Gear up - Flaps up
Above solid overcast on letdown
Time:
1150 Local (Daylight)
Fatalities:
111
Probable Cause:
Navigation Error
Comments:
There were no Radio Altimeters on this aircraft.
This flight track was flown by Sundstrand on 20 Sept. 1971 to confirm flight profile and calculated warnings.
Howard Intersection
Excursion Intersection
4500 fpm
7000
6000
5000
4000
3000
2000
1000
MSL ALTITUDE ~FEET
10 9 8 7 6 5 4 3 2 1 0
STATUTE MILES
70 60 50 40 30 20 10 0
WARNING TIME~SECONDS
Sink Rate
Closure Rate
Flight Path Profile
Alaska Airlines
B-727
Juneau, Alaska
September 2, 1971
Data Source: Unofficial Sources


Fatalities:
99
Hull:
Destroyed
Conditions:
Gear down, 18° flaps
Weather:
Clear
Time:
2342 EST
Comments:
Unsafe nose gear warning light came on during initial approach maneuvering.
Probable Cause:
Preoccupation with nose gear problem probably caused inattention to primary flight duties.
ALTITUDE ~FEET
7000
6000
5000
4000
3000
1000
SOUND OF ALTITUDE ALERT
TURN INITIATED
1500 FPM
SOUND OF RADIO ALERT
8
7
6
5
4
3
2
1
0
DISTANCE ~ NM
60
50
40
30
20
10
0
INSUFFICIENT TERRAIN CLEARANCE (FLAPS) WARNING
EXCESSIVE SINK RATE WARNING
WARNING TIME ~ SECONDS
INITIAL APPROACH
FLIGHT PATH PROFILE
EAL
L-1011
MIAMI
DECEMBER 29, 1972
NTSB -AAR-73-14


ALTITUDE
—FEET
NM. MILES
WARNING TIME—SECONDS
NOTES:
CALCULATED
Flight Path Profile
PAGO PAGO
AMER. SAMOA
JANUARY 30, 1974
GEAR EXCESSIVE
FLY UP / TERRAIN
WARNING
MIDAIR
MARKER
RUNWAY 5
0-1 DN SLOPE
GPI
E VASI
RUNWAY
THRESHOLD
ILS
NDB
2.7 DME
@ 460'
FD ROAD
AUTOMATIC
LIGHTHOUSE
BEACON
TOWER


WEATHER CLEAR
CONDITIONS
TIME NIGHT
FATALITIES 36
POSITION INYO NATIONAL FOREST PO-ETA RIDGE
PROBABLE CAUSE
DELAYED TURN FOR UNKNOWN REASONS.
WHOOP WHOOP PULL UP!
ETC.
ALTITUDE ~FEET
WARNING TO AIRPLANE
CLEARED RIDGE
TERRAIN SHOWN FOR ILLUSTRATIVE PURPOSES ONLY
ESTIMATED RIDGE 040°
GRADUAL 15° BANK LEFT TURN STARTED
~1000 FPM
CLOSURE RATE ~3100 FPM
RWY 12 BISHOP 7500' LONG
10,000
9000
8000
7000
6000
5000
4000
3000
8 7 6 5 4 3 2 1 0
DISTANCE ~ NM
60 50 40 30 20 10 0
WARNING TIME ~ SECONDS
EXCESSIVE CLOSURE RATE WARNING
INSUFFICIENT TERRAIN CLEARANCE
ITFR departure procedures: Climb visually within 2 NM of Bishop Apt. to cross BIH VOR at or above 8000', climb southeast bnd on R-140 to 10000', turn LEFT, proceed to BIH VOR continuing climb in a one minute holding pattern on R-140 (320° inbnd), right turns to the following MCA's: Northwest bnd direct to Nichols Int, 13000'; north bnd direct to OAL VOR, 15500'; southwest bnd direct to FRA VOR, 15000'.
THIS PROFILE FLOWN AND RECEIVED WARNING TIMES CONFIRMED BY:
L. FLICK
G. SCHMIDT
H. WYATT
MARCH 15, 1974
SPECULATIVE
FLIGHT PATH PROFILE
SIERRA PACIFIC AIRLINES
CONVAIR 440
BISHOP, CALIF.
MARCH 13, 1974
Don Bateman
Mar 21/74


WEATHER CLEAR
CONDITIONS INITIAL APPROACH
TIME NIGHT
FATALITIES 107
POSITION
PROBABLE CAUSE
PREMATURE DESCENT
NAV ERROR
"CLEARED TO 2500'"
"I HAVE YOUR FIELD IN SIGHT"
WHOOP WHOOP PULL UP!
7000
6000
5000
4000
3000
2000
1000
MSL ALTITUDE ~FEET
MT. GOA LIAT LEE
MT. MESTHE
DEN PASAR
VOR 115.6 DPS
NDB 230
RWY 9/27 VASI
8
7
6
5
4
3
2
1
0
DISTANCE ~NM
60
50
40
30
20
10
0
WARNING TIME ~SECONDS
EXCESSIVE CLOSURE RATE WARNINGS
SPECULATIVE
FLIGHT PATH PROFILE
PAWA
B-707 FLT 812
BALI
APRIL 23, 1974

During the Subcommittee's hearing, Sundstrand traced development of its GPWS. It began research into a warning system in 1966, as a result of two approach crashes occurring in November 1965. Early impetus for development came from Boeing and Scandanavian Airlines (SAS) as well as from the KSSU European Consortium to which SAS belongs. By August 1970, an early model of the GPWS was furnished to SAS for flight evaluation on one of its DC-9 aircraft.

In the Fall of 1970, Douglas Aircraft Company (Douglas) issued a procurement specification to provide a GPWS for the KSSU fleet of DC-10's. Sundstrand was selected to supply this system and by the Fall of 1971, the GPWS was certified by the FAA as a part of the DC-10 aircraft.

According to testimony at the hearing, it was about this time that Sundstrand began its intensive analysis of CFIT accidents occurring over a 20 year period. It was determined through this analysis that the original GPWS system installed on the KSSU DC-10's would have provided warning in only about one-third of the cases. As a result of this research and subsequent modifications to the system, primarily to Mode 1, the effectivity of the GPWS was increased to provide advance warning in an estimated 47 percent of the cases by the Summer of 1972. SAS ordered the modified system for its DC-8 and DC-9 fleet and the KSSU group ordered the same system for its 747 fleet.

Boeing began flight testing the device on its 737 and the FAA certified the improved system on Sundstrand's Beech Queen Air by the Fall of 1972. At this time, effectivity of the device had, in the opinion of the manufacturer, grown to 58 percent. Boeing estimated effectivity at 60 percent by January 1973.

At about this time, Boeing began looking into a unique warning technique -- a combination tone and human voice with the command to "Pull Up" in addition to the warning light. This system was flight tested on the 747 beginning in Spring 1973. Meanwhile, SAS had begun a fleet retrofit with the first GPWS installation being completed in March 1973.

During the Summer 1973 FAA certifications of the system were obtained on the 707, 727, 737 and 747. Boeing delivered the first GPWS-equipped 727 to Sterling Airways of Denmark and the FAA took delivery of an evaluation system.

In the Fall 1973 Boeing made the decision to install the GPWS as standard equipment on all 747's. Braniff began evaluation flights on a DC-8 and Wien Air Alaska became the first domestic carrier to order the GPWS. In November the first 747 system was delivered to Canadian Pacific Air. According to the manufacturer, by this time many foreign carriers had availed themselves of the Boeing option to order GPWS-equipped 707, 727, 737 and 747 aircraft for later delivery.

By late 1973, a fifth mode was under development aimed at reducing accidents resulting from "ducking under" the glide slope. Even before the fifth mode became operational, Boeing estimated that effectivity of the GPWS had increased to 75 percent. The fifth mode became operational in early 1974. Pan American became the first domestic carrier to undergo a fleet-wide retrofit with its order of the five mode system in May 1974. This system was certified by the FAA on the Pan American 707 and 747 in August and on the Pan American 727 in September.10/

In June 1974 Boeing announced that the GPWS would be basic equipment on all new Boeing-produced commercial aircraft. In August 1974 the device was also made basic to the Anglo-French Concorde. According to the manufacturer, the system was ordered by Braniff and World Airways and the British Civil Aviation Authority took delivery of a five mode system for purposes of flight testing and evaluation leading to certification in the United Kingdom. Moreover, Iberia, the Spanish flag carrier, began flight testing the same system on one of its 727 aircraft as part of the ATLAS European consortium evaluation of the GPWS. Lufthansa, the German flag carrier and also a member of ATLAS, ordered an evaluation system for delivery in October 1974.

The Sundstrand Corporation estimates that the development of its GPWS has now reached an effectivity of over 91 percent in presenting meaningful advance warnings in potential CFIT situations. Boeing estimates effectivity at 85 percent.

10/ The Subcommittee has been advised that operating experience with the glide slope mode has indicated the desirability of providing sufficient flexibility for deliberate and moderate deviations from the glide slope without provoking a warning from the device. Such deviations are desirable in certain specialized landing situations.

These modifications are in progress.

In its review of free world air carrier accidents during the period April 1969 to April 1974, the manufacturer identified 80 CFIT accidents and concluded that its GPWS would have provided meaningful warnings in 68 of the 80 cases, an 85 percent effectivity. It was estimated that 1,700 lives and $510 million could have conceivably been saved had the GPWS been in its present state of development and installed on those aircraft.

There were 42 CFIT accidents involving U.S. and foreign carriers within the U.S. during the same five-year period. The manufacturer maintained that its current device would have provided meaningful warnings in 36 cases for an effectivity of 86 percent. It was estimated that 860 lives and $360 million might have been saved had the device been developed and used at the time of these accidents.

A representative of the manufacturer testified that the cost of the five mode GPWS ranges between slightly over $6,200 to $7,000 depending upon whether certain ancillary equipment is included in the purchase. Installation time of the GPWS was estimated as 40 man-hours costing between $3,000 and $4,000. The representative from Boeing stated that his company is charging $10,000 for the system fully installed on the 747.

Sundstrand Corporation stated it is not production limited in the manufacture of the GPWS.

D. FAA Action

The FAA's response to the mounting death toll from CFIT accidents and to the Safety Board's recommendations for development of a Ground Proximity Warning System as well as to the system now capable of giving meaningful advance warnings in nearly half of all commercial aviation accidents has been a sorry example of administrative inaction and delay. In his prepared statement distributed prior to the Subcommittee's hearing, on September 18, FAA Administrator Butterfield gave one of the FAA's latest pronouncements on the subject:

> "But for the moment, let me just say that pending final development and satisfactory test of such new systems [GPWS], the FAA position has been that present instru-

mentation and procedures do, in fact, provide for safety and adequate terrain clearance as long as proper flight crew discipline is maintained and as long as appropriate flight operations and procedure are followed." 11/

11/ In the Administrator's statement, as submitted in advance to the Subcommittee, this language read as follows:

> "But for the moment, let me just say that pending final development and satisfactory test of such new systems [GPWS], the FAA position will continue to be that present instrumentation and procedures do, in fact, provide for safety and adequate terrain clearance as long as proper flight crew discipline is maintained and as long as appropriate flight operations and procedures are followed." [Emphasis added.]

The original language reflects what had been the FAA position up to the time of the hearing. It is hoped by the Subcommittee that the last minute changes in Mr. Butterfield's statement were taken in consideration of the weight of the evidence and testimony which had been presented by other witnesses prior to his statement, and represents the abandonment of an FAA position which was not in the public interest and cannot be further maintained in the face of the available evidence. This would appear to be the case since the Administrator inserted the following comment in his delivered statement -- a comment which did not appear in the prepared text:

> "In summary, then, we believe the Sundstrand ground proximity warning indicator now does represent a positive step forward and should be installed."

The Administrator's decision following the December 1 TWA crash to issue a rule requiring the GPWS is discussed below beginning at page 111.

It is helpful in reviewing the FAA's action, or inaction, following issuance of the Advance Notice of Proposed Rule Making (ANPRM) on April 18, 1973, to note the context within which it was issued.

(1) The National Transportation Safety Board had already recommended to the FAA on four occasions that a GPWS be developed. The FAA's consistent response was that present instrumentation and procedures were safe and adequate.

(2) The GPWS had been under development for over six years and, according to Boeing and Sundstrand, the effectivity of the device had reached the point four months before the ANPRM issued where it would provide meaningful advance warning in 60 percent of CFIT related accidents.

(3) The 20 year accident study showing that CFIT accounts for about 50 percent of all accidents, or one every 20 days, and the effectivity of the GPWS had already been furnished to the FAA.

(4) The FAA had certificated the GPWS on the DC-10 in the Fall of 1971. Boeing had begun test flights in the 737 and 747. SAS had completed the first GPWS installation in retrofitting its entire DC-8 and DC-9 fleet.

(5) The L-1011 crash killing 99 had occurred in the Florida Everglades in December 1972, five months before the ANPRM issued. The effectivity of the GPWS was such at that time that it would have provided advance warning prior to impact.

Within a few months after the ANPRM issued, other data concerning the GPWS came to the attention of the FAA. In August 1973, a number of FAA engineers from Washington and regional offices were given flight demonstrations by Sundstrand in the San Diego area during an annual technical conference. The tests were conducted with particular reference to the L-1011 crash the previous December near Miami. This activity is contained in a "Report of the Service Improvement Workshop for Better Criteria and Delegation," Report No. AFS130-74-1.

Furthermore, by September 1973, the FAA had received two highly relevant evaluations of the Sundstrand GPWS, the only available device -- one by Boeing and the other by the FAA's National Aviation Facilties Experimental Center (NAFEC) in Atlantic City, New Jersey.

Boeing, which had been under FAA contract to define concepts and requirements for an independent altitude alert system, released its study in a final report entitled, "Development of an Independent Altitude Monitor Concept," Report No. FAA-RD-73-168, dated September 1973. The study included an evaluation of Sundstrand's GPWS. While noting that the device would not be effective in preventing landing and approach accidents which do not involve excessive descent rates, or where the onset of such rates occurs close to the ground, the Boeing report noted that the device had the potential of preventing many accidents. At page 39, the report concluded as follows:

> "Overall the system [Sundstrand's GPWS] has the potential of preventing a high percentage of inadvertent terrain impact accidents which usually result in fatalities and hull loss."

When questioned at the hearing about the Boeing evaluation, Mr. David Israel, the FAA's Deputy Associate Administrator for Engineering and Development, responded, in part, that the Boeing report did not add anything new or different to the FAA's knowledge of the Sundstrand system.

The NAFEC evaluation of the Sundstrand system appeared in a report entitled "Evaluation of a Terrain Proximity Warning System (Downward Looking Radar) for Possible Enhancement of Flight Safety," Report No. FAA-RD-73-134, dated September 1973. The evaluation was purportedly based on a review of published reports and brochures, a review and analysis of available industry flight test data, and a review and analysis of all FAA certification tests concerning the GPWS. (During the summer of 1973, the FAA certified the GPWS on Boeing 707, 727, 737 and 747 aircraft.) No flight tests of the device were conducted in connection with the NAFEC study. The conclusions of the report drawn from test data, were set forth on page six:

"1. This type of a system [Sundstrand's GPWS] shows promise of being able to enhance flight safety in some specific areas.

"2. The system has experienced nuisance alarms which were eliminated by reducing the operating envelope.

"3. The time constant of the system, as currently designed, inhibits the usefulness of the system in some cases.

"4. The optimum warning envelopes for each warning mode have not been defined or documented."

While the FAA's NAFEC report appears generally unenthusiastic concerning the GPWS device, it should at least have led FAA to conclude that high priority should be attached to the perfecting of the alleged inadequacies of the system. On the basis of the evidence and statistics which were presented to the Subcommittee, however, which the FAA did not dispute at the hearing, it appears that the Boeing study was much more realistic as to the reliability and usefulness of the system.

In the light of this background, it is difficult to understand why the issuance of the ANPRM on April 18, 1973, was the last FAA public comment on the GPWS until after the Subcommittee expressed interest in the matter almost a year and a half later. In this regard, on August 23, 1974, the Subcommittee's staff contacted FAA officials to arrange for review of the public comment on the ANPRM. On August 30, 1974, the Subcommittee staff was advised by FAA officials that as a result of the ANPRM a Notice of Proposed Rule Making (NPRM) was under consideration but the prospective date of issuance and the substance of the proposal were indefinite.

On September 5, 1974, the Subcommittee announced it would hold public hearings looking into the feasibility of requiring GPWS on commercial aircraft. 12/ On September 12, 1974, the FAA issued

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12/ On September 11, 1974, an Eastern Airlines DC-9 crashed near Charlotte, North Carolina, in an accident apparently involving controlled flight into terrain. Seventy persons were killed.

an NPRM soliciting comment within 90 days regarding a proposal to require installation of GPWS on turbine powered commercial aircraft.

In an effort to determine the reason for the apparent lack of activity during virtually a year and a half following issuance of the ANPRM, the Subcommittee staff reviewed certain FAA files. This review coupled with testimony of FAA officials seems to chronicle an inexplicable FAA sluggishness in dealing with a matter which almost certainly involved life or death.

The ANPRM allowed 90 days for filing comments -- until July 24, 1973. The files reveal, however, that the comments filed in response to the ANPRM were not analyzed until nine months later, in a memorandum dated April 26, 1974.

In his statement, Mr. Butterfield testified that "the time which has elapsed from ANPRM to NPRM is not unusually long and that evaluation has been continuous throughout." Later, Mr. Butterfield was asked whether he considered the nine months taken to evaluate the public comment on the ANPRM to be excessive. Mr. Butterfield replied as follows:

> "No, I don't consider it excessive, sir. We do not believe that we have waited too long in this case. The problem with GPWS ... is partly one of state-of-the-art, as I am sure you know, and partly one of not knowing exactly what the system should do or could do.
>
> "Now, when the advance notice was issued in April 1973, we asked industry a series of complex questions on the desirability of such a system, and its needed parameters." (Hearings, page 65.)

According to the FAA memorandum of April 26, 1974, analyzing the public comment on the ANPRM, however, only 13 parties filed comments. Of these, five comments favored the GPWS proposal and four opposed it. Other comments made suggestions that were not within the scope of the ANPRM. The memorandum noted that the NTSB, the Air Line Pilots Association (ALPA), and the Air Transport Association of American (ATA) provided the only direct response to

the specific questions raised in the ANPRM. The NTSB and ALPA felt a GPWS was necessary at the time whereas ATA took the position that present instrumentation and procedures provide for safe and adequate terrain clearance as long as proper rigid flight crew discipline is maintained and appropriate flight operations procedures are followed -- the same position enunciated over the years by the FAA.

It is interesting to note that FAA testimony regarding the number of comments filed and the ratio of pro to con views regarding the GPWS presented a slightly different picture than the memorandum.

"Mr. LENT. The only question I have, Mr. Chairman, the Administrator had indicated that he had received a number of responses to the initial ANPRM issued on April 18, 1973. I think he said 16.

Mr. BUTTERFIELD. Yes, sir.

Mr. LENT. Can you tell us how many of them were favorable toward this particular concept and how many were unfavorable?

Mr. BUTTERFIELD. I am sure the Flight Standards people can. Mr. Melugin?

Mr. MELUGIN. Mr. Lent, as I recall, I think a slight majority were against the system as proposed.

Mr. LENT. Against it? Today we have just heard wonderful things about it. What were some of the negative aspects of the system?" (Hearings, page 77.)

* * * * *

"Mr. LENT. The fact that you received 16 responses to the ANPRM and the majority of them were opposed to this concept, could that have been attributed somewhat to the delay, the one and a half year period between the time the ANPRM was issued and the NPRM was issued?

Mr. BUTTERFIELD. That is possible, but I would have to ask Mr. Rudolph.

Mr. RUDOLPH. Mr. Lent, no, it is just the time it takes to evaluate these comments." (Hearings, page 78.)

* * * * *

"Mr. RUDOLPH. Well, may I interject a point here? When you have these kinds of mixed reviews, it takes time to sort these out. It is not just something that is pro or con. It is something that must be evaluated and this does take time ..."
(Hearings, page 78.)

The evaluation memorandum of April 26, which was approved in May 1974, by the Chief, Air Carrier Regulations Section, the Chief, Air Carriers Operations Branch, the Chief, Flight Operations Division, and the Chief, Regulations Staff, concluded that a Notice of Proposed Rule Making should be issued proposing to require a GPWS on aircraft operated under the provisions of Part 121 of the Federal Aviation Regulations. In reaching this conclusion, the staff stated:

"In view of a number of air carrier accidents caused by inadvertent contact with the ground, that might have been averted if the crew had received adequate warning of impending disaster, the FAA has determined that there is a need for a system ... which will provide adequate warning when in close proximity of terrain. Consideration has been given to all comments made in response to ANPRM 73-14, and systems and concepts presently available; consequently, the FAA believes that there are systems available which can satisfy the need for a ground proximity warning system, although study must be made to determine satisfactory parameters and types of warnings."

The FAA staff also concluded, that as an interim measure prior to installation of a GPWS, the NPRM include a proposal to require modification of the radio altimeter so that an automatic aural warning is sounded when an aircraft reaches an approximate height of 500 feet or 1,000 feet above the terrain.

Aisde from memoranda dated in May 1974, pertaining to prospective flight testing of the GPWS, the FAA files made available for review reflected no additional activity by the agency during the period of almost four months beginning with the May approval of the April 26, 1974 evaluation memorandum and ending with the Subcommittee's expression of interest in the matter.

With reference to the flight testing, Mr. Butterfield's testimony indicates that the agency was conducting such testing during the evaluation period of ANPRM comment:

> "Now, when the advance notice was issued in April 1973, we asked industry a series of complex questions on the desirability of such a system, and its needed parameters. In the meantime, we were testing the only known candidate system in our own aircraft, and as was indicated here earlier this afternoon, working fairly closely with designers and manufacturers. We even used one of their breadboard models in one of our own aircraft, the Gulfstream ..." (Hearings, page 65.)

The files show, however, that while there may have been an intention to flight-test during this time, it was never accomplished. Indeed, the little testing that was eventually done took place during the Summer of 1974.

In this regard, a memorandum dated September 6, 1973, from the Director, NAFEC to the Director of Flight Standards Service, Mr. Rudolph, requested availability of the FAA's DC-9 airplane for installation and testing of the Sundstrand GPWS. An attachment to the memorandum contained a time schedule for testing the device. After preliminary steps, such as installation, it was proposed to flight test the device in November 1973. After several months of data collection and analysis, it was further proposed to conduct field evaluations and demonstrations in April 1974, at sites of various CFIT accidents such as Huntington, West Virginia; Bradford, Pennsylvania; Boston and Miami. The final report was anticipated in June 1974. No portion of this schedule was ever met, or even commenced.

A memorandum dated May 14, 1974 from Systems Research and Development Service to Flight Standards Service confirmed another request to install the Sundstrand GPWS in the FAA's DC-9. A staff memorandum to the files dated four months later (September 9, 1974), however, merely discloses a continued intention to install and test the GPWS on the DC-9.

When FAA officials were asked at the hearing why the GPWS had not been put on the FAA's DC-9 for testing after a year had elapsed, the following colloquy ensued:

"Mr. RUDOLPH. I have just been advised that it was just recently pulled out of the test airplane at the test center at NAFEC. And it was in test through July.

Mr. MANELLI. The tests you refer to in the other plane, in the Gulfstream, were conducted in May and June of 1973, so there would have been quite a time after those tests were concluded.

Mr. RUDOLPH. May I ask Mr. Israel when it was completed and taken out.

Mr. ISRAEL. The test was completed this year, but I don't have the date when the equipment was removed. We received the equipment for the Gulfstream in November 1973, proceeded to install it and ran the tests, through the summer of this year. We have now completed the test, and the reports will be available shortly." (Hearings, page 68.)

However, according to FAA memoranda -- prepared by NAFEC and Headquarters staff, dated September 5 and 9, 1974, respectively -- the apparent extensive testing in the FAA's Gulfstream suggested by Mr. Israel actually amounted to approximately 20 hours of test flying performed during the summer of 1974.

E. Comment

(1) It is disquieting to compare the industry's example of safety consciousness as represented by the actions of Boeing and Pan American, with inexplicable footdragging which has characterized the FAA's regulatory response to a pressing safety problem.

(2) There is strong evidence that the state of the art with respect to GPWS development has reached the point where the device will provide meaningful advance warnings in 85 percent to 90 percent of CFIT related accidents. If correct, an opportunity is available to prevent almost half of all commercial aviation accidents. It seems inevitable that widespread deployment and use of the GPWS device will provide data for further improvement. But this process cannot begin until the necessary action is taken to start using the device on domestic passenger aircraft.

In this framework, it is difficult to appreciate the FAA's tendency (prior to the recent TWA crash) to emphasize negative aspects of the device -- aspects which involve only 10 to 15 percent of CFIT accidents -- while continuing to maintain that present instrumentation and procedures are safe and adequate. For example, at the hearing:

> "Mr. BUTTERFIELD. ... The other point I want to make is that the FAA does not believe that such a requirement, if adopted, will serve as the panacea for accidents involving inadvertent flights into terrain." (Hearings, page 62.)
>
> * * * * *
>
> "Mr. BUTTERFIELD. Nevertheless, I would remind you again that there is no single comprehensive solution which can prevent the type of accident we have discussed today." (Hearings, page 64.)
>
> * * * * *
>
> "Mr. RUDOLPH. However, the present system being discussed will not in fact be a cure for all accidents.
>
> the landing configuration making a normal rate of descent. The pilot could go right down and land into a lake or impact the surface provided he didn't traverse interfering terrain. From that standpoint it is not a panacea, as the Administrator pointed out." (Hearings, page 67.)
>
> * * * * *
>
> "Mr. BUTTERFIELD. ... 100 percent of all current jet aircraft have a very effective altitude warning system. I use it all the time when I fly. It goes off loudly in one's ear. A light flashes, and it is a perfectly adequate system.
>
> It is not as though we are drifting along here without altitude warning devices. We have a good many of them in our airplanes today and we have got to look at this thing in its proper perspective and realize that pilots have a responsibility, too, to follow set and standard procedures, to use these instruments which are now available to them." (Hearings, page 72.)

The Administrator's statement is literally true. Present instrumentation does provide means of knowing altitude. It is possible for pilots to set audible reminders or indicators to go off at preset altitudes. But these devices are routinely used by pilots as reminders when changing altitude, either ascending or descending, so as to avoid the necessity of continuously monitoring the dial of the altimeter. This type of aural signal, therefore, is routinely heard repeatedly during the course of a normal flight. Typically it does not signify a dangerous situation, only that the plane has reached a predetermined altitude. In stress situations, however, this type of warning can often be ignored or its significance misunderstood. Many cockpit voice recorders from crashed airplanes contain evidence of such audible tones being ignored by the crew; most large aircraft involved in crashes during recent years have been equipped with such devices.

The GPWS, in contrast, is never heard in normal flight; its warning unmistakably signifies danger and requires immediate response. Furthermore, in addition to altitude, it acts as a monitor of all the factors which have been found to be preludes to CFIT crashes, such as excessive sink rate, improper landing configuration, etc.

It appears that the FAA's mood of negativism toward the GPWS filtered down from headquarters to the FAA regional offices. Three of seven offices filing comment in opposition to the ANPRM indicated an awareness of being consistent with FAA policy. They expressed agreement "with the FAA position" before such a position could or should be formulated in a rulemaking proceeding. The position on which they expressed agreement was that present instrumentation and procedures provide for safety and adequate terrain clearance so long as proper flight crew discipline is maintained and appropriate flight operations procedures are followed.

The Subcommittee notes, however, that not all regional comment was negative. The four regional offices commenting in favor of the GPWS concept included the Western Region and Northwest Region which have jurisdiction over the three large manufacturers of passenger aircraft.

The Subcommittee staff received similar favorable views from FAA field personnel. One such individual, who has considerable experience with the GPWS, believes "countless lives" could be

saved with the device. He told the staff, "If I were God, I'd have this system installed within two weeks on every commercial aircraft."

(3) The FAA demonstrated a lack of knowledge about certain basic features of the Sundstrand GPWS as well as about its own evaluation of the device through testing and consideration of comments filed in response to the ANPRM.

In his prepared statement, Mr. Butterfield said a limitation of the Sundstrand device is "that it cannot monitor flight management with respect to terrain ahead of the aircraft." While the device does not employ forward looking radar, it has the capability of providing meaningful warnings in almost all instances of dangerous terrain ahead of the aircraft. This is the function of Mode 2, an integral part of the system since its early development. A warning is sounded when the GPWS computer calculates imminent forward danger upon the basis of signals received from terrain rising beneath the aircraft. Since such a situation is all but invariably encountered prior to impact against a mountain (excluding the rare instances of a sheer canyon wall) the device does provide a warning with respect to terrain ahead of the aircraft.

In connection with the above-quoted statement, it is also pertinent to note the present unavailability of forward looking radar. Boeing's report to the FAA entitled "Development of an Independent Altitude Monitor Concept," dated September 1973, contains the following language:

> "Terrain proximity warning systems using forward-ranging radar are still in the early stages of development so far as commercial market applications are concerned. The main reason for this is that a suitable low cost radar sensor is not available. Although the terrain-following/terrain-avoidance radar equipment used in some military planes would do the job, the cost and complexity of that equipment would rule out its application." (page 39)

Another example of misunderstanding regarding the Sundstrand GPWS surfaced at a later point in the hearing. During a discussion of the unique quality of the warnings emitted by the Sundstrand device, Mr. Butterfield commented, in part, as follows:

> "... but, I know as well as I know anything that even this new device, when incorporated, will eventually, at least its alerting system, become rather commonplace. And there are times when the device could be made to go off purposely." (Hearings, page 72.)

The Administrator is certainly wrong in his assertion that this warning would become "commonplace," in the cockpits of commercial aircraft. Such a result would presuppose an unprecedented epidemic of reckless flying.

In this connection, it is troubling to the Subcommittee to hear testimony from the Administrator of the agency responsible for air safety comment rather casually about the "real world" of aviation where descents occur at an "excessive rate" in response to instructions from a controller.

> "But in the real world there will be times when it will go off [GPWS] and you will know it is going off and you will endure it while it is going off. You may be at 3,000 feet and the controller says, 'Are you still at three?' and you say, 'Yes'; and he says, 'I told you to descend; now immediately descend to 2,000.'
>
> Then you would descend at an excessive rate and endure the device." (Hearings, page 75.)

Since the GPWS sounds an alarm only when a sink rate is reached which creates a danger in relationship to the ground, it would seem that the term "excessive rate" connotes a risk which should not be tolerated except under certain highly unusual exigencies requiring it.

The FAA also revealed a lack of knowledge about the comments received in response to the ANPRM. For example, Mr. Butterfield said in his prepared statement that 16 such comments were filed by interested parties. Under subsequent questioning, this statement was reiterated and other FAA officials added that the majority of these comments were in opposition to the GPWS concept. This testimony raised the suggestion that the extent of opposition could have accounted to some degree for the FAA's nine month delay in dealing with the comment.

The fact is that there were a total of 13 comments filed -- not 16. Of these, only nine were germane and the majority of those favored the GPWS concept. This is documented in the FAA's NPRM issued September 12, 1974. Moreover, in the opinion of the FAA staff, two of the three most responsive and significant commentators -- the Air Line Pilots Association and the National Transportation Safety Board -- were among the majority favoring a GPWS.

Another illustration involves the extent to which the FAA flight-tested Sundstrand's GPWS device. FAA testimony, taken as a whole, indicates that extensive flight testing took place over the past year. One official testified that after receiving the equipment in November 1973, it was installed on the FAA's Gulfstream and tests were run through the summer of 1974.

From other testimony, however, it appears that the FAA took delivery of an evaluation GPWS during the summer of 1973. In any event, FAA files indicate that flight tests on the Gulfstream were not flown until mid to late summer 1974. Total flight time appears to have been 20 hours.

(4) There is an urgent need for the FAA to reassess its research and development priorities. On April 8, 1974, the President transmitted to Congress the annual report on the Nation's progress in aeronautics and space activities for 1973. The FAA's activities in the area of aviation safety research and developments were therein described. The principal research area listed involved mid-air collisions, the cause of approximately 2 percent of all aviation accidents. Other areas of research and development were also set forth but CFIT, the cause of over 50 percent of all accidents, was not mentioned.

When asked about the agency's questionable ranking of priorities, Mr. Butterfield stated:

> "Well, I would certainly openly admit to our not putting this GPWS in the highest priority category for a number of good reasons: The essential one is that up until now, up until this time that we believe the Sundstrand device to be up to the necessary state of the art, we have taken a position that present instrumentation ... and present procedures do provide for safety and adequate terrain clearance as long as proper flight crew discipline is main-

tained. Perhaps there should have been more emphasis on our checking the airlines for the maintenance of proper air discipline and procedure while airborne." (Hearings, page 70.)

This response seems to suggest that the reason CFIT/GPWS was not accorded the highest priority in research and development was because a system to do the job had not been researched and developed. In the meantime, pending development, the FAA viewed present instrumentation and procedures as safe despite the accident rate from CFIT related causes.

(5) It is quite possible that Mr. Butterfield focused on the central issue in the GPWS matter in two statements made to the Subcommittee:

"I am simply saying that in promulgating a rule which is going to affect everyone, is going to force everyone to buy an $11,000 instrument, a relatively expensive instrument, even though that instrument is probably going to save some lives, I just say we have to be very, very careful about our evaluation. There could be a great proliferation of instruments that the FAA makes mandatory if it were not careful in this procedure. That is all I am saying, sir." (Hearings, page 79.)

* * * * *

"We are a public service organization and we have a responsibility to the public and not to any segment of the community. But, at the same time, we have a responsibility to maintain the good health and welfare of U. S. civil aviation, so we can't afford to take any action which would cut the pins out from under any segment of aviation. This does, in fact, cause dilemmas when a regulatory body such as the FAA has another almost equal responsibility to keep the industry active and alive and well." (Hearings, page 81.)

It is indeed a sad commentary when the Administrator of the agency responsible for aviation safety describes an $11,000 price tag as "relatively expensive" when comparing it to saving lives or, for that matter, saving hull loss in the millions of dollars.

Moreover, the statement underscores the need for the agency to cease viewing passenger safety and the economic health of the airlines as competing interests to be balanced. It is people who are to be kept "active and alive and well." The economic health of the airlines and aircraft manufacturers rests upon public confidence in safety in the air. Should that confidence be further eroded by evidence of regulatory compromise and temporizing with safety, the economic impact on the industry will be extreme and prolonged.

(6) The FAA has exhibited a shocking indifference to airline safety throughout the development of the GPWS. This is particularly highlighted by the unwarranted administrative delays that have occurred since issuance of the ANPRM in April 1973. Even as it existed several months prior to the FAA's Advance Notice, the device would have provided meaningful warning in 60 percent of CFIT accidents, or one-third of all accidents.

Yet, the FAA took nine months to evaluate nine relatively brief comments submitted in response to the ANPRM, the majority of which favored the device. Then the FAA took another five months to issue the NPRM and, indeed, gave no indication of issuing it then until after two contacts by the Subcommittee's staff in August 1974 and the Subcommittee's announcement of public hearings on September 5, 1974. It should also be noted that the FAA did not flight test the device until a year after it took delivery.

When the NPRM finally issued on September 12, 1974, the FAA again allowed 90 days for comment. Moreover, during the hearing, the FAA estimated that five additional months would be necessary to evaluate this second round of comments.

Upon urging of the Subcommittee, both at the hearing and by subsequent letter of September 19, 1974, Mr. Butterfield agreed by letter of October 1, 1974, to shorten the 90 day period for comment to 60 days and the five month period for evaluation to three months. (Texts of the letters follow:)

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NINETY-THIRD CONGRESS

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

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Congress of the United States
House of Representatives
Special Subcommittee on Investigations of the
Committee on Interstate and Foreign Commerce
Room 2323, Rayburn House Office Building
Washington, D.C. 20515

September 19, 1974

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Department of Transportation
Washington, D. C. 20591

Dear Mr. Butterfield:

First of all, let me thank you and your staff for your appearance before the Subcommittee yesterday. I believe that the hearings provided a useful review of the present capabilities of the Ground Proximity Warning System, and the compelling need for its expeditious installation on all commercial passenger aircraft. I was pleased to note that you affirmed the FAA's agreement with this proposition, and stated the agency's position in favor of installation.

I would like to reaffirm, however, the very serious concern which I expressed yesterday during the hearing, that an inappropriate administrative delay appears to be in prospect before the air traveling public will be able to benefit from the additional safety which this device provides. Specifically, I question the necessity of allowing ninety days to receive comments on the proposed rule requiring installation of this device. I fully endorse the remarks of my colleague on the Subcommittee, Congressman Pickle, on this score. Having already gone through an advance rulemaking proceeding last year -- which consumed ninety days for the submission of comments, a further nine months for FAA analysis of those comments, and a further five month period during which the FAA considered the staff analysis and recommendation for issuance of a proposed rule -- it does distress me that we seem on the verge of repeating the whole administrative process all over again. I believe that the estimates provided to us by your staff, whereby the comments would not be required until December 16 with FAA analysis to continue on until April of next year, are inappropriate in view of the exhaustive review of the GPWS question which has already taken place in the industry and within the FAA itself.

September 19, 1974

I was very pleased and encouraged by your statement to us yesterday that you will review and consider shortening the announced ninety-day period for submission of comments on this question. I agree with Congressman Pickle's suggestion that this period be shortened to no more than sixty days. Frankly, it seems to me that it is unlikely that the comments to be received by the agency in response to its notice of proposed rulemaking will add substantially to the body of knowledge already in hand. On that basis, let me suggest that even thirty days would seem to be adequate under the circumstances.

Secondly, I hope that the estimate given us yesterday, whereby the FAA would take five months to review the comments in this latest proceeding, could be reduced to no more than three months. My reasons for urging this are simply that we are not dealing here with a matter which needs to be the subject of exhaustive research. We have a device presently available which is relatively inexpensive and which can be manufactured in sufficient quantities to allow for rapid deployment within the commercial air fleet.

Finally, I must question the 18-month period which the proposed rule allows for installation of the device. On the basis of our information, it seems to me that 12 months would be an ample period of time. Again, I concur with Mr. Pickle's recommendation to you on this point.

In view of all of these considerations, I urge you to announce through the Federal Register that the period for submission of comments has been reduced -- at the least -- to sixty days. Since the NPRM appeared only four days ago, this amendment by the FAA could not work a hardship on any interested party desiring to submit comments. Secondly, I urge you to amend the proposed rule itself so as to provide for a 12-month installation, rather than 18 months as presently provided. Finally, I urge that FAA's administrative review of the comments on the proposed rule be held to no longer than three months rather than five months, which was the estimate we had yesterday.

If you concur in these recommendations, it will result in cutting at least nine months from the process. In view of the statistics showing the rate at which CFIT accidents occur, this reduction in time could have a significant effect on air safety.

Please advise me of the action you intend to take in this matter.

Sincerely,

HARLEY O. STAGGERS
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

— OFFICE OF
THE ADMINISTRATOR

OCT 1 1974

Honorable Harley O. Staggers
Chairman, Special Subcommittee on
Investigations of the Committee on
Interstate and Foreign Commerce
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

Thank you for your September 19 letter. I share your belief that the hearings provided a useful review of the present capabilities of the Ground Proximity Warning System (GPWS) and the need for installing it on all commercial passenger aircraft.

I appreciate your concern over inappropriate administrative delay and wish to assure you that final rulemaking action will be taken on Notice of Proposed Rule Making (NPRM) 74-32 as expeditiously as possible. We have reviewed the necessity for requiring the 90-day public comment period contained in the Notice and agree that 60 days should provide an adequate opportunity for interested persons to submit written comments. Consequently, the time period for submitting comments will be reduced to 60 days. In addition, we plan to complete our review of these comments within three months.

As desirable as it may be, my technical staff advises me that a 12-month period for installing the device is not realistic based on previous experience with regulatory requirements for other warning systems, such as the Altitude Alerting System. For example, several manufacturers assured the Federal Aviation Administration that sufficient quantities of a relatively simple altitude alerting device would be available for installation during the 30 months allowed for compliance. The effective date of this rule had to be extended because of unforeseen problems in the manufacture and distribution of the equipment. Accordingly, we believe that the proposal to allow 18 months for installation of the GPWS may be optimistic.

I appreciate your interest in this matter; and if I can be of further service, please let me know.

Sincerely,

Alex Butterfield

Alexander P. Butterfield
Administrator

(7) The foregoing response of Mr. Butterfield undoubtedly would have been the last development in the ground proximity warning system matter prior to the preparation of this report if the disastrous TWA crash killing 92 had not occurred on December 1, 1974, in the hill country near Dulles Airport.

After early indications strongly suggested that this accident involved another case of controlled flight into terrain, Chairman Staggers wrote to Mr. Butterfield on December 2. Mr. Butterfield was requested to further reduce the time in which the FAA would evaluate comments on the NPRM and to shorten the installation period from 18 to 12 months. The letter follows:

NINETY-THIRD CONGRESS

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

HARLEY O. STAGGERS, W. VA., CHAIRMAN

J. PICKLE, TEX.
CHARLES J. CARNEY, OHIO

SAMUEL L. DEVINE, OHIO
NORMAN F. LENT, N.Y.

Congress of the United States
House of Representatives
Special Subcommittee on Investigations of the
Committee on Interstate and Foreign Commerce
Room 2323, Rayburn House Office Building
Washington, D.C. 20515

December 2, 1974

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Department of Transportation
Washington, D. C. 20591

Dear Mr. Butterfield:

Following the Subcommittee's hearing on September 18, 1974, inquiring into the feasibility of requiring Ground Proximity Warning Systems (GPWS) on all commercial aircraft, I wrote you asking that every effort be made to expedite the FAA's rulemaking proceeding in this matter. I urged you to shorten the time for public comment, as well as the time for FAA evaluation of such comments, and for a reduction of compliance time should a rule be adopted requiring installation of such a device.

You thereafter advised me by letter of October 1, 1974, that you would reduce the time for public comment on the FAA's Notice of Proposed Rulemaking (NPRM) from 90 days to 60 days, thus ending the comment period on November 16, rather than December 16, 1974. Moreover, you advised that the FAA would complete its review of these comments within three months as opposed to five months originally planned. Finally, you stated that you felt the proposed 18 months installation period could not be reduced and may even be optimistic. You advised that you were informed by your technical staff that a 12-month period for installing the device would not be realistic based on previous experience with regulatory requirements for other warning systems, such as the Altitude Alerting System.

Yesterday, 92 persons aboard a TWA Boeing 727 lost their lives in a mountaintop strike during a bad weather approach for landing at Dulles Airport. As you know, the plane had been diverted from its intended destination at National Airport due to the inclement conditions.

While it is too soon to positively know the cause of the crash, early indications strongly suggest that poor visibility and disorientation resulting from the bad weather could have been causative factors. It is

noted that the plane crashed into the west side of a mountain with a 1,750 foot elevation approximately 20 miles west of Dulles. It is our understanding that aircraft do not descend to the 1,800 foot level until within six miles west of the airport. Moreover, there were no indications of mechanical difficulty. It would appear from this information that a GPWS may have provided the warning necessary to have avoided this disaster.

You will recall, I am sure, that testimony at the Subcommittee hearing adduced that over 50 percent of all commercial aviation accidents, or one accident every 20 days throughout the world, involve controlled flight into terrain. These are accidents which occur when an otherwise airworthy aircraft is inadvertently flown into the ground and they result from such causes as poor visibility, navigation error, visual misconception, instrument misreading and confusion. One industry study reveals that over 1,200 persons died in 1972 and 1973 alone from this kind of accident.

In light of the foregoing, I must urge you again to shorten even further the FAA's period of comment evaluation. The agency has had more than sufficient time to evaluate the concept as well as "on the shelf" equipment which is available for installation.

Furthermore, I must strongly urge that the FAA consider shortening the 18-month installation period once the rule requiring the device is adopted. In your letter of October 1, 1974, commenting on previous experience with the altitude alerting device, you note that the compliance period had to be extended because of unforeseen problems in the manufacture and distribution of the equipment. The Subcommittee has been advised by Sundstrand Data Control, Inc., the manufacturer of a GPWS presently available, that it is not production limited. It would appear that Sundstrand alone could meet the requirements of 12-month compliance period for the entire domestic carrier fleet. If subsequent circumstances appear to require an extension of the installation period, that is the proper time to consider it. In my view, we cannot afford to take an unnecessarily negative approach when lives are involved and I, therefore, believe that the earliest feasible compliance period based on current industry information should be established.

Please advise me of any further action you intend to take in this matter.

Sincerely,

HARLEY O. STAGGERS
Chairman

On December 3, 1974, a plane equipped with a GPWS flew several flights over the crash site. (Subcommittee staff members accompanied one of these flights.) The flight paths simulated, as closely as possible, the path of the TWA plane. As the plane approached the mountain, retracing the steps of the TWA aircraft, the GPWS sounded its alarm seven to fourteen seconds in advance of the estimated time of impact which was more than adequate to have avoided this crash. The difference in warning times was due to using varying angles of approach to the crash site.

In addition to this information, other flight data was disclosed which further confirmed that a CFIT accident had occurred and that a GPWS would have provided ample warning to the TWA crew to enable it to avoid the mountain top. On December 4, 1974, Chairman Staggers and Congressman Pickle of the Subcommittee made statements on the Floor of the House calling upon the FAA to require GPWS on commercial airliners and to do so quickly. The statements are set forth in Appendix C.

On December 4, 1974, Chairman Staggers forwarded his statement to Mr. Butterfield and reiterated his request that Mr. Butterfield give the GPWS matter his prompt personal attention. The letter follows:

NINETY-THIRD CONGRESS

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

HARLEY O. STAGGERS, W. VA., CHAIRMAN
J. J. PICKLE, TEX.
CHARLES J. CARNEY, OHIO
SAMUEL L. DEVINE, OHIO
NORMAN F. LENT, N.Y.

Congress of the United States
House of Representatives
Special Subcommittee on Investigations of the
Committee on Interstate and Foreign Commerce
Room 2323, Rayburn House Office Building
Washington, D.C. 20515

December 4, 1974

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Department of Transportation
Washington, D. C. 20591

Dear Mr. Butterfield:

I am writing with reference to my letter of December 2, 1974, concerning Ground Proximity Warning Systems (GPWS) wherein I urged you to speed up the FAA's consideration of this matter and to shorten the proposed compliance time of 18 months.

Since that time, I have received additional information which seems to confirm that a GPWS would have provided ample warning to the TWA crew to enable it to avoid striking the mountaintop near Bluemont, Virginia. As you know, I feel very strongly that GPWS be installed on all commercial aircraft as soon as possible. I am enclosing a statement that I intend to deliver today on the floor of the House calling for that to be done.

I can only reiterate my request to you, which I originally made at our hearing, that you give this matter your prompt personal attention.

Sincerely,

Harley O. Staggers

HARLEY O. STAGGERS
Chairman

Enclosure

On December 5, 1974, the National Transportation Safety Board issued the following release regarding the TWA accident which further indicates that it involved controlled flight into terrain:

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.--20591

Safety Information

For Release:

SB 74-72
(202) 426-8787

IMMEDIATE
Thursday, Dec. 5, 1974

Office of the Chairman

The National Transportation Safety Board revealed today certain facts developed during its investigation of an accident involving a Trans World Airlines B-727 aircraft that crashed during an approach to landing on Runway 12 at Dulles International Airport on December 1, 1974.

Preliminary information developed by the Board investigation indicates that after receiving an air traffic control clearance for a VOR/DME approach to Runway 12, the pilots immediately initiated a descent to the initial approach altitude of 1,800 feet mean sea level although they were in an area where the published minimum en route instrument altitude was 3,400 feet m.s.l. The Board pointed out that although this information appears to indicate what occurred it does not indicate why it occurred, which will be one of the primary questions to be pursued by the Board during its continuing investigation and hearing on this accident.

The Board has been advised by the Federal Aviation Administration that that agency has taken action to require its air carrier inspectors to assure that all air carrier pilots understand that an Air Traffic Control clearance is not authority to descend below any established minimum altitude.

As part of its continuing investigation, the Board said it would convene a public hearing with Member Louis M. Thayer serving as the Chairman of the Board of Inquiry at a time and place to be announced later. During the hearing, the Board of Inquiry will not only seek out all the facts and circumstances concerning this accident but will call as witnesses and take testimony from officials of the Federal Aviation Administration, the Air Line Pilots Association, the Professional Air Traffic Controllers Organization, and others, relative to their views of actions which could be taken to prevent the recurrence of this type of aircraft accident.

The Safety Board will continue to study this type of accident and will not hesitate to make corrective recommendations at any time.

# # # # #

As a result of the recent TWA crash, considerable discussion has evolved between the organizations of pilots and air traffic controllers over whose error may have caused the plane to be at an unsafe altitude. The clarity of the approach chart has also been questioned. The Subcommittee takes no position in this controversy and, in any event, believes it is irrelevant to the GPWS issue. Of course, if there is confusion or misunderstanding between flight crews and ground controllers or in approach charts, it should be corrected immediately. The fact remains, the GPWS is an indispensable back-up system which is activated whenever human error has permitted disaster to become imminent, and in this instance would have given a timely warning. Questions as to which errors, and whose, might have been responsible for the danger can then be settled later -- after the disaster has been averted.

(8) On December 11, 1974, Chairman Staggers received a telegram from Administrator Butterfield in which he advised that before December 20, 1974, he would sign a final rule requiring installation of ground proximity warning systems on all U. S. registered turbojet air carrier aircraft by December 1, 1975. The texts of the telegram and Chairman Staggers' reply follow:

HONORABLE HARLEY O. STAGGERS
CHAIRMAN, COMMITTEE ON INTERSTATE
AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

DEAR MR. CHARIMAN AND COMMITTEE MEMBERS:

THIS TELEGRAM IN THREE PARTS:

PART 1: I HAVE COME TO SEATTLE FOR THE EXPRESS PURPOSE OF LEARNING FIRSTHAND HOW THE FAA MIGHT BEST AND MOST APPROPRIATELY MEET ITS RESPONSIBILITIES TO THE AMERICAN PUBLIC WITH REGARD TO PREVENTING IN THE FUTURE AVIATION ACCIDENTS SIMILAR TO THOSE WHICH RECENTLY INVOLVED A LUFTHANSA 747 AT NAIROBI AND A TWA 727 IN THE HILL COUNTRY 20 MILES WEST OF DULLES INTERNATIONAL AIRPORT.

PART 2: ON THE SUBJECT OF THE 747 LEADING EDGE FLAP OPERATION, THE FAA ALREADY HAS TAKEN REGULATORY ACTION BY MEANS OF AN AMENDMENT TO THE OPERATIONS SPECIFICATIONS OF U.S. CERTIFICATED CARRIERS. THE AMENDMENT REQUIRES THAT FLIGHT CREW MEMBERS ASSURE THAT LEADING EDGE FLAP CONTROL CIRCUIT BREAKERS ARE CLOSED, THAT ALTERNATE FLAP DRIVE AND ARMING SWITCHES ARE IN THE OFF POSITION, THAT THE GREEN LIGHT IS ILLUMINATED ON THE PILOT'S PANEL AND EIGHT GREEN LIGHTS ARE ILLUMINATED ON THE FLIGHT ENGINEER'S PANEL, AND THAT PRIOR TO TAKEOFF, ALL ENGINE BLEED AIR VALVES ARE DOUBLE-CHECKED TO BE IN OPEN POSITION. ADDITIONALLY, AN OPERATIONS INFORMATION ALERT HAS BEEN ISSUED WHICH RECOMMENDS THAT PRIOR TO TAXIING FROM PARKING RAMPS PILOTS EXTEND TAKEOFF FLAPS AND THAT CONFIRMATION OF FULL EXTENSION OF ALL WING LEADING EDGE DEVICES BE RECEIVED FROM QUALIFIED GROUND OBSERVERS. NOW, PURSUANT TO AUTHORITY DELEGATED BY ME, THE FAA NORTHWEST REGIONAL DIRECTOR WILL SIGN A PROPOSED AIRWORTHINESS DIRECTIVE TO REQUIRE MODIFICATION OF THE TAKEOFF AURAL WARNING SYSTEM WHICH ADDS AN ADDITIONAL INPUT TO WARN PILOTS IF LEADING EDGE FLAPS ARE NOT FULLY EXTENDED DURING TAKEOFF ROLL. THIS AIRWORTHINESS DIRECTIVE PROPOSAL WILL BE SIGNED WITHIN 48 HOURS

PART 3: ON THE SUBJECT OF GROUND PROXIMITY WARNING INDICATORS, I HAVE SPENT THIS MORNING AT SUNDSTRAND'S ELECTRONIC DIVISION AT REDMOND, WASHINGTON, WITH PRODUCTION MANAGER RICHARD KELLERMAN. IN CONSIDERATION OF AVAILABILITY OF MATERIALS, PRODUCTION CAPABILITY OF SUNDSTRAND, AND BOTH FLIGHT SCHEDULING AND ECONOMIC IMPACT TO U.S. AIRLINES, I AM CONVINCED THAT GROUND PROXIMITY WARNING INDICATOR DEVICES CAN BE INSTALLED ON ALL TURBOJET AIR TRANSPORTS IN THE DOMESTIC FLEET FAR SOONER THAN WE ESTIMATED INITIALLY.

western union Mailgram

UNITED STATES POSTAL SERVICE U.S. MAIL

ALREADY, THE FAA HAS ELIMINATED FIVE MONTHS FROM THE NORMAL SCHEDULE OUTLINED DURING COMMITTEE HEARINGS-- ONE MONTH OF THIS TOTAL BY REDUCING THE COMMENT PERIOD TO 60 DAYS AND FOUR MONTHS OF THE TOTAL BY REDUCING THE COMMENT REVIEW PERIOD TO 30 DAYS. NOW, BEFORE DECEMBER 20, I INTEND TO SIGN THE FINAL RULE REQUIRING GPWI INSTALLATION ON ALL U.S. REGISTERED TURBOJET AIR CARRIER AIRCRAFT IN LESS THAN ONE YEAR--THAT IS, BY DECEMBER 1, 1975. SINCERELY,

ALEXANDER P. BUTTERFIELD
FAA ADMINISTRATOR
800 INDEPENDENCE AVE., S.W.
WASHINGTON D.C. 20591

22102 EST

MGMWSHT WSA

NINETY-THIRD CONGRESS

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

HARLEY O. STAGGERS, W. VA., CHAIRMAN

J. J. PICKLE, TEX.
CHARLES J. CARNEY, OHIO
SAMUEL L. DEVINE, OHIO
NORMAN F. LENT, N.Y.

Congress of the United States
House of Representatives
Special Subcommittee on Investigations of the
Committee on Interstate and Foreign Commerce
Room 2323, Rayburn House Office Building
Washington, D.C. 20515

December 11, 1974

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C.

Dear Mr. Butterfield:

Let me say how pleased and gratified I was to receive your telegram this morning in which you advise me that you are taking action to require prompt deployment of the ground proximity warning system throughout the U. S. commercial fleet. I think your action is commendable and very much in the public interest. I also was pleased to learn of the action you have taken with respect to the Boeing 747.

Thank you for the personal attention you have given to this very important matter, and for the constructive manner in which you have responded to the concerns expressed by me and my colleagues on the Investigations Subcommittee during our hearings of September 18, and in subsequent correspondence with you.

Sincerely,

Harley O. Staggers

HARLEY O. STAGGERS
Chairman

(9) On December 18, 1974, as final preparations of this report were underway, the FAA issued a rule requiring installation of a ground proximity warning system on commercial aircraft (see Appendix D). The Subcommittee is appalled to find that the rule requires only a four mode device when a five mode device is not only available but necessary to reach 90 percent effectivity in providing warnings in potential CFIT accident situations.

The mode that was omitted (inadvertent "duck-under" the glide slope, see page 78) provides a warning when a plane, during approach, deviates below the glide slope in a dangerous angle of descent. This is the mode which the Boeing representative at the Subcommittee's hearings described as "an absolute necessity." This is also the mode which is included in the five mode device presently being installed on all Pan American planes.

Testimony of FAA officials at the Subcommittee's hearing indicated that they, too, endorsed the five mode system:

> "Mr. BUTTERFIELD. In summary, then, we believe the Sundstrand ground proximity warning indicator now does represent a positive step forward and should be installed." (Hearings, page 63.)
>
> * * * * *
>
> "Mr. MANELLI. ... Is it the FAA's position that we have not yet had final development and satisfactory testing of a reliable Ground Proximity Warning System?
> Mr. RUDOLPH. Mr. Manelli, I think our position is that there is now an acceptable system. I heard the figure given that it would cover about 85 percent of the accidents. I am not sure that that is the figure. I have not analyzed it that closely ...
> Mr. BUTTERFIELD. ...[I]n summary, we believe Sundstrand's GPWS now represents a positive step forward and should be installed. That is the answer to your question." (Hearings, page 67.)
>
> * * * * *
>
> "Mr. RUDOLPH. I believe the attachment to the Sundstrand document quite clearly shows the technology being used at the time, or that was available to us at the time, and it

was not until early in 1974 that the final mode 5 was added to it.

And as early as 1973 we still were just then thinking about connecting the flaps to the system. It is through this technology that we have finally arrived at what we consider now to be a system that does not necessarily prevent all accidents but would assist in alerting crews in the cockpit to any number of those situations resulting in accidents that have happened in the past." (Hearings, page 65.)

Moreover, the manufacturer testified that of the 36 cases in which the existing device would have provided a meaningful warning in accidents in the U. S. within the past five years (see page 91, above), ten of the warnings would have been prompted by the glide slope mode. According to these figures, which were not disputed during the hearings, the effectivity of the device called for by Mr. Butterfield will have an effectivity reduced by 25 to 30 percent. Instead of providing a meaningful warning in 90 percent of potential CFIT accidents, the effectivity will only be 60 to 65 percent. This is no small matter. Uncontested testimony at the Subcommittee's hearings pointed to the fact that over half of all accidents occurring throughout the world are caused by controlled flight into terrain.

There is no question, that if the FAA's action stops with the issuance of the December 18 rule, there will continue to be accidents in the months and years ahead which could have been prevented by a glide slope mode.

On December 19, 1974, just one day after the FAA issued the rule, the Safety Board issued its accident report regarding the crash at Pago Pago last January in which 97 people were killed (see page 3 above). In its release, the NTSB stated the following:

"The Board concluded that after the captain 'went visual' he probably did not refer to the instrument panel to monitor the Instrument Landing System presentation, the vertical speed indicator, or the barometric altimeter. These flight instruments, the Board said, would have indicated that 'the aircraft was below the glide slope and was descending too rapidly to complete the landing safely.'"

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The Board went on to note that all components of the Instrument Landing System were operating properly at the time of the accident. From the foregoing, it appears probable that a glide slope mode in a ground proximity warning system would have provided a warning in advance of this accident. The Board's finding should remove any doubt about the need for the glide slope mode. For this reason the Subcommittee strongly urges the FAA to expeditiously take whatever action may be necessary to include a requirement for the glide slope mode as soon as possible.

IV. CF-6 ENGINE PROBLEM INVOLVING THE DC-10

A. Background

In connection with other inquiries in the FAA's Western Region during April 1974, the Subcommittee's staff undertook a review of General Electric's CF-6 engine performance in powering DC-10 wide-body aircraft. The review covered several matters, but focused on the question of whether the drilled tip turbine fan blades in the CF-6 engine constituted a safety problem which should be corrected.

The drilled tip turbine blade is unique to the CF-6 among commercial aircraft engines. In December of 1973, General Electric converted to solid blades both in new production CF-6 engines and for replacement parts. The majority of CF-6 engines in use today, however, still have drilled blades. Each drilled blade has sixteen holes drilled into its tip thereby reducing weight and increasing acceleration potential of the engine. Evidence had been accumulating in the FAA's Western Region, however, that these blades may be particularly susceptible to foreign object damage (FOD) caused by ice, birds, gravel, etc. While there have been no crashes, some serious incidents have occurred. For example:

(a) In December 1973 at Montreal, the No. 2 engine of a KLM DC-10 ingested ice and nine fan blades were broken with all 38 blades suffering damage. On takeoff, one blade fragment was ejected forward of the containment ring and cut the main fuel supply hose to the No. 2 engine. An engine fire ensued which entered the engine inlet duct before it was extinguished.

(b) In October 1972 at Tulsa, the No. 1 and No. 3 engines of an American Airlines DC-10 received extensive damage on takeoff when the plane encountered a flock of swamp birds. The No. 2 engine was saved by the captain when he pulled the nose up thus shielding it from the birds.

(c) In December 1972 at Chicago, ice was encountered by a United Airlines DC-10 resulting in damage to two engines. Fan pieces were ejected through the wing engine cowl and struck and dented the fuselage.

The FAA's Western Region recounted the accumulating service history of the drilled blade in a summary memorandum dated April 18, 1974, addressed to Headquarters in Washington and to the FAA's Great Lakes Region which certificated General Electric's CF-6 engine.

The memorandum lists 14 instances of FOD resulting in damage to 19 engines. The view was expressed "that a significant hazard exists when these [drilled] fan blades are used." The following conclusion was expressed by the Western Region:

> "Service and test experience indicate that the drilled G.E. CF-6 engine fan blade is very sensitive to FOD. The resulting damage to the engine and aircraft is considered excessive and presents a serious threat to the safety of the aircraft."

The Western Region recommended that steps be taken to remove the drilled fan blades from service on a mandatory basis. The Region also recommended that certain airframe modifications be accomplished on a mandatory basis including increased protection to such areas as the fuel line to the No. 2 engine, the hydraulic lines and critical controls in the aft accessory compartment, the fuselage area in the vicinity of the wing engines, and to the wing and tail engine nacelles.

The files of the Western Region also contained information which raised serious questions about the CF-6 engine icing certification by the Great Lakes Region in 1970, and about the DC-10 icing flight test certification by the Western Region in 1971. There were indications that the tendency of the drilled blades to fragment upon an encounter with FOD was not thoroughly examined during icing tests of both the engine and the aircraft conducted in connection with certification.

On June 11, 1974, the FAA's Great Lakes Region issued a Notice of Proposed Rule Making (NPRM) which disclosed that there had been nine instances in which foreign objects had broken pieces from the tips of the drilled fan blades of GE's CF-6 engine. According to the notice, six of these pieces penetrated the cowling and one punctured the fuel line. The proposal further noted that considerable secondary damage had also been caused by the broken pieces which further degraded the engine's performance. The notice

continued by stating that "[s]ince it is reasonable to expect that such incidents could occur again with even more serious consequences an Airworthiness Directive is being considered to require replacement of drilled blades with ones with solid blades." The proposed AD called for mandatory installation of solid blades in at least one wing engine by June 30, 1975, and in all engines by June 30, 1976. The notice allowed 60 days for comment on the proposal by interested parties.

On July 2 and 10, 1974, during the comment period, the Subcommittee held hearings to review its investigation with FAA officials. These hearings were held in executive session. The obvious sensitivity of the matter constrained the Subcommittee to take great pains not to cause needless panic to the traveling public or to create an unnecessary economic disruption for the industry and its employees. Industry representatives estimated that a retrofit of the entire fleet could approximate $47 million. At the same time, it was understood that confidentiality would be maintained only so long as consistent with the public interest.

On August 23, 1974, the FAA issued an AD which required that a main fuel line to the No. 2 engine be shielded on all GE powered DC-10 aircraft. This was done to prevent a repeat of the KLM incident mentioned above. (On October 15, 1974, the AD was amended to apply only to those airlines powered by GE engines with drilled blades.) Moreover, during August, the FAA issued a maintenance bulletin to all domestic carriers requiring preflight inspections of CF-6 inlet ducts for ice during the forthcoming winter season.

On September 10, 1974, the FAA's Great Lakes Region withdrew the proposed AD with the comment that "[U]pon further consideration, and in the light of the comments received in response to the Notice of Proposed Rule Making, the agency has determined that an unsafe condition does not exist with regard to containment of broken pieces from fan blade tips caused by foreign object damage and degradation of engine performance." This information was formally provided to the Subcommittee by letter dated October 1, 1974.

B. Request of the NTSB

The FAA's decision to withdraw the AD was reviewed by the Subcommittee in the light of the overall available record. A number of disturbing questions were raised by the confusing data and conflicting opinions which were held within the agency itself. Due to the complex technical questions involved, however, the Subcommittee decided to refer the matter to the NTSB for its views. The Safety Board was requested under authority of 49 U.S.C. 1441(a)(5) to conduct a study and investigation to determine whether corrective action needed to be taken to eliminate the possibility of an accident. The letter transmitting the matter to the NTSB follows:

NINETY-THIRD CONGRESS

SPECIAL SUBCOMMITTEE ON INVESTIGATIONS

HARLEY O. STAGGERS, W. VA., CHAIRMAN
J. J. PICKLE, TEX. — SAMUEL L. DEVINE, OHIO
CHARLES J. CARNEY, OHIO — NORMAN F. LENT, N.Y.

Congress of the United States
House of Representatives
Special Subcommittee on Investigations of the
Committee on Interstate and Foreign Commerce
Room 2323, Rayburn House Office Building
Washington, D.C. 20515

October 11, 1974

Honorable John H. Reed
Chairman
National Transportation Safety Board
Washington, D. C. 20591

Dear Mr. Chairman:

As you know, this Subcommittee over the past several months has undertaken inquiries concerning policies and procedures of the FAA with respect to a number of topics. Currently, the Subcommittee is considering a very sensitive and difficult safety issue involving foreign object damage (FOD) on the CF-6 engine which powers the DC-10 and A300B Airbus.

On June 11, 1974, the FAA's Great Lakes Region issued a Proposed Airworthiness Directive (AD) which disclosed that there have been nine instances in which foreign objects have broken pieces from the tips of the drilled fan blades of General Electric's CF-6 engine. Six of these pieces penetrated the cowling and one punctured the fuel line. The proposal noted that considerable secondary damage has also been caused by the broken pieces which further degrades the engine's performance. The preamble to the proposed AD continued by stating that "[s]ince it is reasonable to expect that such incidents could occur again with even more serious consequences an Air Worthiness Directive is being considered to require replacement of drilled blades with ones with solid blades." The proposed AD called for installation of solid blades in at least one wing engine by June 30, 1975, and in all engines by June 30, 1976.

On September 10, 1974, the FAA's Great Lakes Region withdrew the proposed AD with the comment that "[u]pon further consideration, and in the light of comments received in response to the Notice of Proposed Rule Making, the agency has determined that an unsafe condition does not exist with regard to containment of broken pieces from fan blade tips caused by foreign object damage and degradation of engine performance."

The Subcommittee's interest in this matter dates back to April, 1974, when the staff undertook a review of CF-6 engine performance in connection with other inquiries in the FAA's Western Region. Since that time, certain files have been reviewed and interviews conducted. The Subcommittee also held two hearings, on July 2 and 10, 1974, reviewing this situation with FAA officials. These hearings were held in executive session and no press releases or other pronouncements of any kind have been made. The obvious sensitivity of the matter constrained the Subcommittee to take great pains not to cause needless panic to the traveling public.

Now, the FAA's decision to withdraw the AD has been reviewed in the context of the overall available record and a number of disturbing questions have been raised by confusing data and conflicting opinions within the agency itself. However, due to the technical limitations of the Subcommittee and its staff to fully analyze this information, the National Transportation Safety Board is requested under authority of 49 USC 1441(a)(5) to conduct a study and investigation to determine whether corrective action needs to be taken to eliminate the possibility of an accident.

This request should neither be interpreted as a no confidence vote in the FAA nor as an attempt by the Subcommittee to substitute its views for the expertise of the FAA. The contradictory evidence within the FAA, however, coupled with the possibility of a catastrophic accident leaves the Subcommittee with no alternative but to seek the additional expert views of the Board.

The Board should be aware that while the FAA found a safety issue does not exist with continued use of the drilled blade, it has taken two precautionary steps. The FAA's Western Region issued an AD requiring installation of a protective shield around approximately fourteen inches of fuel line in the vicinity of the tail (No. 2) engine. This must be accomplished on all domestic DC-10's by December 1, 1974. In December, 1973, the fuel line on a KLM DC-10 was ruptured by blade fragments and a fire ensued. Dutch authorities credit good fortune to preventing a "major disaster." Secondly, the FAA has issued a maintenance bulletin to all domestic carriers requiring pre-flight inspections of CF-6 inlet ducts for ice during the forthcoming Winter season.

In considering this matter, the Board must address two fundamental questions:

(a) Does the frangible quality of the drilled blade endanger the airworthy condition of airplanes powered by the CF-6 engine?

(b) Is passenger safety jeopardized by flying pieces of fragmented drilled blades?

Some points of contradiction and concern contained in the record of this proceeding are mentioned below:

(1) Although the FAA has determined that the CF-6 engine with drilled blades does not pose a serious safety threat, earlier this year, two key FAA officials expressed strong contrary views.

In a letter dated April 18, 1974, from the Chief, Aircraft Engineering Division of the Western Region to FAA Headquarters and the Great Lakes Region, he analyzed the drilled blade problem and concluded as follows:

> "Service and test experience indicate that the drilled G.E. CF-6 engine fan blade is very sensitive to FOD. The resulting damage to the engine and aircraft is considered excessive and presents a serious threat to the safety of the aircraft." (p. 5)

The Western Region also stated with respect to the CF-6 engine that a "survey of the service record of this blade indicates that a significant hazard exists when these fan blades are used." (p. 2)

In a letter dated February 15, 1974, the Chief, Aircraft Certification Staff in Brussels, with responsibility for certifying the Airbus power plant, advised FAA Headquarters that the A300B Airbus is particularly vulnerable to FOD because both engines are subject to the same operating and environmental icing conditions. He noted that damage to a second engine "could be disastrous" and, moreover, that "[i]t is not improbable that such a condition could occur in service."

(2) The Great Lakes Region stated in the preamble of the proposed AD that there were nine instances when FOD broke tips from drilled blades. However, in its booklet of September 5, 1974, which contains the Region's analysis and conclusion that no safety problem exists, the Region sets forth 58 instances when FOD broke tips from drilled blades. Only one of the 58 occurred after the proposed AD was issued. The Western Region, on the other hand, listed 19 such instances of blade fragmentation. (See Western Region letter of April 18, 1974, mentioned above.)

(3) During the July 2, 1974, hearing, FAA officials presented charts comparing the CF-6 shut-down rate and premature removal rate with that of the engines on other wide-body jet transports. The charts showed the engines to be generally comparable in performance in these areas. When it was suggested during the presentation of the charts that the Subcommittee may be investigating the wrong engine, an FAA official responded, "It would appear that way, sir." (Tr. 23) Under questioning of Congressman Pickle, however, FAA officials admitted that these charts did not disclose the seriousness of defects compared. (Tr. 25)

By contrast, the Western Region's letter of April 18, 1974, mentioned above, contained a detailed comparison of these engines with respect to blade fragmentation and found the service record of the CF-6 to be much poorer than the others. (See pp. 4 & 5) The Western Region stated that "CF-6 fan blades are very sensitive to FOD and are prone to very serious fan deterioration with ingestion of FOD that would produce only minor damage on other fan engines." (p. 3) Moreover, the Western Region in a telegram to Headquarters, dated May 22, 1974, said the following on this point:

> "In comparison with the durability of other fan engines the CF-6 drilled fan blade is less tolerant of damage inducing factors resulting from strikes on these fan blades whatever the source, whether it be from engine ice accumulation or from foreign object damage. Many of these instances which have caused difficulties in CF-6 engines in the DC-10's have occurred in like manner on JT9D and RB211 engines with far less damage resulting to the extent that those engines did not require shutdown.... Our position is that the CF-6 engine blade damage which results from minor incidents is unique with this blade, and should be corrected on a mandatory basis." (pp. 2-3)

(4) The only additional protection afforded DC-10's with CF-6 engines containing drilled blades is the fourteen inch shield around the fuel line of the No. 2 engine.

The Western Region, in the aforementioned letter of April 18, advised that in addition to the fuel line severed in the KLM accident, the Douglas effort was extended to include protection for the aft accessory compartment which contains the stabilizer and elevator control mechanism, numerous hydraulic lines, and the main fuel supply line to the APU and No. 2 engine. In addition, the Western Region took the position that the "fuselage area in the vicinity of the wing engines...must be protected." (p. 4)

The Western Region, in the telegram of May 22 referred to above, said it would support a lenient replacement schedule of drilled blades with solid blades to reduce economic impact "if such a schedule is supplemented by other factors which will improve the overall safety of the aircraft during the scheduled period." (p. 3)

The Chief, Propulsion Branch, FAA Headquarters, in a memorandum dated May 14, 1974, recording his comments on the AD Review Board meeting he attended on May 9 at the Great Lakes Region, stated the following:

> "It was agreed that the evidence shows safety risks in two basic respects:
>
> 1. Aircraft damage from shrapnel. Trajectories and forces can be such as to puncture cowling, damage fuselage, and disable systems. Reported incidents indicate tail position is more critical than wing positions because of plumbing passing through the vulnerable zone...."

Finally, Mr. Rudolph testified that the Douglas Aircraft Company had been told that it "must" afford protection to the critical lines to the No. 2 engine, i.e. the fuel and hydraulic lines. (Tr. 20)

(5) During the hearing on July 2, 1974, the following exchange took place:

MR. MANELLI. We did have this United Airlines incident where a piece of turbine blade penetrated the cowl and dented the fuselage. Mr. Sliff said this morning if it had hit the window your feeling, or the studies on the impact strength of it, would be that it would not have broken the window. Is that correct?

MR. SLIFF. That is the opinion of the people that studied it.

MR. RUDOLPH. Those are double strength windows.

MR. MANELLI. How would their strength compare with the strength of the fuselage?

MR. RUDOLPH. The strength of those two windows is stronger than that piece of metal.

MR. SLIFF. They might have penetrated an outer window.

MR. RUDOLPH. But never the second window.

Douglas Aircraft Company, in a technical analysis filed with the FAA in response to the proposed AD, described the probability of passenger area penetration as remote, i.e. less than one per billion flights. (p. 37)

However, the majority of a Critical Design Review Team, consisting of nine FAA personnel from the Western Region and one from Headquarters, disagreed with this aspect of the Douglas' technical report. Seven of the ten criticized Douglas' data primarily because it was too conservative in estimating dimensions, mass, and velocity of the blade fragment used in its calculation of potential penetration. It appears to have been the general consensus of the seven that fragment penetration of either the fuselage or window may be less than remote. They also appear to agree that while such a penetration may adversely affect the safety of an individual passenger, it will not have a catastrophic effect on the airworthiness of the airplane. (CDR Report submitted 8/30/74)

In the aforementioned memorandum of May 14, 1974, the Chief, Propulsion Branch, FAA Headquarters, commented:

> "The risk of fuselage or window puncture from wing engines cannot be discounted, however, in spite of Douglas' analysis that a fragment does not have sufficient energy to puncture a window."

Finally, the Western Region letter of April 18, 1974, mentioned earlier, stated that "[t]he probability of striking and shattering a passenger window can no longer be considered a remote possibility." (p. 3)

(6) During a briefing of the Subcommittee staff at FAA Headquarters on September 11, 1974, regarding the decision to withdraw the AD, the staff was advised by FAA officials that blade fragments only from the left wing engine (No. 1 engine) can strike the fuselage. It was explained that due to the rotation of the fan and the position of the wing, blade fragments cannot strike the fuselage from the right wing engine (No. 3 engine).

A letter dated September 17, 1974, from the Chief, Aircraft Engineering Division, Western Region to the Great Lakes Region, addressed this issue. The following statement was contained therein:

> "Fragments from the No. 1 engine (left side) could strike at a more direct angle with less resistance to penetration. The No. 3 engine (right side) was assessed as having more resistance to penetration because of a flatter angle of impact. Hence, it was determined that the left side was more critical."

A communication dated February 1, 1974, from the Great Lakes Region to Headquarters stated that on December 13, 1972, a United Airlines DC-10 encountered ice at Chicago and a blade fragment from the No. 3 wing engine struck the fuselage.

(7) A Great Lakes Region booklet dated September 5, 1974, contains the Region's analysis and conclusion that no safety problem exists with respect to the CF-6 drilled blades. At page 52, data is set forth regarding the ice ingestion incident occurring during the flight test at Seattle. The engine vibration level is shown as 4-6.5 mils at the turbine on landing. It is unclear whether this reflects the vibration level at the turbine fan, which would appear to be the critical area. Furthermore, it is difficult to assess, from the data which the Subcommittee has reviewed, what the effect would be in a situation wherein the flight could not be terminated in a short time period. Such a situation would occur, for example, if damage were sustained in the course of a trans-Atlantic flight. The question arises as to whether a vibration level which might be endured for a limited time might, if prolonged, induce further secondary effects, through metal fatigue or otherwise.

It is recognized that the possibility of bird strikes and other FOD might be remote during the midst of a trans-Atlantic crossing. Nevertheless, the Subcommittee is aware that in the recent incident involving an American Airlines DC-10 flying from Pheonix, Arizona, FOD damage -- as yet unexplained so far as the Subcommittee is aware -- took place at 37,000 feet in non-icing conditions.

(8) The aforementioned booklet also contains data concerning the American Airlines bird strike at Tulsa when the Nos. 1 and 3 engines were damaged. At pages 56, 57 and 58, data (including a graph) is set forth showing the respective thrusts of the Nos. 1 and 3 engines as 64.6 percent and 94.2 percent measured with the rotors balanced. At page 59, the thrust of the No. 3 engine is shown in an unbalanced condition as 52 percent "with severe vibration." It is also noted that the testing of the engine in its unbalanced condition was terminated after 20 minutes. There is no indication in the booklet that the No. 1 engine was thrust tested in an unbalanced condition.

While, again, conceding its lack of engineering expertise, the Subcommittee is still unable to perceive any probative value -- as to the engine's ability to sustain its performance after an FOD incident -- in

testing the engine in a balanced condition; i.e., after the performance of adjustments which would be clearly impossible in flight.

Again, as in item No. 7, above, the question is raised as to the possibility of progressive degradation in engine performance in situations wherein it would not be possible to immediately terminate the flight.

(9) Questions have been raised regarding the CF-6 engine icing certification. During August, 1970, prior to certification of the engine, the Western Region along with two NASA icing experts raised many questions, orally and in writing, concerning the adequacy of the icing tests conducted by G.E. under the observation of the Great Lakes Region. The primary objection was that flight conditions were not simulated during the G.E. icing test. It should be noted that the CF-6 is the first of the large turbofan engines which does not incorporate an anti-icing system.

On September 10, 1970, four G.E. representatives met with four FAA Headquarters personnel and G.E. was given an opportunity to reply to each objection raised by the Western Region and the NASA experts. On September 16, 1970, the FAA type certificated the CF-6 engine. Two days later, FAA Headquarters responded to objections of the Western Region and the two NASA experts largely using G.E. input and concluded that the issue had been satisfactorily resolved. One of the NASA experts was contacted by the Subcommittee staff and he continues to disagree with the test procedures employed by G.E. and approved by the FAA.

(10) Questions also have been raised about the DC-10 icing flight test certification. On March 28, 1971, the DC-10 was flown into acceptable icing conditions for the first time as part of the flight test certification program. As a result of a one hour and 16 minute encounter with "light to moderate" icing, three blades in the No. 1 engine were damaged and 26 blades in the No. 2 engine suffered moderate to severe damage. A blade fragment was ejected ahead of the containment ring of the No. 2 engine and was found on the engine work platform below the engine.

The Western Region found the engine damage unacceptable and said the source of the ice would be identified, eliminated and additional flights would be required. The Region also stated that determination would be made that engine icing protection is sufficient to alleviate the sensitivity of the drilled blade to ice and FOD.

On May 27, 1971, five Douglas representatives met with seven FAA representatives in Washington. Douglas attempted to avoid further flight testing since in its view no safety problem was involved. The same argument was made during a second meeting at Douglas on June 5, 1971.

One additional icing test flight was eventually flown in mid-June, 1971. This second flight, however, was flown in less severe icing conditions than was the case in the first, aborted flight giving rise to a question as to whether the two flights were comparable. The Subcommittee was advised by Mr. Sliff (Tr. 112) that the lesser severity of the icing conditions would simply mean that it would take longer to build up the same amount of ice. Other sources have indicated, however, that the quality of the ice (i.e. rime ice as opposed to clear ice) is affected by the rate of accretion. No

engine damage resulted and the plane was considered to have met the FAA's requirements on this phase of certification. The DC-10 was type certificated in late July, 1971.

(11) On March 29, 1973, the A300B Airbus was undergoing icing flight certification testing over the Mediterranean and both engines were damaged as a result of an encounter with ice.

As a result of this incident, the Chief, Aircraft Certification Staff, FAA Brussels, with certification responsibility for the A300B power plant, advised French authorities by letter dated January 15, 1974, in part as follows:

> "To preclude damaging the fan blades when operating in icing conditions we will require, as a condition of A300B certification, that its CF6-50A engines have only the undrilled blades."

On February 1, 1974, FAA Headquarters dispatched a telegram to FAA Brussels advising that its notification to the French had the effect of altering the engine type certification for which the Great Lakes Region has responsibility. FAA Brussels was asked to withdraw the condition of certification on the A300B which it had imposed.

By telegram of February 13, 1974, FAA Brussels advised the French that it was rescinding its letter of January 15, 1974, mentioned above.

On May 16, 1974, when the question of drilled blade reliability remained unsettled, FAA Brussels sent a lengthy telegram to FAA Headquarters seeking the answers to seven questions which reflected its continuing reservations about the anti-icing features of the CF-6 and the frangibility of the drilled blades.

By letter dated May 20, 1974, FAA Headquarters advised FAA Brussels that the questions which were raised had been satisfactorily resolved and it saw no valid reason for not accepting the French icing tests as compliance with FAA requirements.

During the hearing on July 2, FAA officials testified that only minor blade damage resulted from the encounter with ice during the certification test flight of the A300B. (Tr. 67 & 115)

However, an attachment to the Western Region's letter of April 18, 1974, mentioned above, which is entitled "Fan Blade Damage History in Service Aircraft" describes the fan damage resulting from this test flight as "moderate to heavy." (p. 2) This assessment of damage was based upon information furnished by the FAA's Brussels Office.

Moreover, the following exchange took place between Mr. Manelli and a representative of the FAA's Brussels Office at the July 2 hearing:

> MR. MANELLI. Would I be stating your position fairly if I said that you still feel that a preponderance of the evidence points to the engine not having adequate durability? Is that a fair way of putting it? Is that accurate?
>
> MR. FOLLENSBEE. Yes. I would say that there have been incidents since I wrote this memo which have resulted in fractures of the fan blades; yes, I would say, which led to the notice of proposed rule-making.
>
> MR. MANELLI. This has not weakened your position at all?
>
> MR. FOLLENSBEE. No.
>
> MR. MANELLI. If anything, it has confirmed it?
>
> MR. FOLLENSBEE. Yes. (Tr. 46)

It should also be noted that in connection with the A300B icing test, the source of the ice that caused the damage has, in the opinion of some FAA officials, not been resolved.

(12) During the hearing on July 2, 1974, FAA officials presented charts purporting to show that it would be impossible for the industry to produce sufficient replacement solid blades to meet the proposed AD compliance dates of one wing engine by June 30, 1975, and all engines by June 30, 1976. They testified that it would take between 1978 and 1979 to produce the required blades unless additional equipment were brought into service and then the earliest date would be mid-1977. One FAA official testified that "the broach is the problem." He stated there are only two in the entire U.S. capable of making this blade and that it would take an additional two years to construct and place another broaching machine in service. (Tr. 39, 40, 41, 106)

Subsequent to the hearing, the Subcommittee staff contacted industry sources and was advised that the broaching machine is not a bottleneck. The staff was told by industry sources that existing broaching machines have the capacity to meet the compliance dates of the proposed AD. (Tr. 6-9; July 10 hearing)

By letter of July 29, 1974, the FAA advised the Subcommittee that on the basis of independent surveys conducted by the FAA and G.E. following the July 10 hearing, it had been concluded by both of them that the compliance dates in the proposed AD were possible to meet.

This concludes the discussion of some of the areas of controversy and concern. I am enclosing herewith a copy of the record of the two executive hearings as well as copies of all documents referred to in this communication. Other materials are available from the Subcommittee staff. It is suggested that your staff may want to contact the Subcommittee's Chief Counsel, Daniel Manelli (225-4441), to arrange for a transfer of this additional information and backup materials.

I am sure you understand that the Subcommittee is not taking the position that the CF-6 engine in its drilled fan blade configuration is unsafe. In fact, the many hours of safe flight may well demonstrate the contrary to be true. Nevertheless, there have been 58 recorded instances wherein the drilled blade fragmented from FOD; some of these incidents have resulted in rather serious situations. Moreover 57 of these had already taken place when the FAA issued its Notice of Proposed Rulemaking, which stated, with respect to some of them:

> "[It] is reasonable to expect that such incidents could occur again with even more serious consequences...."

The Subcommittee is unable to perceive wherein any intervening developments have vitiated the force of that conclusion. Our concern is heightened by the FAA estimates that it will be 1988 before all drilled blades have been replaced with solid blades through normal attrition; a period of fourteen years during which many millions of passenger miles will be flown. The Subcommittee is uncertain whether such a replacement schedule is consistent with the highest standard of safety that must be maintained.

The Subcommittee realizes that it has taken an unusual step in referring this matter to the Board. But we are also aware that the advent of the wide-body passenger aircraft introduces new problems and the potential for calamitous consequences. We have only to look back a few months at the disastrous Paris crash to illustrate the truth of that statement; 345 persons perished in aviation's worst disaster. Certainly,

this is an area of sufficient importance to warrant the combined expertise of both the FAA and the NTSB.

We believe that the Board constitutes a valuable resource whose activities should not be limited to after the fact analysis of accidents. It appears that disasters of this kind often cast a shadow before them, and it should be a matter of equal urgency to identify such indications if possible. We are confident, moreover, that the statute gives the Board full authority to conduct this investigation. Under the circumstances, the Subcommittee believes that the public interest requires it.

Throughout its inquiry, this Subcommittee has made an effort to avoid unwarranted publicity which might create needless panic in the traveling public, and unjustified damage to the operations of the manufacturers and operators of the DC-10/CF-6 equipment, and their employees. I know the Board will, in turn, accord this matter appropriate confidentiality pending completion of its own analysis.

Under the circumstances, however, and especially in view of the approaching icing season, we must also ask that the Board's review be conducted as promptly as possible. Confidentiality has been appropriate under the unusual circumstances with which the Subcommittee has been dealing; however, a determination must be made in the near future as to whether its continuation is justified.

The cooperation of the Board will be greatly appreciated.

With kind personal regards,

Sincerely,

Harley O. Staggers

HARLEY O. STAGGERS
Chairman

Enclosures

cc: Administrator, FAA

C. Response of the NTSB Recommending AD Action

By letter of November 27, 1974, the NTSB forwarded an interim report to the Subcommittee. The Board found that service problems do exist with the CF-6 engine which incorporate fans with drilled blades. The Board could not state, however, until its investigation is completed, whether drilled blades are less safe than blades with solid blades.

In connection with its interim report, the NTSB recommended to the FAA three courses of corrective action, two of which involve the issuance of AD's. The Safety Board's letter to the Subcommittee and safety recommendations to the FAA follow:

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591

OFFICE OF
THE CHAIRMAN

November 27, 1974

Honorable Harley O. Staggers
Chairman of Special Subcommittee on Investigations
of the Committee on Interstate and Foreign Commerce
U. S. House of Representatives
Room 2323 Rayburn House Office Building
Washington, D. C. 20515

Dear Mr. Chairman:

As you requested on October 11, 1974, the National Transportation Safety Board is investigating CF6 engine problems. A complete report of our investigation will be sent to you later.

The Safety Board finds that service problems do exist with the CF6 engines which incorporate fans with drilled blades. However, until our investigation is completed, we cannot state that fans with drilled blades are less safe than those with solid blades.

With regard to the possibility of fan blade fragments penetrating the fuselage, the same general problem exists with all large, high-bypass turbofan engines. The Safety Board does not believe that the risks of engines with drilled fan blades are any higher than the risks of engines with solid fan blades in this respect.

The major cause of fan blade fragmentation is damage by foreign objects. The two foreign objects which pose the most serious threats are birds and ice. Birds constitute the greater hazard potential because they are difficult to control or eliminate. The FAA has developed a program to eliminate roosting and nesting birds in the vicinity of airports served by air carriers. The Safety Board believes that this program is the most effective method of reducing the possibility of bird ingestion, and we have urged that the FAA place increased emphasis on the program.

To eliminate ice ingestion on the DC-10, the McDonnell Douglas Corporation has issued letters to operators recommending that inlet ducts be inspected for ice formation after an aircraft has been exposed to freezing precipitation on the ground. Also, McDonnell Douglas has issued a service bulletin which recommends that a 3/4-inch diameter drain hole be added in the inlet duct transition ring

of the No. 2 engine. The FAA has issued a maintenance bulletin which requires that its air carrier inspectors insure that domestic carriers have procedures for clearing inlet ducts of ice. The Safety Board has recommended that a method to prevent ice from accumulating in the DC-10 No. 2 engine inlet duct should be incorporated into the aircraft. Until the aircraft can be modified, preflight inspection should be required.

As you know, the FAA has issued an airworthiness directive which requires that the fuel line to the No. 2 engine be shielded on DC-10 aircraft equipped with CF6 engines which incorporate drilled fan blades. The Safety Board has recommended that the FAA expand the AD to include all DC-10 aircraft. This recommendation is based on an incident which involved a DC-10 equipped with JT9D engines which incorporated solid fan blades. Fragments from the blades caused nacelle damage just forward of the fan.

With regard to ice damage to engines on the A300 aircraft, French engineers believe that the icing conditions that damaged the CF6 engines during certification tests were substantially more severe than those that would be encountered during operations. If during our investigation, we reach a different conclusion, we will inform the French and West German authorities of our findings.

The Safety Board has conducted a preliminary review of FAA's certification and airworthiness directive processes, and will further analyze them before drawing final conclusions. Also, the Safety Board will further evaluate advantages and disadvantages of solid versus drilled fan blades as they relate to foreign object damage.

A copy of our letter to FAA, which contains the two recommendations mentioned above, is enclosed.

We compliment your Committee and your staff on the thoroughness of their investigation which has been most helpful to us in our study of this matter.

Sincerely yours,

John H. Reed

John H. Reed
Chairman

Enclosure

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

For Release: 6:30 a.m. December 10, 1974 ISSUED: December 10, 1974

Forwarded to:

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-74-115 & 116

The National Transportation Safety Board is investigating the durability of CF6 engines with drilled fan blades. During its investigation, the Safety Board has discovered problems with the tail engine installation (No. 2 position) of wide-bodied, three-engine aircraft. The Safety Board is concerned about the consequences of foreign object damage to high-bypass ratio turbofan engines, and believes that corrective action is needed.

In December 1973, during severely cold weather, fan blades were damaged on the tail (No. 2) engines of four DC-10 aircraft. The Safety Board believes that this damage was caused by the ingestion of ice which had accumulated in the inlet duct. To alleviate this problem, the McDonnell Douglas Corporation issued Service Bulletin 71-46 which provides for a 3/4-inch-diameter drain hole to be added to the transition ring area, to improve the inlet draining capability of the tail engine. Although this service bulletin may alleviate the problem partially, there is no assurance that all operators will comply. In addition, there is no assurance that the drain, itself, will not be blocked by ice.

The presence of ice in the tail engine inlet of the DC-10 or L-1011 can only be determined by inspection of the inlet duct immediately forward of the fan. In addition to the inlet inspection guidance provided in FAA Handbook 8340.1A, Change 5, Appendix 10, the Safety Board believes that a specific inspection of the tail engine inlet area immediately ahead of the fan should be required for DC-10 and possibly for L-1011 aircraft.

On August 23, 1974, the FAA issued Airworthiness Directive 74-18-17 which required that a main fuel hose shield be installed for the No. 2 engine on all G. E. powered DC-10 aircraft. This shield prevents fan blade fragments from damaging the fuel line. On October 15, 1974, the AD was amended to apply only to those airplanes powered by G. E. engines with drilled fan blades. During its investigation, the Safety Board found that the nacelle of a Northwest Airlines DC-10 with JT9D engines had been damaged by fan blade fragmentation which was probably caused by ice ingestion. The JT9D engines have solid fan blades. Therefore, the Safety Board believes the AD should not have been limited.

Most in-service damage to large fan engines is caused by bird ingestion. We have made bird-control recommendations to the FAA in the past, and much has been accomplished through the Airport Development Aid Program and by other FAA efforts such as those detailed in FAA Order 5200.5, dated October 16, 1974. However, the potential hazard to wide-bodied aircraft created by bird ingestion demands even more attention to the problem of bird control. The Safety Board urges, therefore, that the FAA continue to emphasize its environmental factors bird-control program, as well as place increased emphasis on other promising bird-control programs.

In view of the above-mentioned hazards involving the tail-engine area, the National Transportation Safety Board recommends that the Federal Aviation Administration:

1. Issue an Airworthiness Directive which requires that the tail engine inlet duct (No. 2 position) be modified to prevent ice from accumulating in the ducts of DC-10 aircraft. The AD also should include a requirement, until the duct is modified, for a preflight inspection to be made after precipitation during cold weather to assure (1) that ice in the inlet duct area immediately forward of the fan is detected and removed; and (2) that the fan rotates freely. Also, consider extending these requirements to the L-1011 aircraft.

2. Amend AD 74-18-17 (Amendment 39-1951 dated 10-15-74) to require fuel line protection for all DC-10 aircraft, regardless of the engine installed.

Our Bureau of Aviation Safety staff is available for consultation if desired.

REED, Chairman, McADAMS, THAYER, BURGESS, and HALEY, Members, concurred in the above recommendations.

By John H. Reed
Chairman

D. Comment

The Subcommittee took an unusual step in referring this matter to the National Transportation Safety Board for study and evaluation after the FAA had decided that no safety problem existed. It did so not because the Subcommittee felt the CF-6 engine is unsafe. Rather, conflicting data and views within the FAA itself caused critical questions to remain unanswered and left the Subcommittee no alternative but to seek the additional expert opinion of the Safety Board. The advent of wide-body passenger aircraft and high bypass turbofan engines introduce new problems and potential for calamitous consequences which cannot be ignored. The Subcommittee felt that this was an area of sufficient importance to warrant the combined expertise of the FAA and NTSB.

The referral to the Safety Board now appears to have been fully justified and necessary in the best interests of safety. The Board has recommended to the FAA three courses of action, two of which involve the issuance of AD's. The Subcommittee urges the FAA to adopt these recommendations as soon as possible. It is noted that the Board's analysis is continuing and that final conclusions will be forthcoming when the study is completed.

Aside from the immediate safety issues, the Subcommittee's review of the engine matter further disclosed a pattern of the agency's regulatory deficiencies, particularly with respect to its certification procedures.

In 1970, prior to certification of the CF-6 engine, the first of the large turbofan engines which did not incorporate an anti-icing system, the Western Region and two of the country's foremost experts on jet engine icing, from the National Aeronautics and Space Administration (NASA), seriously questioned the adequacy of the icing tests conducted by General Electric under the observation of the Great Lakes Region. The primary objection was that flight conditions were not simulated during the icing tests. Shortly after the tests were questioned, four GE representatives met with four FAA headquarters personnel without those who had registered objection being present. Six days later, the FAA certificated the engine without further testing or consultation with those in disagreement.

Similarly, in 1971, when the DC-10 was undergoing icing flight test certification, questions regarding the adequacy of the testing arose. When the plane was flown into acceptable icing conditions

for the first time, two engines were damaged. The FAA estimated the damage as "moderate to severe." Thereafter, in two meetings with the FAA, Douglas attempted to avoid further icing flight testing since in its view no safety problem was involved. The FAA prevailed and one additional flight was flown. The plane encountered less severe icing conditions in this instance, however, than was the case in the first aborted flight thus giving rise to the question of whether the two flights were comparable. 13/ No damage occurred and the plane was certificated shortly thereafter.14/

It is the Subcommittee's view that when the FAA is engaging in its critical function of certificating an engine or an aircraft, it must resolve any doubts on the side of caution. It did not do that in this instance. The CF-6 engine had drilled turbofan blades and a different anti-icing capability than previous engines. The FAA should have required simulated flight testing before certificating the engine. Moreover, when damage to the engines occurred during the icing flight test of the aircraft, additional testing under comparable conditions should have been required of the manufacturer.

13/ As to the significance of severity of the icing conditions encountered in the second flight, the Subcommittee was again confronted with two inconsistent expert opinions. In the view of one FAA witness, the lesser severity of the icing conditions on the second test meant only that ice accumulation was slower. But, since the same amount of ice was allowed to build up on the surfaces of the aircraft, he testified, the two tests were comparable. Opposed to this is information contained in FAA files reviewed during the course of this investigation which maintains that the quality of ice is significant, and that this is determined in part by the rate of accretion. Thus, ice which accumulates over a long period of time is likely to be less troublesome (rime ice) and less likely to do damage should it be ingested into the engine than ice which forms comparatively rapidly (clear ice). The Subcommittee has called this consideration to the attention of the NTSB as part of its referral of this matter to the Board.

14/ Two years later during the only icing flight test of the A-300B Airbus, both CF-6 engines were damaged. According to FAA files, one of these engines suffered "moderate to heavy" damage.

When the engine and later the aircraft encountered certification difficulties, the respective manufacturers of each descended on the FAA to forestall further testing and to expedite the certification process. This can no doubt be expected, but the FAA must resist any such pressures to shortcut its procedures. There can be no accommodation when considerations of safety must be paramount.

Despite the reservations which the Subcommittee feels about the certification process, it does wish to point out that a large number of qualified experts have now reviewed the background and characteristics of this engine and pronounced it safe. A further review, performed at the Subcommittee's request, is underway by the Safety Board. As noted above, the Board has recommended certain AD action in connection with its yet to be completed review of this matter. In raising the questions it has as to FAA procedures, the Subcommittee does not take the position that the CF-6 engine is unsafe. On that point, the Subcommittee defers to the qualified opinions of technical experts.

In view of the fact that the National Transportation Safety Board has publicly recommended AD action to the FAA, the Subcommittee has decided to make public its record in this matter.

V. REVIEW OF CERTAIN AIRWORTHINESS DIRECTIVE MATTERS

FAA regulations pertaining to airworthiness directives state in part:

> "A primary safety function of the FAA is to require correction of unsafe conditions disclosed in a product after type certification ... the airworthiness directive (AD) is the medium used by the Administrator to provide notice to aircraft operators and to prescribe the conditions and limitations including inspections under which the product may continue to be operated.
>
> "ADs logically divide into two categories ... (a) those of an emergency nature requiring immediate compliance which are issued in the Federal Register as immediate adopted rules and, if warranted, are issued initially by telegram directed to operators or their designated agents ... (b) those of a less urgent nature requiring compliance in a relatively longer period of time, which are issued first as notices of proposed rulemaking.
>
> "FAR 11 Amendment 11-6 delegates to Regional Directors the authority to issue AD's and grant exemptions from the provisions of AD's.
>
> "In order to assure that each AD is technically adequate and completely justified, all interested organizational segments of FAA should have an opportunity to review it and participate in its development .. for these reasons, it is desirable to have a Review Board comprised of personnel from the appropriate segments of Flight Standards, Aircraft Engineering, Regional Counsel, and any other office which the Regional Director deems necessary, carefully consider each AD prior to rule drafting by the Regional Counsel."

AD's have the force of law. Briefly stated, the procedure for issuing an AD in a Regional Office is as follows: When an engineer has sufficient information upon which to base the belief that an AD is necessary, he initiates action after obtaining his Branch Chief's concurrence. The project engineer obtains an AD project number from

the Executive Secretary of the AD Review Board, and a date is scheduled for presentation to the Board. At the same time, the "Advance Information Record" is prepared and forwarded to the appropriate industry contacts. This includes the product manufacturer and, as appropriate, such organizations as Air Transport Association, Air Taxi Operators, General Aviation Manufacturers Association, etc.

The project engineer then coordinates the proposed AD action with appropriate segments of industry. When the AD involves a transport category airplane, the coordination includes the ATA and the airframe manufacturer. The project engineer is expected to make a thorough investigation of all technical and administrative considerations before presentation to the AD Review Board. This includes such things as determining total numbers of aircraft affected (domestic and foreign), parts availability, recommended inspection techniques, man-hours, etc.

Coordination with principal industry contacts is effected again following the AD Review Board meeting to keep them apprised of the FAA decisions. Valuable inputs are sometimes received as a result of this post-meeting coordination which may improve the final AD. If the Board agrees with the AD proposal, the project engineer coordinates with the Regional Counsel and prepares the AD for final publication. After the AD is signed by the Regional Director, it is transmitted to Washington and the FAA's communications center in Oklahoma City for distribution to interested operators.

The Subcommittee staff conducted a spot review in the Western and Northwest Regional offices, which cover the three largest airframe manufacturers (Boeing, Douglas and Lockheed), of recent AD projects which resulted in no AD being issued. Several preliminary observations are in order at this point.

There are certain disturbing aspects to the manner in which proposed AD's are sometimes handled by the FAA. On occasion, industry representatives actually attend AD Review Board meetings in response to FAA invitation and present their views, although they are not present when the Board makes its decision whether or not to issue an AD. The Subcommittee understands that this is a relatively new innovation by at least one region, the Western Region. While there are no provisions in FAA's regulations

prohibiting the presence of industry representatives at AD Review Board meetings, neither are there provisions providing for their attendance. The Subcommittee is of the opinion that the FAA has ample opportunity in most instances to obtain the necessary data, information and views from industry prior to the Review Board's meeting and that industry representation at these deliberations is unnecessary, unwarranted, and undesirable. Certainly, if the information is relevant and material it should be provided and considered in advance of the decision making process. The presentation of industry positions and data virtually simultaneously with the rendering of agency decisions of such vital importance to the public does not appear well designed for proper evaluation and analysis of such data.

It is especially undesirable when industry opposes issuance of an AD and the FAA ultimately concurs, because an inference might be drawn that the FAA was unduly influenced in its decision, or gave added weight to the industry's position, because of its presence. Finally, industry representation at deliberations which are solely the FAA's responsibility could result not only in the appearance of undue pressure being exerted on the FAA, but in such pressure actually being brought on the agency.

The Subcommittee is of the belief that if industry spokesmen are allowed to attend AD Review Board meetings, then consideration should be given to inviting a representative of the press or consumers' advocate group to insure that the public interest is safeguarded and to preclude any appearance of undue influence.

Moreover, the Subcommittee has witnessed too many instances wherein the FAA has decided against issuing an AD and instead relied on industry assurances that a safety problem would be corrected by specific dates in accordance with a service bulletin, only to find out later that the assurances were not fulfilled. By taking this course of action, the FAA abrogates its responsibility and allows the industry to assume control over a matter that Congress intended the agency to handle. A manufacturer's assurance, no matter how well-intentioned, cannot guarantee that the operators will comply with modification contained in a service bulletin. This FAA deference to self-regulation demonstrates the agency's tendency to lean too heavily on industry in areas where it should lead. Experience has shown that self-regulation should not supplant AD action when fleet-wide corrective steps must be taken in the interests of safety.

In addition, it is distressing to see the FAA's lack of follow-up when it elects to allow a manufacturer to correct a safety problem in lieu of issuing an AD. When self-regulation is permitted in an area which, even though indirectly, is related to safety, an even greater responsibility falls upon the FAA, as well as the manufacturer and operators, to insure full prompt compliance with the agreed-upon corrective action. When this question was raised with Western Region officials, the Subcommittee staff was advised that a position was being created to oversee industry compliance.

Finally, the Subcommittee is concerned when the FAA, solely on the basis of industry information, grants extensions of compliance times to industry in instances where there must be heavy reliance on human factors to prevent accidents until such time as a proper mechanical "fix" can be accomplished. It is usually to industry's economic advantage to have the compliance time as long as possible. When a safety problem exists which warrants corrective action, then the FAA must give particular attention to insure that any compliance period, or extension thereof, is fully justified and within the bounds of continued safe travel.

Set forth below is a review of several AD projects which, with one exception, resulted in no AD action.

A. Lockheed L-1011
Hangups of the Left Rudder Pedal
(Western Region AD No. 73-20)

In May 1973 Lockheed pilots reported rudder pedal hangups during production predelivery flights. The effect of the hangup was to render the pedal inoperative. The cause was determined to be the left-hand rudder panel outboard edge contacting the flight station side kickshield panels splice area.

May 30, 1973 - Lockheed issued an alert to all L-1011 operators.

May 31, 1973 - An FAA Inspector, Wilmington, Delaware, reported that prior to final approach at Philadelphia, an L-1011 crew heard a "clunk" sound and the Captain's rudder pedal became immobile. The First Officer's rudder pedal operated normally,

and when actuated, it, in turn, worked the Captain's pedal. When the Captain's pedal became jammed, the First Officer made a normal landing. At start of taxi inbound, the First Officer's pedal also became inoperative.

June 4, 1973 - FAA Washington issued a GENOT (a General Notice containing instructions to FAA field personnel) instructing FAA Inspectors to insure that their L-1011 operators received the Lockheed alert of May 30, 1973 and recommending a one-time inspection to insure no rudder pedal hangup.

Lockheed issued an Alert Service Bulletin calling for replacement of the existing flight station side kickshield panels with new ones.

June 6, 1973 - A project engineer from the Western Region was assigned to the matter and an Advance Information Record was sent to ATA and Lockheed concerning a proposed AD (AD No. 73-20) to require replacement of the side kickshield panels in accordance with Lockheed's Service Bulletin.

June 8, 1973 - The AD Review Board met and decided to issue an immediate AD requiring, unless already accomplished, an interim inspection as outlined in Lockheed's Alert Service Bulletin within 25 hours after publication of the AD. If discrepancies were found, the interim modification should be installed. It was determined that 50 L-1011 aircraft were involved and that 6-8 man hours would be required to install the kits. The Board decided to reconvene after information pertaining to kit availability and times to install these kits were determined. "AD will be issued after Board reconvenes."

June 13, 1973 - The AD Review Board met and four Lockheed representatives were present. It was reported that three separate incidents involving hangup of pilot's left rudder pedal had been reported. Lockheed participated in meeting and announced that kits would now be available by July 6, 1973, instead of August 31, 1973, as previously reported. Lockheed assured FAA that all L-1011's would be fitted with new panels by their first "C" check after kits become available, or January 1, 1974, whichever occurred first. Lockheed also

assured FAA that interim inspections would be made on all aircraft per the service bulletin, and that Lockheed would provide FAA with progress reports of the retrofit program. AD Review Board then decided that AD would not be issued, and that if progress reports indicated any unreasonable delay, then AD action would again be contemplated.

June 19, 1973 - Lockheed letter to FAA Western Region confirmed the Lockheed retrofit program which was orally presented at the June 13, 1973 AD Review Board meeting.

In May 1974, the Subcommittee staff interviewed the project engineer in the Western Region who handled this matter. He advised that sometime in November or December 1973, Lockheed notified him by telephone that all L-1011 operators had complied with the retrofit program except Trans World Airlines which had experienced some scheduling problems for the retrofit. Lockheed assured the project engineer that TWA would be completed by January 1, 1974. The project engineer could locate no progress reports submitted by Lockheed and had no notes of his own regarding the date of the telephone call or the subject matter discussed. He prepared no memorandum for the files following receipt of the telephone call from Lockheed. The extent of his knowledge of this matter was what he was able to recall of a telephone call made six months earlier. He made no further follow-up with Lockheed to determine if TWA had, in fact, accomplished its retrofit by January 1,1974, but "assumed" they had since he had not heard otherwise from Lockheed.

Comment

There are disturbing aspects to the manner in which Western Region handled this matter. First, four Lockheed representatives attended the AD Review Board meeting (at their request) and gave assurances that the retrofit would be accomplished by specific dates in accordance with their own Alert Service Bulletin. In response to these assurances, the Ad Review Board decided to entrust the matter to Lockheed and not issue an AD. By this action, the Western Region abrogated its responsibility and allowed the industry to assume control over a matter that Congress intended the FAA to handle. A manufacturer's assurance, no matter how well-intentioned, cannot guarantee that the operators will comply with

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modifications contained in a service bulletin. There is no indication that the FAA's action compromised safety in this particular instance. Yet, the action demonstrates the agency's tendency to lean too heavily on industry in areas where it should lead.

In addition, it is distressing to see the FAA's absence of interest or follow-up in the manufacturer's retrofit program involving a safety issue. While there is no indication that compliance was delinquent in this case, the FAA's indifference would have precluded knowledge about delays if they had existed. The episode is typical of a casual attitude which is entirely out of keeping with the seriousness of the subject matter, or the potential consequences to the public. It is an attitude which runs through much of the agency and which must be eliminated.

B. Lockheed L-1011
APU Exhaust Shroud Seal Replacement
(Western Region AD No. 74-7)

Information came to attention of the Western Region that the auxiliary power unit (APU) exhaust shroud seal did not meet fireproof criteria. It was determined that seal failure or deterioration could permit fuel to enter the afterbody of the airplane during certain types of starts, e.g., a second attempt following an aborted start, etc. A fire could then ensue in this area if some exhaust duct failure (hole, crack, etc.) existed.

February 15, 1974 - Advance Information Record advised Lockheed and the ATA that an AD was under consideration to require seal replacements in accordance with a Lockheed Service Bulletin issued to correct the problem. It was proposed that the modification be accomplished at the next "C" check, but not later than 1,800 flight hours after the effective date of the AD. It was noted that the AD Review Board was scheduled to meet on February 25,1974.

February 25, 1974 - A letter from Lockheed to the Western Region referred to a meeting held at the FAA on February 22, 1974. Lockheed reiterated its proposal to have the APU exhaust shroud seal integrity visually inspected within 30 days following receipt of the Service Bulletin; repeat visual inspection of seal each 1,500 flight hours until new seals were

installed; install new seal within 4,000 flight hours following receipt of the Service Bulletin. Lockheed advised that it would report both inspection and seal replacement accomplishments quarterly to the FAA. Lockheed requested FAA approval of the proposal.

February 26, 1974 - The AD Review Board met. There were 55 L-1011's in service which had the unacceptable seal installed. Approximately eight man-hours were required to replace the seal. The Board noted Lockheed's proposal for replacement of the seal in lieu of an AD. The Board observed, however, that a non-compliance item involving the L-1011 type design can only be corrected legally by AD corrective action. An AD was proposed requiring: (1) an initial visual inspection within 100 hours and a repetitive inspection at 500 hour intervals until the seal is replaced; (2) the seal to be replaced within 1,500 hours; and (3) an operating limitation prohibiting starting of the APU in flight. It was decided to withhold completion of the AD until after release of the Service Bulletin which needed further coordination with the ATA and approval by the FAA. An AD Review Board meeting was scheduled for March 5, 1974, "to finalize AD."

March 4, 1974 - A letter from Lockheed to the Western Region advised that a new seal replacement program "has been negotiated" with all foreign and domestic operators, calling for (1) visual inspection within next 100 hours following receipt of Service Bulletin; (2) reinspect each 500 flight hours until new seals installed; (3) install new seal within 1,500 flight hours following receipt of Service Bulletin; (4) install placard on APU control panel prohibiting APU starts in flight except as needed to meet an emergency condition; and (5) review the Aviation Flight Manual. Lockheed stated it would report inspections and seal replacements to the FAA quarterly.

March 5, 1974 - The AD Review Board met and decided that it would not issue an AD. The Board noted that Lockheed would follow the proposal contained in its letter of March 4 and would report compliance progress to the Western Region.

March 13, 1974 - Lockheed issued its Service Bulletin providing for seal replacement.

On May 22, 1974, the Subcommittee staff interviewed the project engineer to determine the extent to which modifications under the Service Bulletin had been accomplished in the fleet of 55 L-1011's.

Lockheed supplied its first progress report on April 19, 1974 (after approximately 300 flight hours which is roughly equivalent to a month's time). At that time, the Service Bulletin work had been completed on ten aircraft and the 100 hour inspection had been performed on 15 others. Thus, after approximately 300 hours flight time, the inspection to be performed before 100 hours of flight time had not even been accomplished on 30 L-1011's.

Lockheed furnished an updated progress report by telephone on May 16, 1974 (after approximately 600 flight hours). The seal replacement work had been completed on 21 of the 55 planes. However, eight planes still did not have the 100 flight hour inspection. There was no indication that the second inspection to be conducted after 500 flight hours had even been considered for any of the 34 planes which had not been modified.

The project engineer acknowledged that the most urgent aspect of the work to be performed under the Service Bulletin was the first-time inspection within 100 hours flight time. Yet, no follow-up action had been initiated by the FAA to determine why the delinquencies were being incurred and, at the very least, when the first-time inspections would be completed.

Comment

This is another case where the FAA was about to issue an AD when it decided to defer to self-regulation by Service Bulletin. In this instance, the industry failed miserably in keeping its commitment to inspect within certain specified times to insure that an unsafe condition had not developed. Fifteen percent of the fleet had not been given the most critical first-time inspection within 600 flight hours when industry had assured that it would be performed within 100 flight hours. It is difficult to understand, particularly after the worst air disaster in history

had just occurred (DC-10 crash, Paris, March 4, 1974), that the FAA would permit such a serious delinquency to occur in the first instance. It is incomprehensible that the FAA did nothing to correct the situation once the broken commitment became known.

C. Lockheed L-1011
Oxygen Mask Drop Reliability
(Western Region AD No. 73-37)

During an Eastern Airlines (EAL) L-1011 flight, it was determined that oxygen should be dispensed to the passengers. When an attempt was made to deploy the oxygen system, however, some oxygen masks failed to drop from the storage compartments, some of which were located eight feet above the cabin floor. As a result of this incident, the FAA Washington issued a GENOT to its inspectors to check the latching and Lockheed issued certain service bulletins to correct the problem.

November 27, 1973 - A letter from the Western Region to Lockheed, referencing correspondence regarding a partial list of L-1011 operator programs for incorporating passenger oxygen system design improvements, advised that Lockheed's program to accomplish implementation of the service bulletins in delivered aircraft was incomplete and did not provide adequate assurance of incorporation of the required modifications. The letter concluded: "Accordingly, we are taking steps to process an AD in this matter. Any additional information you may wish to submit on this subject will be duly considered."

December 21, 1973 - A letter from Lockheed to the Western Region agreed that a definite program had not been provided. According to the letter,the remaining airline commitments had now been received and dates for accomplishment of the modification by individual airlines were set forth. The letter concluded by stating that since all foreign and domestic L-1011 operators had agreed to responsible programs for incorporation, "we trust it will no longer be necessary for you to process an airworthiness directive in this matter."

January 18, 1974 - The Western Region notified ATA and Lockheed that the AD Review Board would meet on January 22, 1974 to consider the problem, pointing out that miscellaneous passenger oxygen system descrepancies can cause failure of passenger oxygen doors to open properly and/or failure of oxygen masks to drop freely. It was further pointed out that in lieu of an AD, the project engineer had suggested that Lockheed's proposal to incorporate the service bulletin was satisfactory, provided Lockheed could supply evidence periodically indicating the program was progressing at a rate which would result in completion within the timeframe advocated.

January 22, 1974 - AD Review Board met. The Board agreed with the project engineer's proposed action and suggested that Lockheed report every 30 days on the progress of the service bulletin modifications.

February 4, 1974 - Western Region letter advised Lockheed that its proposal was satisfactory if evidence supplied that program was progressing at rate resulting in completion within the timeframe specified. Reports were to be submitted beginning March 1, 1974, with following reporting periods on the 15th of each succeeding month. Letter concluded: "Please advise this office if this arrangement is satisfactory."

March 7, 1974 - Lockheed replied to Western Region's letter of February 4, 1974, and advised that Lockheed would provide the service bulletin accomplishment information requested by the FAA. This letter also served as Lockheed's initial report and noted the accomplishment by two airlines. Lockheed advised that the second report would be provided on or about April 15, 1974.

The Subcommittee staff interviewed the project engineer on May 22, 1974 to determine the progress of the service bulletin accomplishment. He advised that Lockheed furnished him handwritten notes on April 30, 1974 as its submission for the second report which was due on April 15, 1974. These notes reflected that, in all, there were 38 L-1011 aircraft subject to the service bulletin modifications. Of these 38 airplanes, 17 had been completed (all three service bulletins), 8 had been partially completed, and no

modification work had been performed on the remaining 13 belonging to four different airlines. The project engineer advised that Lockheed's third report, due May 15, 1974, had not been received to date. At the staff's request, he called Lockheed and learned that 11 additional aircraft had been completed and that as of May 22, 1974, 10 remained to be completed. Lockheed advised it would confirm this in writing.

Comment

This case further illustrates one of the regulatory deficiencies evident in the DC-10 cargo door matter. When an AD Review Board decides to resolve a safety question through industry self-regulation rather than through AD action, there is no assurance that corrective measures will be taken which are consistent with the high standards of safety that must be maintained.

Lockheed's assurances to the Western Region concerning completion schedules for modifications under the service bulletin were not met and the FAA did not raise this issue with the company. In its letter of December 21, 1973, Lockheed advised the FAA of certain modification completion dates prior to May 1974. None of these commitments were fulfilled. As of May 22, 1974, ten planes remained to be completed, half of which should have been completed the previous month.

Moreover, it is disturbing to note that at the time of the Subcommittee's staff inquiry, none of the three agreed-upon progress reporting dates had been met by Lockheed.

The Subcommittee is not criticizing the Western Region for failing to issue an AD. It possesses insufficient information to make that judgment. The Subcommittee contends, however, that when self-regulation is permitted in an area which, even indirectly, may be related to safety, an even greater responsibility falls upon the FAA, as well as the manufacturer and operators, to assure full, prompt compliance with the agreed-upon corrective action.

D. Douglas DC-10
Failure of Passenger Door Emergency Air Motor Clutches
(Western Region AD No. 73-1)

On January 16, 1973, FAA's Western Region notified Douglas Aircraft Company of proposed AD action to require the replacement as soon as possible, of passenger door air motor clutch assemblies on all DC-10 aircraft manufactured prior to April 3, 1972. Seven failures of air motor clutches had been reported, the most recent on December 3, 1972 during an emergency evacuation test. Faulty clutches cause doors to be inoperative during an emergency and may cause a catastrophic incident during emergency evacuation. Air motor clutch assemblies manufactured subsequent to April 3, 1972, were not considered faulty due to an improvement in torque load.

Two FAA inspectors recommended AD action. Douglas had an Alert Service Bulletin pending which called for testing and eventual replacement of all suspect clutches; however, Western Region did not consider this action to be rapid enough and initiated proposed AD action.

The Review Board met on January 17, 1973. At that time, the Aircraft Engineering Division felt that the Douglas proposed plan of corrective action was acceptable and would provide the necessary "fix" at least as soon as would be achieved through issuance of an AD. The Douglas proposal included supplying all necessary parts and completing all tests and inspections within 30 days from the date of the Alert Service Bulletin. The Board unanimously agreed that this matter constituted a "safety problem" and concluded that the Douglas proposal was acceptable provided the company would concur that all corrective action would be completed by February 20, 1973, and would provide FAA with an appropriate letter stating compliance had been completed by that date.

A letter setting forth the Board's position was sent to Douglas on February 6, 1973.

On February 20, however, the FAA ascertained that only partial compliance (less than 25 percent) had been accomplished at that time. Moreover, Douglas issued its service bulletin on January 25,

but downgraded it from Alert to Routine. Accordingly, the Review Board determined on February 21 that the issuance of an AD was then warranted to assure that full compliance would be achieved within a reasonable time limit. Douglas objected to the issuance of the AD; however, the Review Board decided on February 26 to issue one, compliance being required within 300 hours' time in service after the effective date of the AD.

By letter dated March 1, 1973, Douglas advised Western Region of the intent of DC-10 operators to comply with the requirements of the service bulletin. Based on this information and the fact that all doors have a manual opening capability, Douglas reiterated its position that it did not feel an AD was warranted. Douglas further advised that it appeared that all affected aircraft would be purged of the suspect air motors before formal AD compliance would be required.

The Review Board was reconvened on March 5, 1973 to consider, at the Regional Director's request, the latest proposal by Douglas. An AD had been prepared, but the Regional Director had withheld his signature in view of a telephone call he had received earlier, on March 5, from the Douglas Director of Regulatory Affairs/FAA Liaison, requesting that the AD not be issued. The stated reason was that Douglas felt it could achieve compliance through company efforts within the same timeframe. After the Board assembled, the Douglas official was reached by telephone and a conversation was conducted on a speaker-phone between this official and members of the Review Board. The Board requested that he reiterate the Douglas position and proposal, which he did. Later in the day, the Douglas official was advised that for FAA to consider the Douglas proposal, Western Region would need a letter from the company outlining their plan of action and including a commitment as to accomplishment of the retrofit. The Douglas official indicated he did not know if he could comply with that request, and asked for time to clear the matter with his company.

The Review Board again met on March 6 to consider a draft of a proposed letter which had been received from Douglas by telephone. The Board felt the letter was unacceptable as to the commitment aspects. Subsequently, another Douglas official proposed a revised draft letter which the Board found acceptable, with minor revision.

Further, it was the Board's feeling that the letter should be delivered by the next day so as to avoid further delay in the FAA's decision on the issuance of the AD. Two members of the Review Board then discussed the Board's decision with the Regional Director. It was concluded that the Douglas letter of commitment was acceptable. This decision was "influenced" by a telephone conversation between Mr. John C. Brizendine, then Executive Vice President of Douglas and the FAA Regional Director during which Mr. Brizendine assured the latter that accomplishment of the air motor replacement program by May 1, 1973, would have the full support of the Douglas Aircraft Company.

The Douglas letter of March 7, 1973, confirmed the operators' intentions to complete the retrofit on or before May 1, 1973, and stated that Douglas was "committed to ensure that DC-10 operators comply with Service Bulletin 52-56 in accordance with the schedule indicated." Douglas further advised it would provide weekly status reports to the FAA.

Between March 7 and May 1, 1973, Douglas furnished FAA with eight weekly status reports of the accomplishment progress. In its final letter of May 1, Douglas advised that no further reports would be furnished in this matter, unless requested by the FAA, as all DC-10 aircraft had been modified with the exception of one American Airlines plane (partially accomplished) and two Turkish Airlines planes (retrofit scheduled to commence on May 7, 1974.)

In its reply of June 1, 1973, Western Region advised Douglas as follows:

> "We were disappointed that your efforts to ensure that all DC-10 operators would complete the inspection/ replacement of passenger door emergency air motors ... on or before May 1, 1973 ... were not successful."

Douglas was requested to continue reporting the progress in this matter until retrofit was verified to be complete on all affected DC-10's.

Douglas replied by letter dated June 11, 1973, that the service bulletin had been accomplished on 66 of 69 DC-10 aircraft as of May 1, 1973, and that the American Airlines plane was com-

pleted on May 14, and the two Turkish Airlines planes had been inspected and replacement air motors were on order from the United States.

Western Region advised Douglas on July 6, 1973, that the action reported on the Turkish aircraft was considered satisfactory and the matter was considered completed.

Comment

This case again highlights the difficulties and deficiencies that can be encountered when the industry is permitted to self-regulate a safety matter. If the Western Region would have issued an AD in February or even March, as it proposed, compliance would have been effected at a much earlier date than actually occurred. The Board initially felt that the "safety problem" was of sufficient gravity to call for correction by February 20, 1974. The files reflect no lessening of the safety problem during the succeeding months; rather, an increasing industry pressure to allow self-regulation.

This particular matter, in many ways, is similar to the DC-10 aft cargo door "fix". On that occasion the President of Douglas and the FAA Administrator conferred by telephone. Assurances of compliance were also given and went unfulfilled; self-regulation prevailed in lieu of an AD.

It is interesting to note that when the Western Region agreed to accept the Douglas proposal for inspection/replacement of the air motors, rather than issue an AD, Douglas apparently decided to downgrade its pending Alert Service Bulletin and subsequently issued it as a routine Service Bulletin. At that point, the regulatory process began to deteriorate.

E. Boeing 747
Escape Slide Girt Bar
(Northwest Region AD No. 72-7)

This matter was precipitated by an incident that occurred on September 1, 1972, at JFK International Airport, New York, involving a B-747 operated by TWA. During an evacuation of the aircraft, the escape slide at the number 5 door separated from the air-

plane. The failure was attributed to a bracket which holds the girt bar to which the escape slide is attached.

This condition could cause possible injuries to passengers in addition to denying a door exit during evacuation.

September 14, 1972 - Boeing Company sent a wire to ATA and all 747 operators requesting a one-time inspection of all door girt bar bracketry. This inspection disclosed that 60 brackets were cracked.

October 15, 1972 - Boeing sent two Maintenance Tips to all 747 operators concerning the proper operation and maintenance of the doors. Boeing advised that the cracks in the brackets were due to overloads resulting from a jammed condition due to improper operation, improper girt bar installation, or foreign objects lodged under the girt bar.

October 17, 1972 - Northwest Region, FAA, sent Advance Information Record to Boeing and ATA advising that the AD Review Board would meet October 30 to consider issuing an AD to accomplish the following: within 600 hours, conduct initial inspection on doors 2, 4 and 5 (where bracket cracks were detected) for bracket cracks and replace all cracked aluminum casting brackets with identical dimensioned steel casting brackets. Within 5,000 hours, accomplish replacement of all aluminum casting brackets with steel ones.

October 26, 1972 - ATA advised Northwest Region that with one exception, all 747 operators felt the 600 and 5,000 hours compliance times in the proposed AD action were reasonable, assuming availability of parts. One carrier objected to imposition of an AD on the basis that a chronic problem does not exist and that replacement could be effected when the parts become available by attrition. Based on this, however, ATA felt that "an AD was not worth the paperwork."

October 30, 1972 - AD Review Board met. Project engineer pointed out that although it was recognized that improper door operating procedures may have caused the majority of the brackets to fail, better training probably would not give the desired results. He proposed that a Notice of Proposed Rule Making (NPRM) be issued requiring stronger brackets that could not fail as the best answer to this problem. The Board

decided that the NPRM would be drafted but not released to the Federal Register until Boeing had an opportunity to further discuss its position with FAA.

November 8, 1972 - At a pre-AD Review Board meeting, six Boeing and six Northwest Region personnel discussed this matter. Boeing noted that the basis for solution of this problem was the improved operational and maintenance techniques by 747 operators; that girt bar linkage contains several other elements which could fail even if the lifter brackets were strengthened; that the 747 fleet was being surveyed and cracked parts replaced; that Maintenance Tips were furnished to all operators in correcting operational and maintenance deficiencies; and that Boeing would monitor the fleet to verify that improved operational and maintenance methods would alleviate the problem.

The AD Review Board then met and the project engineer advised that a cracked girt bar lifter bracket will not cause the escape slide to become inoperative as it would take a completely broken bracket to do this. He recommended that AD action be "held in abeyance for an indefinite period of time to permit Boeing to self-regulate themselves." The Board's decision was "to hold the issuance of an AD in abeyance pending further results from Boeing in their endeavor to institute a corrective action program that will produce the desired results."

May 9, 1973 - Boeing submitted a status report to FAA on the matter and made the following points:

(1) The November 8, 1972 Review Board meeting caused postponement until May 11, 1973 of the decision concerning issuance of the AD;

(2) Issuance of the AD would be redundant because voluntary action by the industry is resolving the problem satisfactorily through

(a) inspection programs stricter than those proposed in the AD;

(b) removal rate of brackets was reduced by 85 percent;

(c) replacement schedules are earlier than those proposed in the AD.

(3) Retrofit was in progress and all airlines planned completion before February 1974 except

(a) Domestic - Pan Am and UAL

Pan Am - is inspecting girt bar engagement each flight and its removal rate was virtually zero (substantiated by spares usage).

UAL - is inspecting girt bar mechanism, including brackets, each 100 hours; has improved door operating procedures and training of personnel; incorporated service bulletins to improve door operation and reduce bracket exposure to damage; and is replacing cracked brackets with the stronger parts.

(b) Foreign - the KSS group

There is no further information in the files of the Northwest Region indicating that any additional action was taken in this matter. Apparently, Boeing's status report of May 9, 1973 was accepted and approved without further action of the Board.

Comment

This is a rather unusual matter in that Northwest Region elected to hold the AD action "in abeyance for an indefinite period of time to permit Boeing to self-regulate themselves."

The indefinite period of time turned out to be six months, although there is no indication in the AD file when the date of May 11, 1973 was established. This seems to be a rather lengthy period of time, particularly in light of the initial attention given this safety problem by the FAA during October and November 1972.

The Subcommittee has no information to suggest that this matter would have been handled any differently by AD action, and in this regard, Boeing contends that its inspection programs were

stricter and its replacement schedules were earlier than those proposed in the AD. Experience has demonstrated, however, that self-regulation should not supplant AD action when fleet-wide corrective steps must be taken in the interests of safety.

F. Boeing 707
Horizontal Stabilizer to Elevator Contour Mismatch Can Result in In-Flight Pitching Oscillations
(Northwest Region AD No. 74-14)

On August 28, 1973, a Boeing 707 enroute from Honolulu to Los Angeles experienced longitudinal oscillations (porpoised) while descending through 22,000 feet about 35 miles west of Los Angeles. Over 50 oscillations occurred during about two minutes. The oscillations subsided as airspeed was reduced and the flight continued to Los Angeles without further difficulty.

Of the 152 persons on board, one passenger was injured critically and died two days later, and one flight attendant and two other passengers were injured seriously. These persons were standing in the aft coach section and were thrown repeatedly from floor to ceiling while the aircraft porpoised, sustaining fractures and internal injuries.

October 18, 1973 - NTSB advised FAA that while investigation of the accident was not yet completed, initial findings indicated that faults in the longitudinal control system might have been contributory. It was noted the same aircraft had been involved in a similar accident on July 18, 1972, near Windsor Locks, Connecticut, after climbing and leveling at 12,000 feet with the autopilot engaged. One stewardess was seriously injured when the airplane experienced a series of pitch oscillations that persisted for about 15 seconds. NTSB's findings at the time indicated an encounter with in-flight turbulence; however, the Board was now of the opinion that a longitudinal control system fault might have been contributory to the 1972 mishap as well.

NTSB recommended that FAA initiate the following interim actions: (1) issue an Air Carrier Operations Bulletin with applicable cautions and recommended pilot procedure regarding

such instability; (2) issue an AD requiring all 707's be subjected to an elevator breakout force check and any found to exceed maximum allowable values be further inspected to insure elevator balance panel seal compression was not excessive; and (3) require changes in the 707 Maintenance Manual to specify more precise methods for measuring and adjusting the components involved.

November 2, 1973 - FAA advised NTSB that issuance of an Operations Bulletin might be confusing and that an AD was not appropriate at that time, but that these recommendations would be reconsidered upon completion of the investigation. With regard to changes in the Maintenance Manual, FAA advised that Boeing agreed that accurate measurement of balance seal compression was difficult and would work toward an improved procedure.

March 4, 1974 - FAA advised NTSB that as a result of tests conducted, two revisions to the Maintenance Manual would be made and an Operations Bulletin would be issued. FAA expressed the belief that this would be a satisfactory solution to the problem.

May 15, 1974 - NTSB advised FAA it was aware that Boeing intended to establish new tolerances, modify Maintenance Manuals, and issue a service bulletin to require inspection and accomplish modification, if needed, but felt FAA action was required to insure that corrective measures were implemented. Accordingly, NTSB recommended that FAA issue an AD (1) specifying new tolerances; (2) describing procedures for measuring; (3) requiring inspection of all 707's at next scheduled maintenance visit; and (4) modifying any aircraft found to be out of tolerance.

May 22, 1974 - FAA advised NTSB that an AD covering the Board's four recommendations was currently being prepared for early adoption, with the exception that the time of inspection might not be at the next scheduled maintenance visit since that time would differ between operators. FAA advised that a time of inspection would be established to achieve timely coverage and might be expressed in terms of flight hours.

May 22, 1974 - Northwest Region's AD Review Board met and decided to issue an NPRM which would require inspection and adjustment of the horizontal stabilizer to elevator contour mismatch and elevator balance panel seals within 1,000 hours time-in-service.

June 11, 1974 - Northwest Region issued NPRM advising that AD was being considered to correct in-flight pitching oscillations which might occur in 707 and 720 aircraft. Comments were solicited from interested persons by August 1.

July 8, 1974 - Boeing advised Northwest Region that no AD was needed in its opinion because (1) erratic pitching motion would occur only if four conditions were fulfilled, (2) possibility of these conditions existing at the same time was remote (known occurrences of erratic pitching motion were four in 24 million hours of 707/720 flight), and (3) a Boeing Operations Manual Bulletin was issued April 22, 1974, advising flight crews of amplified procedures were followed, no cases of erratic longitudinal pitching should occur.

Boeing further advised that if FAA considered that an adopted rule (AD) was necessary, in spite of evidence to the contrary, the words "Within 1,000 hours time-in-service from the effective date of the AD ..." be deleted and replaced with wording that would permit accomplishment at the next normal maintenance period when the elevators were removed. Boeing gave as its reason for this proposed change its belief that no safety problem exists if crews are informed and airplanes are within original tolerances.

Boeing further stated its belief that past FAA policy on issuing AD's has been appropriate, in that AD action has been implemented not only where there has been a flight safety concern, but also where a reasonable probability exists that other incidents might occur; i.e., isolated incidents have been treated as such. Boeing also felt that a policy of full justification for each AD issued is highly essential to prevent an accumulation of undue burdens being placed on the operators. For these reasons, Boeing reiterated its belief that no AD was necessary.

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July 1974 - Boeing issued Service Bulletin in mid-July recommending inspection and adjustment of the contour mismatch of the upper surfaces between the horizontal stabilizer and elevator, and suggesting this be accomplished at a normal maintenance period during which the elevators were being removed.

August 13, 1974 - Northwest Region's AD Review Board met and decided to issue an AD requiring inspection and adjustment of the horizontal stabilizer to elevator contour mismatch by September 1, 1976 in accordance with Boeing's Service Bulletin. It was noted that the compliance time (by September 1, 1976) was established "through coordination with ATA and consideration of existing operations information" and that the "compliance date [was] compatible with ATA recommendations."

August 20, 1974 - Northwest Region issued AD which states in part: "FAA proposed a compliance time of 1,000 hours time-in-service from the effective date of the AD; this was considered to be unduly restrictive by the commentators. FAA, after review of the matter, agrees that the compliance time can be revised; accordingly, the AD provides that accomplishment of the corrective action must be made by September 1, 1976."

The AD also states: "Another comment pointed out the chain of events which must take place before erratic longitudinal pitching oscillations can occur. The FAA recognizes the probabilities involved; however, the fact remains that all of the necessary anomalies have actually combined to produce the in-flight incident which precipitated this action. Such erratic longitudinal pitching oscillations can be and have been hazardous. Therefore, FAA has determined that the necessary corrective action must be taken."

Comment

The FAA's handling of this AD matter raises certain questions. In its communication to NTSB in May 1974, FAA advised that an AD was being prepared and that the time-of-inspection might not be at the next scheduled maintenance visit since that time would differ between operators. Further, that a time-of-inspection would be established to achieve timely coverage and might be expressed in terms of flight hours.

This appeared to indicate the FAA was considering a relatively shorter timeframe for inspection compliance, an indication which was actually reflected in the FAA's NPRM of June 11, 1974, which proposed that inspection and adjustment be accomplished fleet-wide within 1,000 hours time-in-service. Yet, the AD which issued in August 1974 extended the compliance time from 1,000 hours (about 3-4 months time-in-service) to two years. Justification for this extension was the fact that the operators considered the 1,000 hours "to be unduly restrictive."

Despite the comments filed by the manufacturer/operators in response to the NPRM citing the relatively few incidents of this problem (four in 24 million flight hours) and the opinion that no safety problem existed since flight crews had been informed, through Boeing's Operations Manual Bulletin in April 1974, of amplified procedures specifically aimed at avoiding occurrence of the erratic pitching problem, FAA issued the AD stating: "... that irrespective of the small number of incidents involving these airplanes, a cause of unwanted pitching oscillations is inimical to the interests of safety and corrective action should be undertaken to preclude recurrence." In light of the FAA's stated position, the Subcommittee finds it difficult to comprehend why the FAA extended the compliance time for a period six or seven times longer than that originally proposed.

The Subcommittee recognizes that the FAA must rely, to a large extent, on industry's advice as to the availability of parts and their reasonable incorporation in aircraft consistent with probability factors relating to recurrence of a safety problem. The concern, however, is that it is usually to industry's advantage, due to economic considerations, to have the compliance time as long as possible. The FAA's position is that it is not involved or concerned with the dollars and cents factors in any economics vs. safety considerations. Yet, the input FAA receives from industry as to availability and installation of parts <u>is</u> based on economic considerations. It is difficult to assess what influence, if any, this data has on FAA's decisions regarding compliance periods. It is noted, however, that time after time, the Subcommittee has witnessed extensions of proposed compliance times at industry's request, never a reduction of the corrective time period.

It would also appear that this is but another example, like the DC-10 cargo door problem, wherein the industry has placed heavy reliance on the human factor to avoid an accident until such time as a proper mechanical "fix" can be accomplished -- in this instance, inspection and adjustment of the component parts. Reliance on an Operations Manual Bulletin to alert flight crews to the problem and provide instructions for corrective action presupposes that a pilot will not only assimilate this information, but recognize promptly and react immediately to the problem, should it arise, anytime within the next two years.

The experience with the "peephole" interim corrective action on the DC-10 cargo door causes the Subcommittee to be wary of industry reliance on the human factor, as a prolonged substitute for a mechanical "fix." The Subcommittee is not desirous of having undue burdens placed on manufacturers/ operators by the FAA at anytime. On the other hand, when an in-flight problem occurs whose hazardous consequences warrant AD action, as the FAA determined in this instance, then any extension of the compliance period beyond the shortest and most reasonable that could be accomplished, is to tamper with the public safety.

VI. EMPLOYEE ACCEPTANCE OF GIFTS, ENTERTAINMENT AND FAVORS

This Subcommittee has long been concerned that officials and employees of the regulatory agencies conduct the public business entrusted to them in a manner which, both in form and in substance, justifies continued public confidence in the administrative processes of our government. The regulatory agencies falling within the jurisdiction of this Subcommittee individually and collectively administer laws which affect the safety and quality of life of all Americans. The public expects that these laws will be administered in an effective and even-handed manner; they have a right to expect this and, in these days especially, we must react strongly to conduct which casts doubt on the fairness and impartiality of the administrative process.

The acceptance of gifts, entertainment and favors by members and employees of regulatory agencies has been a recurring problem over the years. It has sapped public confidence in the fairness and impartiality of government. Despite widespread publicity which has occasionally resulted when specific instances have been disclosed in the past, the episodes have continued.

Particular care should be taken that this kind of fraternization is not tolerated with respect to regulatory activities which may have a bearing upon public safety. The Subcommittee's examination of FAA activities and procedures did not specifically address itself to the issue of adherence to the agency's regulations on employee acceptance of gifts, entertainment and favors. Nevertheless, one instance of questionable employee conduct was noted.

The FAA employee, a supervisory engineer assigned to a regional office, accepted from an industry representative lunches and dinners on many occasions over a period of several years. At times, the employee was the recipient of other entertainment and gratuities as well. The company records of the industry representative document over 50 such instances of entertainment. When confronted with them, the FAA employee denied some of them but indicated there were still others which were not reflected on the list of entertainment shown to him.

During the period of association, the FAA employee had the responsibility of decision making with respect to a number of official FAA matters involving this particular individual and the company he represented. The areas of FAA business were important. FAA approval was sought concerning a number of products directly related to safety. Moreover, companies which had been represented by this individual were subsequently the subjects of airworthiness directives.

The Subcommittee found no evidence of special treatment being given in response to the gratuities. When interviewed, both the FAA employee and the industry representative denied any impropriety. Nevertheless, such activity is both improper and frought with danger.

The FAA's regulations clearly forbid this kind of fraternization. Title 49 of the Code of Federal Regulations provides in part as follows:

> Subpart B - ETHICAL AND OTHER CONDUCT AND RESPONSIBILITIES OF EMPLOYEES
>
> § 99.735-7 GENERAL
>
> " (a) Each employee shall avoid any action, whether or not specifically prohibited by this part, which might result in or create the appearance of --
>
> (1) Using public office for private gain;
> (2) Giving preferential treatment to any person;
> (3) Impeding Government efficiency or economy;
> (4) Losing complete independence or impartiality;
> (5) Making a Government decision outside of official channels; or
> (6) Affecting adversely the confidence of the public in the integrity of the Government."
>
> * * * * *
>
> § 99.735.9 GIFTS, ENTERTAINMENT, AND FAVORS.
>
> " (a) Except as provided in paragraphs (b) through (e) of this section, no employee may solicit or accept, directly or indirectly, any gift, gratuity, favor, entertainment, food, lodging, loan or other thing of monetary value from a person or employer of a person who --

(1) Has, or is seeking to obtain, contractual or other business or financial relationships with the Department,
(2) Conducts operations or activities that are regulated by the Department.
(3) Has interests which may be substantially affected by the performance or nonperformance of that employee's official duties.

(b) Notwithstanding paragraph (a) of this section, an employee may --

(1) Accept a gift, gratuity, favor, entertainment, loan, or other thing of value when the circumstances make it clear that an obvious family relationship rather than the business of the persons concerned is the motivating factor;
(2) Accept food or refreshment of nominal value on infrequent occasions in the ordinary course of a luncheon or dinner meeting or other meeting or on an inspection tour if the employee is properly in attendance ..."

The Subcommittee believes the proper operation of a democratic government requires that regulatory decisions and policies be made within the prescribed regulatory framework and that officials responsible for those actions be independent and impartial.

It would appear that this kind of fraternization with the industry may be even more insidious than outright bribery because of the obscurity of its motivation and the subtlety of its effect. In its more sophisticated form, this activity may not even include a request for a favor. Rather, the extension of amenities and courtesies in the form of free transportation, hospitality and adjuncts to gracious living can create a climate more conducive to rendering decisions or taking actions more favorable to the industry.

The Subcommittee has no interest in making what may be an unjustified example of the individuals involved. The specific details of the situation noted by the Subcommittee have been provided to the FAA Administrator for appropriate further review.

The Subcommittee is concerned, however, with the possible implications of the situation. At best, the conduct noted displays an insensitivity to the importance of preserving both the form and the substance of impartiality and absence of favoritism. While

this may well be an isolated example, it raises a question as to whether the FAA has sufficiently impressed upon its employees the fact that acceptance of frequent gratuities, favors, and entertainment violates the agency's standards of conduct. Strict adherence to those standards must be insisted upon in an agency charged with heavy responsibilities so directly bearing upon the public safety.

The Subcommittee, therefore, takes this opportunity to publicly call upon the FAA Administrator to see to it that the agency's standards of conduct are clearly understood and adhered to.

VII. AIR TRANSPORT OF HAZARDOUS MATERIALS

A. Introduction

Each year the number of air shipments of hazardous materials increases, resulting in a growing safety problem. Today, the types of hazardous cargo allowed on aircraft include acids, live viruses, explosives, and radioactive materials.

These factors, coupled with the increase in serious incidents involving the air transport of hazardous materials, both on cargo planes and passenger aircraft, during the last several years, prompted the Subcommittee to conduct investigation and hold hearings on April 25 and 30, 1974, to inquire into the effectiveness of procedures and safeguards established by Federal agencies to regulate and administer this potentially dangerous and highly complex area of aviation safety.

It was anticipated that further inquiry and a comprehensive report on this matter would be issued by the Subcommittee; however, in view of the recent reorganization of the House of Representatives, which requires that aviation oversight jurisdiction be transferred to another Committee, such an effort is uncertain at this writing. Accordingly, a summary of pertinent data developed by the Subcommittee during its inquiries into hazardous materials matters is being included in this report.

B. Recent Air Incidents Involving Hazardous Cargo

(1) Delta Air Lines - Radiation Exposure (April 1974)

On Friday, April 5, 1974, a shipment of radioactive material (iridium 192, used in industry x-ray of materials), consigned from an engineering firm in Virginia to a supplier in Louisiana, was transported on Delta passenger flight 311 (Boeing 727) from Washington National Airport to Atlanta,where it was unloaded and stored overnight in a Delta warehouse.

On Saturday, April 6, the shipment was transported on Delta passenger flight 585 (Douglas DC-9) from Atlanta to Baton Rouge, where it was stored in a Delta warehouse over the weekend and picked up and delivered to the consignee on Monday, April 8.

Through detection instruments, the consignee discovered that the shipment was leaking radiation. When the outside container was unpacked, it was determined that the radioactive material was in an unshielded position in the box packed within the container. Investigation by the Office of Hazardous Materials, Atomic Energy Commission (AEC), and FAA determined that the shipment was improperly packed at the engineering company.

A total of 213 persons were possibly exposed to radiation from this shipment including 158 passengers and 55 airline and freight forwarding personnel. These persons were urged to have blood samples taken for examination to determine the amount of radiation exposure. There is no indication that any of these persons received excessive dosages of radiation. In June 1974, the AEC imposed civil penalties amounting to $8,000 against the engineering firm for violations of AEC regulations pertaining to improper packaging of the radioactive material in its special container.

(2) Crash of Pan American Cargo Plane - Nitric Acid (November 1973)

On November 3, 1973, smoke filled the cockpit of Pan American flight 160, a scheduled jet cargo plane (Boeing 707) enroute from New York to Frankfurt. The aircraft attempted to land at Boston, but went out of control, crashed and burned, killing all three crew members. The NTSB conducted investigations and held hearings concerning this accident, but at this writing has not issued its findings as to probable cause. Investigation indicates that an in-flight fire may have been caused by nitric acid that was improperly packaged and stored aboard the aircraft.

Included in the flight's cargo were numerous chemicals including 160 containers of nitric acid, 60 of sulfuric acid, and 50 of hydrofluoric acid. FAA regulations require that nitric acid be shipped in glass bottles within a metal container packed with a noncombustible mineral-cushioning material. Nitric acid packages recovered at the crash site consisted of glass bottles with plastic caps, packed in wooden boxes with sawdust used as the cushioning material. Sawdust, of course, is highly combustible and tests conducted after the accident disclosed that leakage of a bottle of nitric acid into the sawdust produced large quantities of smoke and temperatures sufficient to melt the bottles and ignite the wooden boxes.

Further, some of the wooden boxes were improperly stored aboard the aircraft. The boxes did not carry the marking "This Side Up" or "This End Up," although two arrows were stenciled on all four sides suggesting how the packages were to be oriented. The boxes were stacked on metal aircraft cargo pallets, but in order to match the contour of the freight stacked on the pallets with the contour of the fuselage, some of the boxes were laid on their sides.

(3) Delta Air Lines - Radiation Contamination (January 1972)

Liquid radioactive material (Molybdenum 99) leaked from a bulk shipment on board Delta passenger flight 925 on December 31, 1971, while enroute from New York to Texas. The aircraft, a Convair 880, was contaminated and 917 passengers traveled aboard the plane on some 15 flights before the leakage was discovered and the aircraft was removed from service on January 2, 1972.

The aircraft was decontaminated at Atlanta and placed back in service on January 3. On January 6, one week after the incident and more than three days after decontamination, the airplane landed at Tampa where it was checked for radioactivity and was found to be contaminated. The aircraft was returned to Atlanta for further checking. Two spots were discovered in the cargo bin that produced contact readings. The interior lining of the fuselage was removed, no contamination was found, and the airplane was returned to service.

Delta conducted a contamination survey of the passengers' luggage. Several suitcases examined in Chicago had spotty contamination, and a few spots of contamination were found in the homes of these passengers.

C. Magnitude of Problem

(1) Number of Shipments

There is no accurate data available concerning the amount and type of hazardous materials transported by air or the number of flights carrying such cargo. In 1973, it was estimated that over 950,000 packages of radioactive material were transported in this country (compared to an estimated 200,000 packages in 1961), of which some 780,000 were carried on aircraft, the majority on passenger planes. Most of the air shipments are radiopharmaceuticals

for medical diagnostic and therapeutic uses in hospitals and doctors' offices. Even among the various other modes of transport there are only estimates as to the volume of hazardous materials carried.

This fact alone -- that there is no accurate information as to the amount, type and frequency of hazardous cargo shipped by particular mode -- is indicative of the indifference with which Federal agencies, especially the FAA, have treated this problem over the years. On principle, it seems impossible that effective and realistic regulation can be forthcoming while the dimensions of the problem -- the very subject matter which is to be regulated -- remain matters of conjecture and speculation.

In early 1974, the FAA did undertake a nationwide survey of the extent of air shipments of hazardous materials. This study was based on a random sampling of cargo load manifests and was conducted over a 30-day period. It entailed examination of more than 150,000 individual load manifests representing about 100 operators at some 400 airports. The purpose of the survey was to determine the percentage of departures of both cargo and passenger flights on which both hazardous and radioactive materials were being carried, as well as to measure such activity at selected major airports.

Preliminary data from the survey reflects that in passenger operations about three percent of the departures carry hazardous materials and one percent carry radioactive materials. The percentage of departures of passenger flights with hazardous cargo ranges higher for selected major airports, with a high of 13.2 percent at Newark.

The question arises as to the accuracy of the FAA's survey. The agency claims that with a confidence level of 95 percent the survey has an accuracy within plus/minus three percent of the actual percentage. This, of course, presupposes the validity and accuracy of the document being examined in the random sampling -- in this case, the cargo load manifest. The FAA acknowledges that non-sampling error does occur in surveys of this type and that principally this is human error that includes (1) not marking the cargo load manifest; (2) computational errors; (3) duplicate counting of records; and (4) packages not properly marked.

It is not possible to measure the effect of this type of error on the survey figures. It is possible, however, to speculate that the effect could be considerable, particularly in light of collateral information. For example, in March and April 1974, the FAA conducted an inspection of air carrier and freight forwarder facilities at four major airports. This inspection revealed that in all, 240 discrepancies were discovered in 62 of the 70 shipments observed. The discrepancies were: documentation: 47; marking: 47; certification: 47; labeling: 48; and packaging: 51.

Significantly, so far as the above survey is concerned, some of the discrepancies relate directly to the non-sampling type error cited in the FAA's survey, i.e., not marking the cargo load manifest (documentation), and packages not properly marked (certification, labeling and marking). Thus, with a remarkably high discrepancy ratio of 89 percent in this small and limited inspection of 70 shipments, the Subcommittee can only surmise that the accuracy of the 150,000 cargo load manifests examined in the survey were themselves largely inaccurate.

The Air Line Pilots Association (ALPA) has also challenged the validity of the FAA's survey based on the use of cargo load manifests. ALPA representatives have determined that most airlines do not mark the cargo load manifests when hazardous materials are being shipped in accordance with FAA regulations; in actual practice, the manifests are used for various purposes by different airlines; and some carriers use the manifests to record the weight and balance computations of the cargo.

Thus, when FAA examined some 150,000 cargo load manifests as the basis for its survey, it was using a form which does not accurately reflect the data it is supposed to contain -- namely, the presence of hazardous cargo aboard a particular flight. ALPA is of the opinion that FAA should have examined, as the basis for its survey, the form used in notifying the pilot in writing when hazardous cargo is aboard, also an FAA regulation, which is maintained on file by the carrier for a specified period of time.

2. Studies on Number of Violations

The Federal Aviation Act of 1958 authorizes FAA to regulate air shipments of hazardous cargo and to impose civil and criminal sanctions for violations.

On May 1, 1973, the General Accounting Office (GAO) issued a report to Congress entitled "Need for Improved Inspection and Enforcement in Regulating Transportation of Hazardous Materials" in which it concluded that the Department of Transportation needed to improve its inspections and enforcement program to insure compliance with regulations for the safe transport of hazardous cargo. GAO further stated that the Department's program was handicapped by (1) a lack of basic data on hazardous materials movements; (2) a small and unsystematic inspection effort; and (3) inadequate enforcement actions.

GAO made the following findings with specific reference to FAA:

(1) As of June 30, 1972, FAA had 834 operations inspectors whose duties included surveillance over compliance with hazardous materials regulations;

(2) FAA did not have a program for systematic and routine inspection of air shipments of hazardous cargo;

(3) FAA placed primary reliance on air carriers' accepting only those hazardous materials shipments that met requirements;

(4) FAA did conduct a small number of routine inspections and also when complaints were received; and

(5) FAA did not maintain statistics on the number of such inspections.

GAO cited the July 1971 interagency study of air shipments of radioactive materials conducted by AEC and HEW in six cities which disclosed that of 300 packages inspected, 175 violated FAA regulations.

Regarding FAA enforcement, GAO examined records of enforcement actions available in FAA's New York and Los Angeles regions. These records showed that, during the 21-month period ended March 31, 1972, 16 civil cases were initiated against either shippers, freight forwarders or carriers for 70 violations of hazardous materials regulations primarily as a result of incidents reported to the FAA. Records were not available for similar reported incidents which may have involved violations but did not result in penalty proceedings.

As of June 1972, penalties totaling $10,050 had been assessed in seven of the cases ranging from $250 to $3,000, four cases were closed without fine, and five cases were pending.

GAO concluded that because FAA did not maintain a readily identifiable record of its hazardous materials inspections, there was no basis for evaluating the effectiveness of FAA's enforcement actions when violations were found.

The AEC, in a joint study conducted in 1969 with DOT and the Public Health Service, surveyed about 300 packages of radioactive material in transit at six major airports. More than half of the packages were in violation of Federal standards.

A second group of studies were conducted by AEC in 1973, in cooperation with DOT. The first survey was to evaluate radiation levels in regular operating aircraft at Chicago O'Hare and Boston Logan Airports over four consecutive weeks during May and June 1973. The latter study was to establish a relationship between the total transport index and the resultant radiation levels in the passenger and crew compartments on regular flights. While the Chicago data were within acceptable limits, the radiation levels in some aircraft at Boston were higher than expected. Data on package placement related to the higher radiation levels in Boston indicated personnel were not loading packages of radioactive material in accordance with FAA regulations.

Following this survey, FAA took steps to correct the noncompliance by carrier loading personnel and Logan Airport was resurveyed during October-December 1973. Data collected in the second survey indicated the levels of radiation had been reduced significantly and complied with regulations.

While the number of studies conducted on hazardous materials violations has been limited, it highlights an alarming fact: Violations were detected in over half of the packages examined.

Concern over the safe transport of hazardous materials by air is apparently shared by the traveling public. The August 12, 1974 issue of Aviation Week and Space Technology reported:

"Frequency of questions by passengers as to whether aircraft cargo areas contain radioactive or other potentially hazardous materials is increasing. Gate agents, flight deck and cabin crews at both Delta and Eastern Airlines are reporting several inquiries each day on whether or not potentially hazardous cargo is being carried on passenger flights. 'A year ago,' one airline official said, 'we might get one question, maybe two, a month. Now we're getting that many a day.'"

D. Division of Authority

One reason for the inadequacy of regulation and enforcement in the area of hazardous materials is the division of authority among several departments and agencies. No single agency has the jurisdiction to devise policies or to regulate shippers of hazardous materials and the various carriers which transport the cargo. Although DOT has the regulatory responsibility for the safe transportation of all hazardous materials in interstate and foreign commerce, the operating administrations of DOT have direct authority for regulating the various modes of transport.

In addition, nongovernmental regulations governing hazardous materials are issued by private associations, such as the American Trucking Association and the International Air Transport Association. The proliferation of regulations which emanates from the various governmental and nongovernmental agencies leads to a great deal of confusion and to overlapping of jurisdiction and creates areas which are ignored because no jurisdiction is asserted.

Under the present division of authority, the FAA has primary jurisdiction for regulating air carriers in the transportation of hazardous materials including radioactive materials, from the time they are tendered for shipment, during shipment, and until delivery to the consignee or another mode of transport.

The FAA has the authority to make rules governing packaging, labeling, classification and marking of hazardous materials containers. The FAA also conducts training and education programs for shippers, carriers and the agency's own personnel. Inspection of air carriers for compliance with hazardous materials regulations

and enforcement of such regulations is also FAA's responsibility. These two areas -- inspection and enforcement -- are the most important in assuring safety in the transport of hazardous cargo; yet they appear to be the weakest in terms of present agency regulation.

E. Complexity of Regulations

The regulations governing the transportation of hazardous materials by air and other modes are complex and voluminous. These regulations are scattered throughout the U. S. Code and the Code of Federal Regulations.

The Subcommittee recommends that FAA and OHM take steps to simplify and index all hazardous materials regulations so they can be easily located and comprehended by the shippers, manufacturers and air carriers who use them.

The Code of Federal Regulations is difficult to use and, moreover, it is not being used. Certainly, a primary reason for the lack of knowledge and lack of compliance with regulations is the fact that the regulations are so voluminous and complicated. They should be redrafted so that they are intelligible, carefully indexed, and easy to use.

F. Inadequate Inspections

The FAA's inspection record of hazardous materials shipments has been notably poor in the past. During 1971-72, for example, FAA conducted only 571 hazardous cargo inspections, despite the fact that such checks were part of the responsibilities of the more than 800 operations inspectors then employed by FAA.

In 1973, the agency conducted a total of 9,073 hazardous materials inspections. This significant increase in the number of inspections, while commendable in itself, nevertheless highlights two points: the inspection record of 1971-72 looms even more deplorable, and the 9,073 inspections conducted in 1973 produced only 237 violations processed for noncompliance, or 2.6 percent. This clearly suggests that despite the increased number, the caliber and thoroughness of the inspections were inordinately poor. No other conclusion can be drawn in light of the studies mentioned above which disclosed that violations were detected in over half of the packages examined.

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(1) No checklist - FAA regulations governing air shipments of hazardous materials contain a myriad of rules and procedures dealing with documentation, labeling, marking, packaging, storing, certificating, and transporting this sensitive cargo. The regulations are complex in nature, difficult to understand and interpret, and nearly impossible to retain by memory. Even FAA inspectors specifically trained in hazardous materials matters have difficulty recognizing violations due to the thousands of hazardous products being shipped by air today.

Because the inspection of hazardous cargo shipments is a demanding and difficult assignment, the Subcommittee feels that inspectors should be equipped with some form of basic checklist to help simplify their task. Incredibly, no such checklist existed on an agency-wide basis prior to the Subcommittee's hearings in April 1974. This is indicative of the indifference with which FAA Headquarters has viewed hazardous materials matters over the years. Despite the apathy in Washington, the Subcommittee staff discovered that there are personnel in some FAA regional offices who have taken the initiative and are attempting to do something about the problem.

Several weeks prior to the Subcommittee's April hearings, the staff interviewed the hazardous materials coordinator in the FAA's Western Region Office concerning the daily problems encountered in inspecting hazardous cargo. He advised that this is such a complicated area of responsibility that he could not operate efficiently without a checklist. Accordingly, he devised such a checklist several years ago for use by the air carrier inspectors in the Western Region and subsequently furnished copies to other regional offices and FAA Headquarters. To his knowledge, no action was taken by Washington and no system of checklists was implemented throughout the FAA.

During the April hearings, the following questions on this point were put to Mr. Joseph Ferrarese, Chief, Flight Operations Division, FAA Headquarters (page 326):

> "Mr. MANELLI. Does FAA or any of the area regional offices supply any sort of checklist for these inspectors to use when they are going through their inspections on cargo?
>
> Mr. FERRARESE. Some regional offices supply checklists. We have developed one nationally which we are

about to send out to the field.
Mr. MANELLI. When is that going to be released?
Mr. FERRARESE. Within 30 days."

In July 1974, FAA furnished the Subcommittee with a copy of a report containing an evaluation of the agency's hazardous materials program which was prepared by an FAA evaluation team and based on a study conducted by this team in March-April 1974. Included in the report is a "Suggested Checklist for Ground Surveillance" for use by FAA inspectors. The Subcommittee notes that this checklist is identical to the one devised by the hazardous materials coordinator in the Western Region and furnished to Washington some time ago.

(2) Positions Not Filled - In August 1973, FAA was authorized to establish 18 full-time hazardous materials positions in the regional offices; however, no follow-up was made in Washington to see that this was done. Moreover, no initiative or direction emanated from headquarters to formulate an effective hazardous materials program until early 1974, when the aforementioned nationwide survey was undertaken involving examination of some 150,000 cargo load manifests.

When the Subcommittee's hearings were announced in mid-April, FAA discovered that not all of the 18 full-time positions had been filled. Several days before the first hearing, FAA Administrator Butterfield issued instructions to the field to immediately assign personnel to these positions. Again, this typifies the past indifference at FAA, particularly on the staff level, toward hazardous materials matters. In addition, it reveals a basic FAA weakness -- lack of strong, centralized administrative authority which is essential to provide the impetus and coordination necessary to have a uniform, effective program.

(3) No FAA Radiation Detection Equipment - Although the FAA is responsible for regulating the air transport of radioactive material and has devised complex regulations which are designed to prevent passenger exposure to illegally high doses of radiation, the agency has not provided radiation survey equipment (Geiger counters) to its inspectors to insure the enforcement of such regulations.

The FAA has proposed a regulation which would require each air carrier to purchase radiation monitoring equipment and to check the radiation levels on passenger aircraft by monitoring equipment and to check the radiation levels on passenger aircraft by monitoring the amount in the passenger cabin prior to takeoff. This, however, does not in any way alleviate the necessity for FAA inspectors to have similar equipment and to conduct similar inspections. The FAA is an enforcement agency and cannot rely on the air carriers to do the job which the FAA was established to do. The FAA must have the proper equipment in order to determine whether air carriers have in fact made the required survey and whether their equipment is in proper working order.

Concern over reports that Federal regulations dealing with air shipments of radioactive materials were being violated at local airports has already prompted one municipality to adopt its own safeguards. On May 20, 1974, the Minneapolis-St. Paul Metropolitan Airports Commission passed the nation's first local radiation monitoring ordinance. This regulation was proposed by the Mayor of St. Paul in February 1974, and public hearings were held in April. Citing the lack of enforcement measures on existing controls as "a terribly dangerous situation which is a disgrace to this area and to our nation," Mayor Lawrence Cohen added, "It is frightening to realize that hundreds of thousands of air passengers and people working at airports are daily being exposed to levels of radiation which are unacceptable by anyone's standards."

Opponents of the proposed ordinance argued that it could be even more dangerous to delay shipping radioactive materials that are vital in the treatment of hospital patients. Nevertheless, the ordinance passed and requires registration of all incoming and outgoing packages containing radioactive materials and examination of the packages to determine their radioactive emissions. In the event the radioactivity of a package exceeds that allowed under Federal law, the package is detained and the Minnesota State Board of Health and the FAA are notified.

The action taken in Minneapolis-St. Paul represents the first serious effort at any airport in the country to enforce Federal regulations governing radioactive materials. The ordinance contains no provision which either conflicts with or is more restrictive than the Federal regulations. Ultimately, of course, Federal regu-

lation must provide the radiation safeguards on a national level that have been achieved in this single community's ordinance. A proper step in this direction would be for the FAA to equip its inspectors with radiation detection equipment so that Federal regulation is not abrogated in favor of self-regulation.

(4) Training of Inspectors - The FAA has done a good job in stepping up the training of its air carrier inspectors and others in hazardous materials matters during the last two years. The agency must now find a way to utilize to maximum efficiency the expertise of these trained personnel.

During 1973, FAA trained over 100 of its inspectors at the agency's training facility at the Transportation Safety Institute in Oklahoma City. By 1976, the FAA anticipates it will have trained approximately 435 of its inspectors in hazardous cargo matters. In addition, FAA and OHM have conducted 28 two-day seminars involving 2,900 persons, including air carrier personnel, shippers, law enforcement personnel and the like. These seminars are continuing throughout the country.

Training is the key to effective regulation of hazardous materials shipments. The success of any training program, however, is in the utilization of personnel once they have been trained.

G. Lack of Enforcement

Any analysis of FAA's enforcement record must necessarily include consideration of its inspection record. As stated previously, the FAA's record of inspections of hazardous cargo shipments has been notably poor over the years. In light of the previous surveys conducted in which violations of FAA regulations were detected in over half the inspections made, the Subcommittee can only conclude that the agency's inspection/enforcement efforts have been uninspired and ineffective.

As previously noted, only 237 violations were processed for noncompliance in 1973, out of 9,073 inspections conducted, a remarkably low enforcement record of only 2.6 percent. During the Subcommittee's hearings, FAA officials testified that there were a "great many more than 237 discrepancies observed" but that "many of

the alleged violations or discrepancies ... were taken care of on the spot with some minor corrective action or were dropped out by FAA regional attorneys as not being violations that could be proved in a court of law." (Hearings, p. 354). The FAA was unable to furnish the number of these violations that were observed but not processed as no records were maintained of such figures.

According to FAA, of the 237 violations that were processed, 36 civil penalties were imposed against carriers (17 pending), and 42 against shippers (25 pending). Fines collected amounted to $14,800 from carriers ($17,800 pending), and $16,500 from shippers ($37,700 pending). Administrative actions taken included 13 warning notices and 21 letters of correction to carriers, and 20 warning notices and 38 letters of correction to shippers.

FAA's action with respect to "discrepancies" which are "taken care of on the spot with some minor corrective action" is not the Subcommittee's interpretation of effective enforcement. Such "slap on the wrist" enforcement action is not conducive to promote future compliance, although unquestionably it is expedient. If enforcement is pursued vigorously and aggressively through imposition of civil penalties, the number of violations -- as evidenced by the various surveys -- will decrease. When pressure is applied in the form of civil penalty, shippers and carriers eventually will react. Sooner or later they will take steps to educate and instruct their personnel to comply with Federal regulations, with the result that the airways will be safer for the traveling public.

(1) Inadequate Penalties - One FAA position in defense of its enforcement record is that the maximum allowable civil penalty of $1,000 for each violation has not been increased since 1938. This is specious argument. While the Subcommittee concurs that the maximum civil penalty should be raised (there is, at this writing, a bill pending which would increase the maximum to $10,000 for each violation), it is FAA's responsibility to enforce the regulations with the penalties prescribed -- in this case, a maximum civil penalty of $1,000. This the agency has not done.

If the maximum civil penalty were raised to $10,000 and FAA pursues enforcement in the same lackadaisical fashion that has marked its performance to date, the agency will be no closer to obtaining compliance with the regulations it is entrusted to enforce.

(2) Carriers Reject Improper Shipments - No Record Made or Enforcement Action Taken - One problem area detected by the Subcommittee in air shipments of hazardous materials is that carriers will, on occasion, reject shipments at their receiving dock when the package and/or papers do not comply with FAA regulations. There is nothing, of course, to prevent the shipper from tendering the package to another carrier traveling to the same destination. The second carrier might well fail to detect the violation and accept the package for shipment. No record is made by the first carrier of the violation and no effective enforcement action can be instituted to correct the situation. Thereafter, the shipper might regularly use the second carrier whose vigilance in detecting noncompliance items is not as good as the first carrier.

The Subcommittee recommends that FAA require any carrier who rejects a shipment which does not meet hazardous materials regulations to call it to the attention of FAA immediately, if feasible, or impound the shipment until the agency can be notified, or, at the very least, make a record of the matter for referral to the FAA.

H. Comment

(1) Hazardous materials regulations are scattered throughout the U. S. Code and Code of Federal Regulations. They are complex and voluminous. They should be redrafted so that they are intelligible, carefully indexed, and easy to use and compiled under one cover.

(2) FAA should immediately equip its inspectors with radiation detection instruments (Geiger counters) so that they can personally determine,through periodic spotchecks, whether or not shippers and carriers are complying with regulations pertaining to the air transport of radioactive materials.

(3) The list of hazardous materials presently allowed on passenger aircraft should be reviewed and only those essential items, such as radiopharmaceuticals, should continue to be transported.

(4) FAA Headquarters must assume a more dynamic role in providing the leadership necessary to ensure an effective program of hazardous materials regulation. Checklists should be updated periodically and made available to every inspector in the field. Checklists should be maintained on file for a specified period of time to ensure (a) that inspectors are devoting a certain amount of their time to this important area of responsibility, and (b) to detect undesirable trends in noncompliance on the part of shippers and carriers.

(5) All enforcement action pertaining to violations and discrepancies, whether processed or not, should be made a matter of record for a specified period of time.

(6) Carriers rejecting improper shipments should be required to report such noncompliance to the FAA. Appropriate enforcement action should follow.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The United States can be justly proud and appreciative of the contributions made by the aircraft industry to the safety of air travel and to the Nation's economy. The pre-eminence of American commercial aircraft throughout the world has come about through the combined creativity, engineering and scientific talents, managerial expertise, and dedication on the part of the officers and employees of our great airframe and engine manufacturing corporations. Similar credit must be given to the generally high level of efficiency and concern for safety which has been characteristic of the operating air carriers.

The pre-eminent position which the United States has achieved in the production and operation of commercial aircraft has also been largely due to the high standards of Federal regulation pertaining to air safety which has been maintained over the years by the Federal Aviation Administration. The certification of new aircraft designs, and their subsequent operation and maintenance, has traditionally been accompanied by a high degree of regulatory activity designed to require and achieve the very highest degree of safety possible.

The indications, which have appeared relatively recently, of erosion in the agency's traditional insistence on excellence and attention to detail constitute a threat to public confidence and to the continued worldwide acceptance which has heretofore been accorded to American aircraft. It is time for the FAA to reassess all of its policies and procedures relating to air safety and to reaffirm the predominent and primary importance of this aspect of its regulatory mission.

The Subcommittee's recommendations, most of which have been mentioned in the text of the foregoing report, are repeated here in summation:

(1) In the future there must be no resort to non-regulatory procedures, self-regulation, or "gentlemen's agreements" in matters affecting air safety. Assurances of voluntary compliance, and reliance on service bulletins in lieu of Airworthiness Directives must not be employed in the future as they were in the case of the DC-10 cargo door problems.

(2) FAA policies and procedures must be realigned and improved so as to insure that all Airworthiness Directives, and all service bulletins affecting the safety of the aircraft, are completed before an aircraft is released for delivery from the manufacturer.

(3) FAA procedures and policies must be modified so as to insure that there is a free flow of information from, not only the prime contractor, but the major subcontractors of aircraft being developed for certification by the agency. Rather than passively await the presentation of facts and data from the prime contractor, the FAA should be more active in seeking out information and questioning both the prime and the subcontractors as to any reservations they might entertain concerning safety aspects of aircraft being developed for certification.

(4) Contractual arrangements which provide, expressly or by implication, that a subcontractor is prohibited from independently contacting the FAA concerning an aircraft under development, are contrary to the public interest and should not be countenanced by the FAA.

(5) The FAA should promulgate regulations which explicitly define the duty of both the manufacturer and the operating carrier to bring to the attention of the agency all service difficulties having a bearing on safety.

(6) A thorough review and study of the continuing service difficulties and the basic design characteristics of the DC-10 cargo doors should be conducted so as to verify that the highest possible degree of safety is being attained. In short, the closing, latching, and locking arrangement should be reconsidered from a safety standpoint.

(7) The FAA should explore the necessity of requiring all DC-10's, and other wide-bodied aircraft as well, to be modified so as to be more resistant to structural floor collapse brought on by rapid decompression due to openings in the fuselage. The McDonnell Douglas Corporation has devised a system for accomplishing this, and it will be incorporated into new production aircraft in 1975.

(8) Determinations on the part of FAA regional directors to issue Airworthiness Directives pursuant to delegated authority should not be overridden or countermanded except by written directive from the FAA Administrator or his designee.

(9) The FAA's response to recommendations by the National Transportation Safety Board (NTSB) needs to be improved. The FAA's failure to fully explore and consider the NTSB's recommendations immediately after the Windsor, Ontario, DC-10 accident did not serve the interests of safety. The Board's two-fold recommendation -- i.e., that the DC-10 doors be made foolproof and that measures be taken to prevent floor collapse -- are now receiving attention. The improved "closed-loop" DC-10 door design was not mandated by the agency until after the Paris crash. Attention is now being given to the question of installing relief vents and/or strengthening structural members to prevent floor collapse. The Safety Board's repeated calls for development of a Ground Proximity Warning System is another example of FAA unresponsiveness to NTSB recommendations.

(10) Earlier this year, concerning another matter, the Chairman of the Subcommittee recommended to the NTSB that it follow up its own recommendations in a more energetic fashion. This recommendation is equally applicable to questions affecting air safety. The NTSB recommendation pertaining to the DC-10 door and floor collapse problem was not met with a satisfactory response by the FAA and the NTSB did not effectively press for a definitive answer from the FAA as to the implementation of these recommendations.

(11) The report of the Ad Hoc Investigative Committee contains a number of recommendations to the FAA Administrator. It has not been practical for the Subcommittee to evaluate all of the recommendations of the Ad Hoc Investigative Committee, although some of them parallel recommendations which the Subcommittee is making in this report. The FAA, however, should carefully evaluate all of the recommendations in the Ad Hoc Committee's report. In addition, although not the subject of a specific recommendation in the Ad Hoc Committee's report, the proper role and function of manufacturer-employed, FAA Designated Engineering Representatives (DER's) should be reassessed. The same should be done with respect to manufacturer-employed FAA Designated Manufacturing Inspection Representatives (DMIR's). In the Ad Hoc Investigative Committee's report, DERs are

defined as "private persons who have been designated by the FAA to represent the Administrator," and have the function of assessing compliance with many sections of the type certification requirements. DMIR's are defined as "private persons who have been FAA approved and designated to represent the Administrator;" these individuals are given the primary function of performing the detailed inspections necessary for FAA airworthiness acceptance once the production certificate is issued. (Reference p. 5, 14, Ad Hoc Committee Report.)

(12) Industry representation at AD Review Board meetings appears to be a recent innovation in at least one region and is a practice of questionable desirability. Such private participation in an official deliberative process of such importance to the public carries the danger of creating both the appearance and the substance of undue influence. Unless these deliberations are to be conducted in public, they should be confined to those FAA officials who are charged with the responsibility of decision. Last minute assertions and submissions made during the course of an official deliberative process do not seem to offer the best technique for acquiring information regarding airworthiness and safety matters.

(13) The FAA normally establishes a compliance time, or extends a proposed compliance time, for correction of a safety problem solely on the basis of industry information. There are economic considerations that may affect industry's figures regarding availability and installation of parts and the "down-time" of aircraft involved. It appears industry feels it is to its advantage to have the compliance time as long as possible. When a safety problem exists that warrants corrective action, particular attention should be given by FAA to insure that any compliance period or any extension of the compliance period beyond the shortest and most reasonable period is fully justified. The FAA should verify industry's data.

One example should suffice. In this regard, during the Subcommittee's hearings on the CF-6 engine problem, FAA officials testified, allegedly on information furnished by the manufacturer, that the compliance time set forth in the NPRM could not be met because of production limitations of a subcontractor. The Subcommittee staff subsequently contacted the subcontractor and determined that the subcontractor's production capability was not

limited in this particular area, and that no inquiries had been made by the FAA. It would appear that the FAA should have attempted to verify production capacity before taking the position that the compliance time was impossible to meet.

(14) Following the accident of the Icelandic DC-8 at New York in July 1973, which was caused by the inadvertent deployment of the ground spoilers in flight, the FAA's Western Region commenced a review of the problem preparatory to issuing an AD. Engineering personnel in the Western Region could not locate in file reports of two similar crashes -- one in Canada in 1970 and the other in Russia in 1972. Copies of these reports were eventually obtained from FAA Headquarters -- four months after the July 1973 accident.

FAA Headquarters should insure that Regional Offices covering aircraft manufacturers promptly receive all foreign and domestic accident and incident reports concerning those aircraft for which they are responsible.

(15) Manufacturers Service Bulletins contain the statement that the bulletin is "FAA approved." Douglas issued Service Bulletin A52-35 as an Alert Service Bulletin to install the peephole in the DC-10 cargo door. Several weeks later, Douglas issued Service Bulletin 52-37, the initial mechanical fix for the cargo door, but this bulletin was issued as a routine notification, not an Alert. By definition, "Alert Service Bulletins shall be issued on all matters requiring the urgent attention of the operator and shall generally be limited to items affecting safety."

Certainly, Service Bulletin 52-37 related to safety. It provided the mechanical fix to correct the cargo door latching problem to prevent explosive decompression, floor collapse, and a repetition of the near catastrophic accident that occurred at Windsor, Canada. The FAA approved the issuance of this bulletin; yet, it was not an Alert bulletin.

Regardless of the manufacturer's opinion of the status of the bulletin, the FAA should insure that Service Bulletins issued in connection with safety matters and of an urgent nature are properly classified as Alert. In addition, the FAA should insure that the Alert Service Bulletin clearly sets forth the reasons why the bulletin is classified as Alert. Service Bulletin 52-37 made no mention of the safety problems involved.

(16) During its inquiries into air safety matters, the Subcommittee noted an undesirable tendency on the part of both the FAA and industry to rely, on occasion, on the human factor instead of a mechanical solution to correct a safety problem. For example, shortly after the DC-10 accident at Windsor, Canada, the manufacturer issued Service Bulletin A52-35 calling for the insertion of a one-inch viewing port in the cargo door to enable the ground crew to see whether it is properly latched. Several weeks later, the manufacturer came out with the first of a series of Service Bulletins, 52-37, designed to provide a mechanical fix for the latching problem. As one Douglas Vice President informed the Subcommittee staff, A52-35 was a means to doublecheck the door, while 52-37 was the mechanical correction to the problem. It is noted that the Turkish DC-10 that crashed near Paris had the inspection window in the aft cargo door.

Similarly, following the catastrophic accident of the DC-8 at Toronto, Canada, the FAA issued an AD requiring that a placard reading "Deployment in Flight Prohibited" be displayed in the cockpit near the ground spoiler lever. It was not until three years later, following the near catastrophic accident of the Icelandic DC-8 -- a plane which incidentally carried the placard in the cockpit -- that the FAA issued a second AD calling for a mechanical fix to the same problem, the inadvertent deployment of the ground spoilers in flight. As one Canadian air official termed the placard "fix," the FAA might just as well have said, "Do not crash this airplane."

In matters involving critical safety issues, the FAA and the industry should never attempt to resolve the problems through a "fix" that depends upon the human factor versus a mechanical correction. The Subcommittee believes that such a solution, no matter how expedient, is not worth the risk. All of us are human and we make mistakes. There can be no reliance on the margin of human error in matters of air safety; safety must be assured through foolproof designs.

(17) The Subcommittee has detected instances in the FAA's administrative practices wherein it fails to follow the progress of modifications called for in an AD. The agency's responsibility does not end with the issuance of an AD to correct a safety problem. It must insure that (a) modifications are accomplished on

all model aircraft affected, and (b) that such work is completed within the prescribed compliance period. The FAA cannot abrogate its responsibility to the manufacturer and rely upon his notification as to the carriers' modification progress. Accordingly, whenever an AD issues, the FAA Regional Office issuing the AD should require written certification that all modifications required have been accomplished within the prescribed compliance period for all aircraft affected, including those in-service, production-line, and pre-sale.

(18) AD's published by the FAA in the Federal Register contain a preamble setting forth the reason (safety problem involved and any accidents that have occurred therefrom) behind the issuance of the AD. The AD notice that FAA sends to the manufacturers, operators and any other recipient parties, however, is an abridged version which seldom contains this necessary information. The FAA's communication to these parties should also disclose the reason for the AD so that appropriate treatment will be accorded to them. The same requirement for adequate disclosure should be imposed with respect to manufacturer's service bulletins approved by the agency.

(19) The FAA urgently needs to reassess its research and development priorities in air safety. According to the President's Report to Congress (April 1974) concerning the Nation's progress in aeronautics and space activities for 1973, the FAA's principal research area involved mid-air collisions, the cause of approximately 2 percent of all aviation accidents. Other areas of research and development were also set forth. Yet, controlled flight into terrain type accidents, the cause of 56 percent of all aviation accidents throughout the world, were not mentioned.

(20) The Subcommittee urges the Administrator to reiterate to all FAA personnel, both in the field and at headquarters, the necessity for full and complete adherence to the agency's regulations and standards relating to the acceptance of gifts, entertainment and favors. Relationships of this kind create a climate more conducive to rendering decisions or taking actions more favorable to the industry, and erode public confidence in the impartiality and effectiveness of regulation affecting air safety.

(21) Of concern to the Subcommittee is the FAA's dual responsibility for passenger safety and for the economic well-being of the airline industry. The FAA must cease viewing passenger safety and the economic health of the airlines as competing interests to be balanced. The economic health of U. S. airlines and aircraft manufacturers relies upon public confidence in safety in the air. Unless the FAA gives first priority to its responsibility for passenger safety, the economic impact on the industry will be extreme and prolonged.

(22) It is the Subcommittee's view that when the FAA is engaging in its critical function of certificating an engine or an aircraft, it must resolve any doubts on the side of caution. It did not do that in icing tests conducted on the CF-6 engine and later on the DC-10 aircraft. The FAA should have required simulated flight testing by the manufacturer of the engine before certificating the engine. Moreover, when damage to the engines occurred during the icing flight test of the aircraft, additional testing under comparable conditions should have been required of the manufacturer. It would have seemed that should have been particularly so in this instance because the CF-6 engine which powers the DC-10 aircraft had drilled turbofan blades and an anti-icing capability different from previous engines.

(23) Hazardous materials regulations are scattered throughout the U. S. Code and Code of Federal Regulations. They are complex and voluminous. They should be redrafted so that they are intelligible, carefully indexed, easy to use, and compiled under one cover.

(24) FAA should immediately equip its inspectors with radiation detection instruments (Geiger counters) so that they can personally determine, through periodic spot checks, whether or not shippers and carriers are complying with regulations pertaining to the air transport of radioactive materials.

(25) The list of hazardous materials presently allowed on passenger aircraft should be reviewed and only those essential items, such as radiopharmaceuticals, should continue to be transported.

(26) FAA Headquarters must assume a more dynamic role in providing the leadership necessary to insure an effective program of hazardous materials regulation. Checklists should be updated periodically and made available to every inspector in the field. Checklists should be maintained on file for a specified period of time to insure (a) that inspectors are devoting a certain amount of their time to this important area of responsibility, and (b) to detect undesirable trends in noncompliance on the part of shippers and carriers.

(27) All enforcement action pertaining to hazardous cargo violations and discrepancies, whether processed or not, should be made a matter of record for a specified period of time.

(28) Carriers rejecting improper shipments for failure to comply with hazardous materials regulations should be required to report such noncompliance to the FAA. Appropriate enforcement action should follow.

(29) The FAA should, as rapidly as possible, require that Ground Proximity Warning Systems be required to provide warnings in cases of dangerous deviations from ILS glide slope. These accidents comprise one-fourth to one-third of all preventable controlled flight into terrain (CFIT) crashes and the recently promulgated FAA rule is severely deficient in its failure to provide for such capability. It appears to the Subcommittee that it is only a mtter of time before another commercial airline disaster will occur which might have been prevented by this presently available technology.

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APPENDIX A

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

CHAIRMAN'S REPORT TO THE ADMINISTRATOR

of the

AD HOC INVESTIGATIVE COMMITTEE

relative to

THE McDONNELL DOUGLAS MODEL DC-10 AIRCRAFT

CERTIFICATION HISTORY

and

SERVICE ACCIDENTS

APRIL 19, 1974

Oscar Bakke

OSCAR BAKKE
ASSOCIATE ADMINISTRATOR
FOR AVIATION SAFETY

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INTRODUCTION

By letter of March 5, 1974, the Administrator (AOA-1) directed the Associate Administrator for Aviation Safety (ASA-1) to set up and chair an "Ad Hoc Investigative Committee" to review thoroughly and carefully the pertinent certification history of the McDonnell Douglas Model DC-10 airplane as well as to investigate reports of all Model DC-10 accidents and/or incidents which bear even slight similarity to the Turkish Airlines (Turk Hava Yollari, i.e., THY) operated, Model DC-10-10 accident which occurred near Paris, France on March 3, 1974.

It appears that the THY accident was caused when the aft "bulk" cargo compartment door opened in flight at an altitude of approximately 13,000 ft. It further appears that loss of the door resulted in a high cabin pressure differential on the floor above the compartment, floor collapse, severance of vital controls located under the floor, and loss of aircraft control.

This report presents the results and findings of the committee review and presents the Chairman's recommendations to the Administrator for appropriate FAA action.

The Ad Hoc Investigative Committee members were:

Oscar Bakke; Chairman and Associate Administrator for Aviation Safety (ASA-1), FAA Headquarters, Washington, D.C.

M. Craig Beard; Chief, Safety Regulations Staff (AFS-110),
Engineering and Manufacturing Division
Flight Standards Service
FAA Headquarters, Washington, D.C.

Edward Griffin; Airframe Branch - Chief, Dynamics and Loads Section (AFS-124)
Engineering and Manufacturing Division
Flight Standards Service
FAA Headquarters, Washington, D.C.

Neil Eisner; Chief, Accident Counsel (AGC-42)
Litigation Division, Office of the Chief Counsel
FAA Headquarters, Washington, D.C.

Richard Sliff; Chief, Aircraft Engineering Division (AWE-100)
FAA Western Region, Los Angeles, California

Everett Pittman; Airframe Branch - Project Engineer (AWE-120)
Aircraft Engineering Division
FAA Western Region, Los Angeles, California

Francis Mosher, Jr.; Principal Maintenance Inspector (AIFO-NY)
International Field Office
FAA European Region, New York, N.Y.

Will H. Trammell; Systems and Equipment Section
Aeronautical Engineer (ASO-213)
Engineering and Manufacturing Branch
Flight Standards Division
FAA Southern Region, Atlanta, Georgia

Jonathan Howe; Regional Counsel (ANW-7)
FAA Northwest Region, Seattle, Washington

Ivan Connally; Airframe Section - Project Engineer (ANW-212)
Engineering and Manufacturing Branch
Flight Standards Division
FAA Northwest Region, Seattle, Washington

APPLICABLE RULES & CERTIFICATIONS

Type Certification Basis

The "type certification basis" (i.e., applicable regulations re FAR 21.17) of the McDonnell Douglas Model DC-10 series airplanes consisted of the following FAA regulations:

1) FAR 1; "Definitions and Abbreviations."

2) FAR 21; "Certification Procedures for Parts and Products."

3) FAR 25; "Airworthiness Standards: Transport Category Airplanes," effective February 1, 1965, as amended by Amendments 25-1 through 25-22 inclusive, plus Section 25.471 effected by Amendment 25-23.

4) FAR 36; "Noise Standards: Aircraft Type Certification," effective December 1, 1965.

5) Special Conditions No. 25-18-WE-7, issued January 7, 1970, plus Amendment No. 1, issued July 9, 1971. (Applicable to all versions of the Model DC-10 series airplanes.)

6) Special Conditions No. 25-46-WE-14, issued October 26, 1972. (Applicable only to the Models DC-10-40 and DC-10-30 series airplanes.)

7) Exemption No. 1573 regarding compliance with FAR 25.807(c)(5), issued April 28, 1972. (FAR 25.807(c)(5) relates to passenger emergency exits.)

Fail-Safe Philosophy

Perhaps the most important single principle which governs the transport category aircraft airworthiness standards of the United States is the philosophy of fail-safe design. This principle contemplates that, while each critical component or system element is required to perform functions within the design envelope of the aircraft, its failure will nevertheless be assumed. Accordingly, appropriate analyses and tests are required to insure that sufficient redundancy exists so that after single failure, redistribution of functions will occur to other components which are capable of assuming them safely. Exceptions are sometimes permitted, however, in cases of certain components possessing such considerable margins of safety, or

levels of reliability that their failure need not be taken into account. The objective of this philosophy in transport category aircraft certification is to insure that catastrophic consequences, i.e., loss of the aircraft, will not result from failure or malfunction of any single structural or system element unless the applicant for type certification "shows" (i.e., demonstrates to the satisfaction of the FAA) that the probability of failure would be "extremely remote." Determination of extreme remoteness is a matter of engineering judgement and, although it has not been quantitatively formalized in either the regulations or agency directives, it has frequently been associated with a probability of occurrence equal to or less than 10^{-9} (i.e., one chance in a billion).

Type Certification Program

FAA Type Certificate No. A22WE was issued to the McDonnell Douglas Corporation of Long Beach, California, on July 29, 1971, thereby approving the Model DC-10-10 airplane type design on that date. Type Certificate No. A22WE was subsequently amended three times on October 20, 1972, November 21, 1972, and March 30, 1973, for FAA approval of the Models DC-10-40, DC-10-30 and DC-10-30F airplane type designs respectively.

The original type certificate and subsequent type certificate amendments were issued by the Aircraft Engineering Division (AWE-100) of the FAA Western Region, located in Los Angeles, California. Procedures used were consistent with the standard type certification procedures defined by FAA Handbook 8110.4.

The function of assessing compliance with many sections of the type certification basis was delegated to McDonnell Douglas employed, FAA Designated Engineering Representatives (D.E.Rs.). (D.E.Rs. are private persons who have been designated by the FAA to represent the Administrator pursuant to Section 314 of the Federal Aviation Act and FAR 183.29.)

Pertinent Airworthiness Requirements - Cabin Pressure Containment and Protection from Rapid Decompression

The pertinent regulatory sections of the type certification basis, relative to design for cabin pressure containment and protection from rapid decompression, including provisions for door locking and reliability, consist of the following requirements:

1) FAR 25.365; Pressure Cabin Loads

"For each pressurized compartment for occupants, the following apply:

(a) The airplane structure must be strong enough to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting.

(b) The external pressure distribution in flight, and stress concentrations and fatigue effects must be accounted for.

(c) If landing may be made with the cabin pressurized, landing loads must be combined with pressure differential loads from zero up to the maximum allowed during landing.

(d) The airplane structure must be strong enough to withstand the pressure differential loads corresponding to the maximum relief valve setting multiplied by a factor of 1.33 omitting other loads.

(e) If a pressurized cabin has two or more compartments separated by partitions, bulkheads, or floors, the structure supporting the prescribed flight and ground loads (and any other structure that, if it failed, could interfere with continued safe flight and landing) must be designed to withstand the effects of sudden release of pressure in any compartment through an opening resulting from the failure or penetration of an external door, window, or windshield panel, or from structural fatigue or penetration of the fuselage in this compartment, unless it is shown that the probability of failure or penetration is extremely remote.

(f) In determining the probability of failure or penetration and probable size of openings, the fail-safe features of the design may be considered if possible improper operation of closure devices and inadvertent door opening are also considered. The pressure relief provided by intercompartment venting may also be considered.

(g) Reasonable design precautions must be taken to minimize the probability of parts becoming detached and injuring occupants while in their seats."

2) FAR 25.783(b), (e), and (f); Doors.

"(b) There must be a means to lock and safeguard each external door against opening in flight (either inadvertently by persons or as a result of mechanical failure) . . . Auxiliary locking devices may be used." . . .

"(e) There must be a provision for direct visual inspection of the locking mechanism by crewmembers to determine whether external doors, for which the initial opening movement is outward (including passenger, crew, service, and cargo doors), are fully locked. In addition, there must be a visual means to signal to appropriate crewmembers when normally used external doors are closed and fully locked."

"(f) Cargo and service doors not suitable for use as an exit in an emergency need only meet paragraph (e) of the section and be safeguarded against opening in flight as a result of mechanical failure." . . .

3) FAR 25.841(a); Pressurized Cabin.

"(a) Pressurized cabins and compartments to be occupied must be equipped to provide a cabin pressure altitude of not more then 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions. If certification for operation over 25,000 feet is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in the event of any reasonably probable failure or malfunction in the pressurization system."

4) FAR 25.843(a); Tests for Pressurized Cabin.

"(a) Strength test. The complete pressurized cabin, including doors, windows, and valves, must be tested as a pressure vessel for the pressure differential specified in 25.365(d)."

5) FAR 25.1301; Equipment, Function and Installation.

"Each item of installed equipment must -

(a) Be of a kind and design appropriate to its intended function;

(b) Be labeled as to its identification, function, or operating limitation, or any applicable combination of these factors;

(c) Be installed according to limitations specified for that equipment; and

(d) Function properly when installed."

6) FAR 25.1309(a) and (b); Equipment Systems and Installations.

"(a) The equipment, systems, and installation whose functioning is required by this subchapter, must be designed and installed to insure that they perform their intended function under any foreseeable operating condition.

(b) The equipment, systems, and installations must be designed to prevent hazards to the airplane if they malfunction or fail."

7) Special Propulsion Condition 1; Turbine Engine Installation.

"In lieu of the requirements of §25.903(d)(1), the airplane must incorporate design features to minimize hazardous damage to the airplane in the event of an engine rotor failure or a fire which burns through the engine case as a result of an internal engine failure."

8) Exemptions.

There were no Exemptions (Ref. FAR 11.53) issued on the Model DC-10 which pertained to design for pressure containment and protection from rapid decompression, or door security.

Pertinent Airworthiness Requirements - Cargo Compartment Classification.

The pertinent regulatory sections of the type certification basis, relative to classification of the Model DC-10 "under floor" cargo compartments for fire protection, and which could have an affect on intercompartment venting considerations, consist of the following requirements:

1) FAR 25.855(e); Cargo and Baggage Compartments.

"(e) Cargo compartments must meet one of the class requirements of §25.857. In addition, flight tests must be conducted to show compliance with the provisions of §25.857 concerning -

(1) Compartment accessibility;

(2) The entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers; and

(3) The dissipation of the extinguishing agent in Class C compartments.

During these tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any one compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously. "

2) FAR 25.857(c) and (d); Cargo Compartment Classification.

"(c) Class C. A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which -

(1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;

(2) There is an approved built-in fire-extinguishing system controllable from the pilot or flight engineer stations;

(3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;

(4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment; and

(5) (Replaced by Special Airframe Condition 15, stated below)"

"(d) Class D. A Class D cargo or baggage compartment is one in which -

(1) A fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants;

(2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases from any compartment occupied by the crew or passengers;

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits;

(4) (Replaced by Special Airframe Condition 15, stated below)

(5) Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane.

"For compartments of 500 cu. ft. or less, an airflow of 1500 cu. ft. per hour is acceptable." . . .

(FAR 25.857(a), (b), and (e) define Calss A, B, and E cargo compartments, respectively, none of which are used "under floor" on the Model DC-10. Class A and B compartments must be accessible to the crew in flight. Class E compartments apply to airplanes used only for the carriage of cargo.)

3) Special Airframe Condition 15; Cargo and Baggage Compartments

"In lieu of the requirements of 25.857(c)(5) and (d)(4) . . ., the following apply . . ."

"(b) Class B through Class E cargo or baggage compartments as defined in 25.857, must have a liner and the liner must be constructed of material that at least meet the requirements set forth in Special Airframe Condition No. 14(b), must be separated from (but may be attached to) the airplane structure, and must be tested at a 45 degree angle in accordance with the applicable portion of Special Airframe Condition No. 17, or other approved equivalent methods. (Remaining portion not pertinent) . . ."

Means of Compliance - Airworthiness Requirements

Compliance with FAR 25.365(e) and (f), FAR 25.783(e) plus compliance with FAR 25.1390(a) and (b) should have precluded loss of an aircraft as the consequence of rapid decompression due to any reasonably probable failure. The certification office (AWE-100) has advised that the approved Model DC-10 design was considered to be in full compliance with these requirements at the time of original type certification; and, that the "equivalent level of safety" provision of FAR 21.21(b)(1) was not invoked in their acceptance of the design. The certificating office's rationale in finding compliance with these requirements relative to the cargo doors and the cargo compartment classification requirements at the time of original type certification was as follows:

1) Compliance with FAR 25.365(e) and (f).

In the Model DC-10 design, vital systems such as flight controls, engine controls, electrical wiring, hydraulic and fuel lines, etc.,

run the length of the fuselage within and under the cabin floor structure. Collapse of the floor structure could, therefore, cause jamming of the vital systems which would interfere with the continued safe flight and landing of the aircraft. In view of this situation, compliance with FAR 25.365(e) and (f) would, among other things, require that either (1) the floor structure be designed to withstand the differential pressure loads associated with the loss of a cargo door taking credit for any intercompartment venting relief present; or (2) a door latching and security systems must be provided so that opening or loss of the door in flight, after pressurization of the fuselage would be "extremely remote." At the time of original type certification, the certificating office found compliance with FAR 25.365(e) and (f) by virtue of the latter alternative, supported by both test and analysis (but no failure mode fault analysis). The probability of in-flight loss of the door after aircraft fuselage pressurization was then considered to be "extremely remote," i.e., failure was not expected during the service life of the aircraft. The latch door was therefore permitted to be considered an integral part of the fuselage structure for the purpose of assessing its fail-safe integrity.

In accepting the probability of door opening to be extremely remote, it was thought that the vent doors on each cargo door, which is mechanically linked to the door latching safety system, would stay open and thus preclude cabin pressurization unless the cargo door was fully locked and secure.

The largest opening in the pressure (fuselage) vessel assumed for the purpose of stressing the floor for the rapid decompression, differential pressure loads was a hole area of 0.9 ft.^{2}. This hole area is the area of the largest skin bay as bound by longerons and tear stopper, and corresponds to the largest hole considered reasonably probable from structural fatigue. Loss of a cabin window or windshield was not considered because of their fail-safe design, and the probability of openings larger than 0.9 ft.^{2} due to penetration by foreign objects, such as engine parts after rotor failure were thought to be "extremely remote."

Just before and shortly after the AAL accident in June 1972, McDonnell Douglas developed a number of cargo door latching, locking and warning system modifications which would, if installed in a then envisaged four-stage program, increase the reliability of the cargo doors security. Incorporation of these modifications would further reduce the probability of in-flight cargo door separation. Most of these modifications were made the subject

of a number of McDonnell Douglas "Recommended" service bulletins, one of which was given special emphasis (i.e., Alert Service Bulletin A52-35) by virtue of it being issued as an ALERT bulletin. All of the bulletins were "FAA approved" but none of the modifications prescribed were made "required changes" to the type design (Ref. FARs 21.99 and 39.1) by Airworthiness Directive prior to the THY accident.

2) Compliance with FAR 25.783(e)

The initial opening movement of the Model DC-10 cargo doors is outward. Compliance with FAR 25.783(3), would therefore require ". . .provision for direct visual inspection of the locking mechanism by crewmembers to determine that the doors are fully locked."

The vent door, along with the cargo door latch safety system actuation handle (also called "vent door handle") on each cargo door, were considered to provide a direct visual indication or means of determining the locking mechanism position. The rationale was that both the vent door and door latch safety system actuation handle are integral parts of locking mechanism referred to by the rule. It was thought that the vent door and handle would, by virtue of direct mechanical linkage, stay open if the corresponding door was not fully latched, thus providing a visual means of determining door latch security. Furthermore, considering the latching design peculiar to the Model DC-10 cargo doors, it was the opinion of the certificating office that direct visual inspection of the latching lugs would not provide as high a level of assurance that the door was safety latched as would observation of the vent door and handle position.

A one inch (1.0") diameter viewing port in each cargo door was later developed after the AAL accident in June 1972 to provide an additional means of visually inspecting for door latch security. Installation of this viewing port, which is one subject of McDonnell Douglas Alert Service Bulletin A52-35, dated June 16, 1972, was not made mandatory by Airworthiness Directive, but McDonnell Douglas agreed to attain and confirm accomplishment on all aircraft in service as well as all future production aircraft.

3) Compliance with FAR 25.1309(a) and (b)

The certificating office did not believe it to be a requirement that systems safety analyses, using probability procedures, fault mode

analyses, and considering consequence of failures be submitted for certification acceptance of the Model DC-10 cargo doors latching, locking, or lock security warning systems; consequently, none were submitted at the time of original type certification. Findings of compliance with FAR 25.1309(a) and (b) were made by "engineering judgement." Also, tests were conducted to attempt to improperly close the door and to determine if the safety provisions did, in fact, perform their intended function. It was concluded that it was not within the expected strength of ground service personnel to force the vent door handle closed when the door latch safety pins were blocked from proper placement by unsecured latches.

4) Cargo Compartment Classifications.

The Model DC-10-10 airplane design such as were the airplanes involved in both the AAL accident and the THY accident, has three separate cargo compartments "under floor" - a forward Class C compartment, a center Class C compartment and the aft "bulk" cargo compartment, which is a Class D compartment. Ventilation to the aft compartment is controlled and limited for fire protection integrity.

In the Model DC-10-40 and DC-10-30 airplane designs, all three compartments are Class C compartments and the aft "bulk" compartment is separated from the center compartment by only a fabric curtain. Therefore, there is no significant restriction of airflow between the center and aft cargo compartments on these later models.

Production Certification.

The Model DC-10 series airplanes are being produced by McDonnell Douglas in Long Beach, California, under FAA Production Certificate No. 27. Many components, both major and minor, are being manufactured by many U.S. and foreign suppliers under subcontract to McDonnell Douglas. FAA production certification requirements, including the pertinent quality control standards, are set forth in Subpart G of FAR 21.

Under FAR 21, Subpart G, an aircraft manufacturer may be issued production certificate when the FAA finds, after examination of the supporting data and after inspection and approval of the organization and production facilities in question, that the manufacturer has established and can maintain

a quality control system for the product so that each article (e.g., each aircraft produced) will meet the design provisions of the pertinent type certificate. The production certificate holder is responsible by regulation (FAR 21.165) to maintain his quality control system in conformity with the quality control data and procedures approved by the FAA; and to determine that each completed article submitted for airworthiness certification conforms to the approved type design and is in a condition for safe operation. Once the production certificate is issued, FAA quality assurance inspectors may do sample inspection for production system surveillance purposes; however, the primary function of performing the detailed inspections necessary for FAA airworthiness acceptance is delegated to a manufacturer's employed FAA Designated Manufacturing Inspection Representatives (D.M.I.R.s).

D.M.I.R.s are private persons who have been FAA-approved and designated to represent the Administrator pursuant to Section 314 of the Federal Aviation Act and FAR 183.31.

By virtue of Production Certificate No. 27, and through the use of McDonnell Douglas employed, FAA D.M.I.R.s, McDonnell Douglas has been delegated the function of accomplishing all detail quality control inspections on the Model DC-10 aircraft for "Original" airworthiness certification (Ref. FAR 21.183 (a) and/or export airworthiness certification (Ref. FAR 21, Subpart L) as the case may be. These airworthiness certificates are issued by the McDonnell Douglas D.M.I.R.s within the limits prescribed by and under the general supervision of the FAA Western Region.

Pertinent Ground Servicing Standards.

FARs 121.195 and 121.123 require that U.S. air carriers (i.e., operator) ". . . must show that competent personnel and adequate facilities and equipment . . . are available at such points along the air carrier's route as are necessary for the proper servicing, maintenance, and preventive maintenance of the airplane and auxiliary equipment." Before a U.S. air carrier is authorized to operate a particular airplane type over a particular route, the FAA participates in a "route proving run," whereupon the FAA assesses, among other things, the competency of ground service personnel at each point along the route where service may be performed.

The AD, issued on March 7, 1974, after the THY accident, now explicitly requires U.S. operators of Model DC-10 airplanes to have and/or initiate a cargo door training program and to insure that only responsible and properly trained personnel are used to close and to ascertain cargo door security.

Foreign operator of U. S. manufactured aircraft would not be required to comply with FAR 121, unless the cognizant foreign airworthiness authority elects to require compliance. During our visit with the Turkish authority on March 7/8, 1974, the Turkish authority appeared reluctant to discuss the possible "route approval" aspects of the THY accident. The subject was not pressed because American Embassy representatives thought the subject might be considered by the Turkish authority to be a "red herring."

Unfortunately, under French law, the French accident investigation authority does not have interrogation authority over the ground service personnel that handled the THY accident aircraft in Paris, prior to take-off. This function is reserved to the judiciary authority alone, and information on the interrogations conducted has not as yet been made available to the FAA.

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DUTCH

RIJKSLUCHTVAARTDIENST (RLD) CONCERN REGARDING CONSEQUENCES OF RAPID DECOMPRESSION OF WIDE-BODY JET TRANSPORTS

In their April 20, 1971, letter to AFS-1, the Dutch civil airworthiness authority (RLD) expressed concern about the possible catastrophic consequences of rapid compartment decompression if this were to be experienced by the new generation of wide-body jet aircraft. At that time, the RLD was most concerned about decompressions resulting from small bomb explosions in a cargo compartment and sought FAA views on bomb sizes which should be considered. Following the American Airlines accident, the RLD wrote AOA-1 on August 18, 1972, to reemphasize their concern and to point out that, in their opinion, the Model DC-10 was more critical than Boeing Model 747 because of the location of vital controls on the Model DC-10 which could be damaged as a result of floor collapse from rapid decompression. AFS-1 replied to the RLD on September 14, 1972, stating that McDonnell Douglas had initiated an extensive program to minimize the possibility of future decompression due to loss of a cargo door. AFS-1 also advised that the FAA was studying the more general program of rapid decompression due to openings which might occur in the pressure cabin and would advise the RLD of the results.

The RLD subsequently accepted the Models DC-10-30 and DC-10-30F airplanes for operation on the registry of The Netherlands by KLM and Martin's Air Charter; however, the RLD stated as a matter of their certification record -- "So the RLD isn't happy with the present situation, but for this generation of aircraft, we have to live with it." (Ref. attachment to RLD letter of September 19, 1973, to AWE-100.)

SERVICE DIFFICULTY CORRECTION PROGRAMS

Service Bulletins.

McDonnell Douglas Model DC-10 service bulletins (S. B. s) are issued and distributed to users in consonance with the Air Transport Association of America, "Specification for Manufacturers' Technical Data" (ATA Spec 100), Sections 2-7-0 through 2-7-4 inclusive. Accordingly, Model DC-10 service bulletins are issued as one of the following ATA Spec 100 categories (Ref. ATA Spec 100 Section 2-7-1, page 1, dated March 15, 1968):

"1. Campaign Wire

Matters of extreme urgency shall be transmitted by telegraph, cable or in some cases by telephone. These shall be identified as "Alert Bulletins" and shall contain a Service Bulletin number. An "Alert Service Bulletin" shall be prepared and mailed promptly to confirm and elaborate upon all such messages.

2. "Alert" Service Bulletin

Alert Service Bulletins shall be issued on all matters requiring the urgent attention of the operator and shall generally be limited to items affecting safety. Alert Service Bulletins shall be prepared on LIGHT BLUE colored Service Bulletin forms with the word "ALERT" in the heading and the sequence number shall be preceded by an "A" to assist in distinguishing them from routine Service Bulletins. Alert Service Bulletins shall generally have a letter type format and shall contain all information necessary to accomplish the required action. In cases where more information is needed on the same subject, the Alert Bulletin shall be followed up by a standard Service Bulletin identified by the same number and shall include a statement that it revises the "Alert." In this way, advance information and Standard Service Bulletin information will be filed together for future reference.

3. Service Bulletin (Standard)

Standard Service Bulletins shall be issued where the use of Campaign Wires and/or "Alert" Service Bulletins are not required."

As of December 15, 1973, McDonnell Douglas had issued some 965 service bulletins for the Model DC-10 series and, it is estimated that well over 1, 000 had been issued by the time of the THY accident. Nine (9) of the approximately 1, 000 service bulletins were "ALERT" service bulletins. These were:

1) S. B. A22-73; "AUTO FLIGHT - Autopilot-Autoland Operation Restriction, " dated March 1, 1974.

2) S. B. A25-49; "EQUIPMENT/FURNISHINGS-- Emergency-Inspect And/Or Modify Evacuation Slide Valise Release Strap, "dated May 16, 1972.

3) S. B. A27-27; "FLIGHT CONTROLS - Rudder-Replace Alternate Nonreversible Motor Pump Piping," dated March 16, 1972.

4) S. B. A27-68; "FLIGHT CONTROLS - Horizontal Stabilizer - Remove Hydraulic Surge Dampers, " dated November 9, 1972.

5) S. B. A30-7; "ICE AND RAIN PROTECTION - Pitot and Static - Revise Pitot Heater Wiring, " dated May 2, 1972.

6) S. B. A32-31; "LANDING GEAR - Extension And Retraction - Replace Nose Landing Gear Upper Lock Link Assembly, " dated November 13, 1972, Rev. 1, dated September 13, 1973.

7) S. B. A32-76; "LANDING GEAR - Extension and Retraction - Install Stops On Control Valve, " dated February 22, 1974, Rev. 1, dated March 1, 1974.

8) S. B. A34-12; "NAVIGATION - Attitude And Direction - Modify Compass Systems Wiring, " dated December 6, 1971.

9) S. B. A52-35; "DOORS - Cargo - Install Lock Mechanism Viewing Window, " dated June 19, 1972, Rev. 2, dated August 25, 1972.

All but two of the above "Alert" Service Bulletins, i. e., S. B. s A32-31 and A32-76 were issued first as "Campaign Wires. " Corrective actions to resolve the difficulties associated with "Alert" S. B. s A22-73 and A27-68 are required by ADs 74-8-7 (new) and 73-10-5 respectively. Compliance with S. B. A52-35 is now required by virtue of the "cargo door" AD, issued March 6, 1974; and a new AD issued March 28, 1974, require compliance with S. B. A32-76.

All McDonnell Douglas service bulletins are "FAA approved"; and most of these approvals were granted by McDonnell Douglas employed, FAA Designated Engineering Representatives (D.E.R.s). The Aircraft Engineering Division (AWE-100) screens all service bulletins to determine if further FAA action, e.g., issuance of an Airworthiness Directive, is necessary.

The vast majority of Model DC-10 service bulletins are for product improvement; i.e., reduction of nuisance difficulties, improved maintainability, reduction of operational costs, etc.

Airworthiness Directives

Airworthiness Directives (ADs) are Federal Aviation Regulations (FAR 39) issued by the FAA to require correction of an unsafe condition that is likely to exist or develop on other products of the same type design. Manufacturer's service bulletins are often, but not necessarily, referenced in an AD to facilitate statement of the corrective action to be taken. It is not common for U.S. manufacturers to mark their service bulletins in any way to indicate that they have been made the subject of an AD. The authority to issue ADs has been delegated (31 F.R. 13697) to the Directors of the various regions within the 48 contiguous states. ADs on products approved by the European, Pacific, and Alaska Region are issued by the Director, Flight Standards Service, Washington, D.C.

At the time of the THY accident, a total of four ADs had been issued against the Model DC-10 airplane and no ADs had been issued against the General Electric (G.E.) Model CF6 series engine which is installed on the Model DC-10. The AD on the Model DC-10 consisted of the following:

1) AD 73-10-5; To prevent hydraulic fluid loss in the rudder standby power hydraulic system loops from inducing an additional failure in an adjacent second hydraulic system and to maintain flight control system margin capability. McDonnell Douglas S.B.s 29-40 and 29-46 were referenced for accomplishment instructions.

2) AD 73-26-4; To determine that the correct (nacelle) nose cowl attach bolts are installed and to assure the proper installation of the bolts. No McDonnell Douglas S.B.s were referenced for accomplishment instructions.

3) AD 74-5-4; To provide a proper test of the yaw damper systems prior to take-off. No McDonnell Douglas S.B.s were referenced for accomplishment instructions.

4) AD 74-8-7; To prevent poor lateral autoland performance which could lead to an unsafe condition when operating in low weather minimums. McDonnell Douglas S.B. A22-73 pertains to this same subject.

Three additional ADs were issued subsequent to the THY accident, only one of which related to the accident. There were:

5) AD (March 7 as amended March 22, 1974); To prevent possible in-flight depressurization of the airplane due to loss of a cargo door. Compliance with McDonnell Douglas S. B. s 52-27, A52-35, 52-37, 52-43, 52-44, 52-49, and 52-54 is required.

6) AD (March 22, 1974); To assure proper alignment and detection of deformed passenger door stop bracket.

7) AD (March 28, 1974); To prevent failure of the main landing gear to extend during free fall operation. McDonnell Douglas S. B. A32-76 pertains to this same subject.

Voluntary Compliance Programs.

So called "voluntary compliance" programs are known to have been administered by the FAA to correct an unsafe condition, in lieu of issuing ADs, in the following Model DC-10 service difficulty areas.

1) To prevent emergency evacuation slide malfunction, by compliance with McDonnell Douglas S. B. A25-49.

2) To prevent dual hydraulic system failures due to complete depletion of system fluid from a single failure, by compliance with McDonnell Douglas S. B. A27-27.

3) To prevent unreliable air speed indications on all three air speed indicators, by compliance with McDonnell Douglas S. B. A30-7.

4) To prevent fatigue failure of the nose landing gear bungee cylinder bracket and the upper lock link which could allow the nose gear to collapse, by compliance with McDonnell Douglas S. B. A32-31.

5) To prevent slewing both compass gyros off heading due to discharge of static charges on the windshield, by compliance with McDonnell Douglas S. B. A34-12.

6) To improve reliability of the Gutton engine vibration monitoring (EVM) system, by compliance with McDonnell Douglas S. B. 77-26.

7) To prevent failures of the powerplant fire detector system.

8) To prevent thermal discharge of the firex bottle for the No. 2 engine/APU, which is located in the aft accessory compartment and which has caused the bottle to break loose from its mounting, by compliance with McDonnell Douglas S. B. s 26-4, 49-12, and 49-15.

9) To prevent a possible explosion hazard due to failure of fuel boost pump connector plugs.

10) To prevent freezing of the engine throttle controls at altitude, caused by water collecting and freezing in the outer flex cable sheathing, by compliance with McDonnell Douglas S. B. s 53-23, and 76-9.

Four cases where "voluntary compliance" programs were administered on the G. E. Model CF6 engine are as follows:

1) To prevent in-flight separation of the low pressure turbine, borescope inspection were required plus rework of the "C" sump area, and modifications to the turbine cooling and venting systems, by compliance with G. E. Alert S. B. s A72-279, A72-339, A72-342 and A72-392.

2) To prevent in-flight separation of the nacelle nose cowl and loss of fan blades, modifications per G. E. S. B. 72-476 were required to increase the fan blade tip clearance and to groove a rub strip so as to minimize the contact area in the event of blade tip rub. (Note: AD 73-26-4 against the Model DC-10 require further airframe modification relative to this same problem area. AD 73-26-4 did not, however, require compliance with G. E. S. B. 72-476.)

3) To prevent failure of the engine starter turbine wheel which has caused a fire.

4) To prevent failure of engine fan blades by incorporation of redesign fan blade retention device.

General Notices (GENOTs)

General Notices (GENOTs) are instructions issued by Flight Standards Service, Washington, D. C., to FAA field personnel. The purpose of GENOTs is to set forth recommended courses of action regarding areas such as aircraft inspections, modifications, and operational limits. GENOTs may also

include feedback instructions if applicable. Where possible, GENOTs refer to a manufacturers publication for accomplishment instructions. GENOTs, as well as other nonregulatory, maintenance and operations advisory programs, have made significant contributions to aviation safety, but were never intended to be used in lieu of Airworthiness Directives to correct an unsafe design condition.

Approximately 14 GENOTs have been issued relative to the Model DC-10 airplane and the G.E. CF6 engine since the airplane was introduced into service:

Notice No.	Subject	Date
8340.138*	Ground fire resulting from fuel leak	5-2-72
8340.140*	CF6 engine-turbine rear frame C sump inspection	5-9-72
8340.143*	CF6 engine-turbine midframe C sump inspection	5-19-72
8340.145*	CF6 engine-turbine midframe C sump inspection	6-13-72
8340.146	Baggage/cargo compartment doors	6-14-72
8340.149*	CF6 engine-turbine midframe C sump inspection and adnormal oil consumption	8-9-72
8340.158	Pneumatic direct failure	4-27-73
8320.121*	Cabin electrical fire	3-8-73
8320.125*	Auto throttle flight guidance	4-18-73
8320.126*	ILS Control panel	4-16-73
8320.130	Cabin door bolt interference	5-19-73
8320.133	Cargo door seal failure	6-8-73
8320.140	Inadvertent cabin door opening and escape chute deployment	7-16-73

Notice No.	Subject	Date
8320.142	Aircraft portable dry chemical fire extinguisher	7-31-73
8320.144	Tail cone platform doors	8-3-73
8320.157	Cargo doors	3-7-74
8320.158	Cargo doors	3-14-74

*The GENOTs marked above with an asterisk (*) recommend significant modification or inspection action on the airplane or engine to correct an unsafe condition and for which no ADs were issued.

AMERICAN AIRLINES (AAL) ACCIDENT - JUNE 12, 1972

Probable Cause

In the Model DC-10-10, American Airlines, Inc. (AAL) accident of June 12, 1972, near Windsor, Ontario, Canada, the cargo door opened in flight and separated from the airplane. A rapid loss of pressure in the cargo compartment created a pressure differential on the floor above the compartment. This resulted in floor displacement in a downward direction, severing some control cables and seriously interfering with others. The crew retained control of the aircraft, and accomplished a landing without loss of the aircraft or lives.

The accident was investigated by the Bureau of Aviation Safety, "National Transportation Safety Board" (NTSB) and was reported in the Board's Aircraft Accident Report No. NTSB AAR-73-2 (File No. 1-0004), adopted February 28, 1973. The NTSB determined that the probable cause of the AAL accident was the improper engagement of the latching mechanism for the aft bulk cargo compartment door during the preparation of the airplane for flight. The NTSB further stated that the design characteristics of the door latching mechanism permitted the door to be apparently closed when, in fact, the latches were not fully engaged, and the latch lockpins were not in place.

Contributing Factors

The cargo door latching mechanism was not driven to its "overcenter" and fully latched position. This was attributed to low voltage to the latch actuation motor. Also, the ramp service agent forced the vent door handle closed with his knee with the latch safety pins forced against the side of the latch lugs instead of sliding behind them into the normal safely locked position. The small vent door was thus forced closed through adnormal deflection of the latch safety system linkage which, in turn, permitted fuselage pressurization without the cargo door being safely latched.

NTSB Safety Recommendations & FAA Replies

On July 6, 1972, the NTSB issued the following safety recommendations to the FAA:

1) Recommendation A-72-97:

"Require a modification to the DC-10 cargo door locking system to make it physically impossible to position the external locking handle and vent door to their normal door locked positions unless the locking pins are fully engaged."

2) Recommendation A-72-98:

"Require the installation of relief vents between the cabin and aft cargo compartment to minimize the pressure loading on the cabin flooring in the event of sudden depressurization of the cargo compartment."

In a letter reply to the NTSB on July 7, 1972, the FAA stated that all Model DC-10-10 operators were performing 100-hour functional checks on the cargo door system and would incorporate McDonnell Douglas Service Bulletin 52-27 and Alert Service Bulletin A52-35 within 300 hours. These modifications improve inspection and operation of locking and vent mechanisms. The FAA reply also stated that additional modifications to the cargo door locking and pressurization systems were being considered as part of a continued investigation effort. In conclusion, the July 7 letter stated that: "While a preliminary investigation indicates that it may not be feasible to provide complete venting between cabin and cargo compartments, your recommendations will be considered with respect to further action taken."

A follow-on NTSB letter of February 23, 1973, to AOA-1 suggested that if complete venting is not possible, partial venting would be beneficial to prevent collapse of cabin floor in event of rapid decompression. The FAA's reply of March 15, 1973, advised that McDonnell Douglas had been requested by the FAA to reassess the Model DC-10 design with regard to the effect on safety of probable large openings in the pressurized fuselage. This would include consideration of rerouting vital systems, reinforcement of the floor as well as incorporation of additional venting between compartments, including various degrees of venting.

FAA Actions

1) On June 14, 1972, AFS-1 issued a telegraphic General Notice (GENOT 8340.146) to alert the FAA offices concerned of the AAL accident and the apparent cause. Also by this GENOT, all DC-10 operators were requested to perform one time inspection of all cargo doors before further flight, and to correct any unsafe conditions found, including adjustments and repairs, in accordance with "applicable Douglas instructions." No changes to the type design were suggested by this GENOT.

2) On June 16, 1972, AWE-100 drafted a telegraphic Airworthiness Directive (AD) on Model DC-10-10 aircraft for promulgation as a rule under FAR 39. The AD would have required functional checks of the cargo door at intervals of 100 hours time-in-service. Also, incorporation of the modifications defined by McDonnell Douglas Service Bulletins 52-27 and A52-35 would have been required

within 300 hours time-in-service, and after which the 100-hour functional checks could be discontinued. A decision was made, however, not to issue ADs on this subject; and instead, the FAA decided to seek accomplishment of the necessary modifications to the cargo compartment door latching mechanism through voluntary compliance by the operators with the pertinent McDonnell Douglas service bulletins. (See next item below.)

3) On June 16, 1972, a telegram signed by Mr. Ken Smith (then Deputy Administrator) was sent to the Presidents of all Model DC-10 operators (then there were only four domestic air carriers) and ATA. The telegram confirmed telephone agreements Mr. Smith had reached with the air carriers, and documented his expectation that all four air carriers would accomplish the same initial course of corrective action as had been proposed by the AWE-100 draft AD (see item 2 above). Technical corrections to the Deputy Administrator's telegram of June 16, 1972, were made by AFS-1 on June 19, 1972, in a follow-on telegram to the air carriers. AFS-1's June 19 change added compliance with McDonnell Douglas S. B. A52-35 to the list of modifications expected.

   Both messages; i. e., June 16 and June 19, to the air carrier operators stated: "This telegram is an interim action and will be superseded or augmented as further recommendations and design changes are forthcoming from the manufacturer." The June 19 message was, however, the last message or instruction sent to the operators by the FAA on this subject, even though additional door improvements were developed by McDonnell Douglas.

4) On June 16 and June 19, 1972, AFS-1 sent messages to each Regional Director who held responsibility for a Model DC-10 operator. The AFS-1 messages first quoted the messages sent to the operators and then stated: "Request you take all necessary steps to insure contents are accomplished through your assigned principal maintenance inspector for each carrier involved."

5) By letter of June 16, 1972, AFS-1 requested that AWE-1 review systems, cables, latches, floor and switch adjustments and take such action as is necessary.

6) AWE-100's follow-on letter of July 12, 1972, to McDonnell Douglas requested McDonnell Douglas provide a bi-weekly summary regarding modification program of Douglas-recommended changes.

7) On July 20, 1972, AWE-1 replied to AFS-1's June 16, 1972, letter (see item 5 above) by explaining a four-phase program had been initiated by McDonnell Douglas which would culminate in a door system "intended to be foolproof and fail-safe." Phase I consisted of the same action as was set forth in the FAA's last (June 19) message to the four operators. No action was taken by the FAA to insure that the operators would comply with Phases II, III, and IV, which were described by AWE-1's July 20, 1972, letter. Installation of the so-called "closed loop" latch safety system, which is now the subject of McDonnell Douglas S. B. 52-49 and the FAA's March 22, 1974, AD, was Phase IV and was described in AWE-1's letter as being "considered the final resolution of the problems determined from the investigation of the inadvertent door opening and resultant explosive decompression."

8) McDonnell Douglas, by letter of August 7, 1972, stated modifications were complete on all airplanes in accordance with Service Bulletin 52-27 and Alert Service Bulletin A52-35. McDonnell Douglas letter to AWE-100 of August 18, 1972, stated that Service Bulletin 52-37 would commence.

9) AFS-120's letter of January 15, 1973, to ANW-212 and AWE-120 expressed concern on the long-range safety implications of the AAL DC-10 accident from the standpoint of structural collapse of the floor due to rapid decompression affects. An assessment of this situation was requested which would consider such factors as:

(a) rerouting of vital systems

(b) floor reinforcement; and

(c) incorporation of additional venting in the floor.

10) By letter of February 2, 1973, AWE-100 requested McDonnell Douglas and Lockheed to make an assessment of their airplanes based on the design considerations set forth in (9) above. A letter covering this same subject was sent to Boeing by ANW-210 on February 8, 1973.

11) A series of letters were exchanged between AFS, AWE, ANW, AEU and the U.S. manufacturers of "wide-body" airplanes from March 1973 to March 1974. The U.S. manufacturers indicated an unwillingness to consider changes involving floor venting, floor reinforcement, vital systems relocations or any other major design improvement assessments on the basis of manpower availability. McDonnell Douglas even suggested that FAA should fund any such study because of the magnitude of the

burdens involved and because the questions raised were not unique to the Model DC-10. AWE-120 stated by letter of June 12, 1973, to AFS-120 they did not believe that the request for a detailed reassessment of the Model DC-10 was warranted since the fleet was retrofitted with the door latch system modifications and no subsequent service difficulties had occurred.

The only foreign manufacturer contacted by the FAA was Airbus Industries of France, who was, at that time, still in pre-production development of their airplane, the Model A300B "European Airbus." As a result, action was taken by the cognizant foreign authorities at the request of the FAA; and changes were made in the Model A300B design to increase cargo door latching system reliability, to insure a combination of adequate floor strength and intercompartmental venting, and to insure that vital systems and controls were so located as to provide adequate protection in the case of floor collapse. The "Airbus" for example can experience at least a 16 ft.^{2} hole in either of the two cargo compartments at 38,000 ft. altitude without floor damage, according to information received from AEU-100.

TURKISH AIRLINES (THY) ACCIDENT - MARCH 3, 1974

As a result of the THY accident near Paris, France, which appears to have involved in-flight loss of the aft cargo door, the FAA Headquarters initiated the following action program:

1) By direction of the Administrator, a special committee was formed on March 5, 1974, under the Associate Administrator for Aviation Safety (ASA-1) to review thoroughly and carefully the pertinent certification history of the McDonnell Douglas Model DC-10 aircraft as well as to investigate reports of all Model DC-10 accidents and/or incidents which bear even slight similarity to the THY accident, and the circumstances surrounding that accident which are known to be factual.

2) A telegraphic AD was issued by AFS-1 on March 6, 1974, to all operators/owners of Model DC-10 series airplanes to perform certain modifications in accordance with McDonnell Douglas S.B. 52-27, A-52-35, and 52-37, and to perform functional checks of the cargo doors. The AD also required Model DC-10 operators to institute a cargo door training program and to insure that only qualified and properly trained personnel would be used to ascertain cargo door security prior to take-off. This AD pertained to all cargo doors on the Model DC-10, of which there are three per airplane.

3) A General Notice (GENOT 8320.157) was issued on March 7, 1974, to instruct FAA inspectors to insure that compliance with the terms of the March 6 AD.

4) GENOT 8320.158 was issued on March 14, 1974, to obtain a detailed review of the Model DC-10 cargo door service history with emphasis on any cargo door difficulties experienced by U.S. operators.

5) Over the weekend of March 16/17, 1974, an FAA surveillance action was taken to determine that all U.S. operators of Model DC-10 airplanes were, in fact, using qualified personnel to ascertain cargo door security prior to take-off. One hundred and thirty (130) departures by seven operators out of ten airports were checked by FAA inspectors and only two instances were found where door closure was accomplished by questionably trained personnel.

6) On March 22, 1974, AWE-1 amended AFS-1's March 6 AD to require further modifications to the Model DC-10 cargo doors in accordance with McDonnell Douglas S.B.s 52-43, 52-44, 52-49, and 52-54. These modification include changes to improve the door closure warning system reliability and incorporation of the "closed-loop" cargo door latch safety system.

Reports from FAA personnel participating in the THY accident investigation have indicated the following regarding the door that separated from the aircraft in flight.

1) The vent door torque tube bearing plate described in McDonnell Douglas Service Bulletin 52-37, believed to have been installed on the aft cargo door while the aircraft was at McDonnell Douglas was, in fact, not installed.

2) A hole appeared to have been drilled in the cover plate on the door over the latch actuator motor. Such a hole could have been drilled to provide for insertion of a hand crank for manual actuation of the latches.

3) The latch safety pin viewing port, and associated placards which were subjects of McDonnell Douglas S.B. A52-37, and the FAA's June 19, 1972, messages to the U.S. air carriers, were installed on the cargo door that separated from the aircraft in-flight.

CARGO DOOR SERVICE EXPERIENCE

On March 14, 1974, FAA air carrier maintenance field personnel were requested by GENOT 8320.158 to review maintenance records (pilot reports, mechanical interruption summaries, etc.) pertaining to Model DC-10 cargo door problems, and to submit a report to AFS-300 by April 15, 1974.

Reports have been received to date from the FAA Certificate Holding Offices for American, Delta, National, Northwest and Overseas National Airways encompassing the time period September 1973 through March 15, 1974. A review of the reports reveals, in summary, that all five carriers have had repeated door closing latching problems, primarily in the electrical mode, and have had to manually close the doors many times. The latching discrepancies were due to actuator door seals and electrical door lock/unlock limit switches. The door seals lead the problems list.

Northwest Airlines has had three (3) flight returns during this period due to loss of pressurization, or unable to pressurize. In each incident, the problems were with the center (right cargo) door. Two returns were due to the center cargo door opening. The carrier reported "replacing an actuator" and "manually closing" as the corrective action effected. These incidents are under investigation by the FAA Certificate Holding Office. The third incident was due to an improperly seated door seal.

The reports received regarding cargo door difficulties experienced by National, Delta, and Overseas National Airlines indicated the following:

1) Actuators replaced - 43

2) Door seals - Total 181

   a. Repair - 30
   b. Replacement - 27
   c. Reinstallation - 124

3) Electrical - Total 44

   a. Door lock/unlock limit switch - 21
   b. Warning door light - 7
   c. Loose connectors - 6
   d. Reset circuit breaker - 10

Similar nuisance difficulties were being experienced by all the U.S. operators of Model DC-10 airplanes.

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ANALYSIS

Model DC-10 Design Features

The lack of sufficient venting provisions into and from the aft cargo compartment, the lack of isolation or protection of critical systems passing through the floor of the passenger compartment, and the lack of adequate partition (e.g., floor) strength distribution to compensate for extreme pressure variation between compartment due to large openings in the pressure vessel now appear to be questionable design practice. A need for extensive FAA and industry studies is clearly indicated to determine what can practicably be done toward improved design concepts in these areas so as to provide increased protection from the consequences of rapid decompression. These studies should be accomplished, not only for the Model DC-10, but for all other present, as well as future, wide-body jet airplanes, e.g., the Lockheed Model L-1011, Boeing Model 747, and the Airbus Industries (French) Model A300B. In the light of the two accidents, first priority should be given to the Model DC-10; furthermore, non-plug type cargo doors are used, the aft cargo compartment is a Class "D" compartment with limited venting potential, flight controls plus other vital systems are routed under the floor.

The present FARs do not require, nor in my judgement, has justification been demonstrated for requiring floors and bulkheads to support the maximum pressure differentials for which the passenger compartment is intended. However, it should be possible at least to insure that failure of internal structure will not prevent continued control of the aircraft. Clearly, a combination of actions would be needed to accomplish such a result.

Prudent design practice would suggest examination of options to provide more intercompartmental pressure differential relief in the event of rapid decompression - from whatever the cause. For instance, were the aft "bulk" cargo compartments of the Model DC-10-10 reclassified from a ventilation limited Class "D" compartment to a Class "C" compartment, as it is on the Models DC-10-40 and DC-10-30, the bulkhead between the aft compartment and one or both of the other cargo compartments could be removed or redesigned and the liner walls similarly modified to provide increased venting capability. Additionally, with the change in classification, the same type of venting and airflow control could be provided in the aft compartment as was provided in the forward cargo compartments. Such

an arrangement might possibly have furnished some relief from severe pressure differential effects in the event of rapid decompression.

By virtue of their present routing under the floor structure, many of the Model DC-10's vital systems and flight controls are unnecessarily exposed to floor collapse due to rapid decompression. Rerouting of these systems and controls, or the installation of backup systems could make a significant contribution toward reducing the consequences of floor collapse, particularly if judicious selective strengthening of floor areas containing critical systems, is also accomplished.

There still remains some question concerning the detail design of the Model DC-10 door latching mechanism. It appears that a central design deficiency may continue to exist. If latching action is, for some reason, terminated while the latch hooks are over the latch spools but before the mechanism has been driven to its "over-center" position, any pressurization of the aircraft to 4.5/5.0 pounds-per-square-inch (i.e., approximately 11,000 to 13,000 ft. altitude) would cause latch loads to be passed through the latch actuation mechanism, and, in turn, would cause failure of the actuator attachment bolts. In the event of such failure, the latches would immediately release from the latch spools and the door would open. Only when latch actuation is terminated in the full "over-center" position, does the design provide sufficient capability to withstand full fuselage pressurization. To compensate for this deficiency, a number of additional design add-on have been devised in order to insure that the objectives of the FARs are fully met. While there is no longer any doubt that it is safe, it is an inelegant design worthy of Rube Goldberg. Notwithstanding the lack of explicit regulatory prohibition, prudent design practice would suggest reconsideration of this arrangement.

FAA Certification Findings.

Model DC-10 design compliance with the specific requirements of FAR 25.365(e) and (f), FAR 25.783(e) as well as FAR 25.1309(a) and (b) now appear questionable in the light of the two accidents involving rapid decompression. These requirements are pertinent to design for cabin pressure containment, protection from rapid decompression, and door systems reliability.

The Model DC-10 intercompartment structures (i.e., partitions, floors, bulkheads, etc.) were not designed to cope with, or prevent, failures that would interfere with the continued safe flight and landing after the sudden release of pressure in any compartment due to opening of a cargo door. It

was therefore, incumbent on McDonnell Douglas to show that loss of the cargo door, after airplane pressurization, was "extremely remote" for compliance with FAR 25.365(e). There is no doubt that once the door is properly latched and locked, the probability of it coming open in flight is indeed extremely remote. FAR 25.365(f), however, required that the possibilities of improper door operation be considered in determining remoteness of failure. That is, unless the cargo doors are effectively protected against improper operation, their opening in flight should not have been assumed "extremely remote." It would appear, in the light of two accidents, that the level of protection and reliability provided in the cargo door latching, safety locking mechanisms design, and the associated warning systems, was insufficient to satisfy the requirements of FAR 25.365(e). Additionally, it now appears that the possibilities of improper door operation were not given adequate consideration for compliance with FAR 25.365(f).

Compliance with the first sentence of FAR 25.785(e) would, in the case of the Model DC-10 cargo doors design, require that a means be provided for direct visual observation of the door latching mechanism to ascertain security. The visual inspection means which was originally accepted; i.e., visual observation of the vent door and handle position, should not have been considered to fully meet the intent of this rule. A means to visually inspect the latch hook to spool connection should have been provided. Addititionally, the warning means provided to signal the appropriate crewmember when the doors are not properly closed and fully locked do not now appear to have been designed, either with respect to location, wiring system, or reliability to satisfy the requirement of the last sentences in FAR 25.785(e). Service experience has shown that the systems provided have been unreliable in as much as common failure modes can prevent a warning from being given (Ref. McDonnell Douglas S.B. 52-37 and 52-43), and problems have been experienced with false nuisance warnings (Ref. McDonnell Douglas S.B. 52-55).

In view of the cargo door's criticality and the catastrophic consequences of failure, a systems safety analysis should have been made of the cargo door latching, locking and warning system for compliance with FAR 25.1309 (a) and (b) before a finding of "extremely remote" was made as provided for in FAR 25.365(e)." No such analyses were submitted to the certificating office.

None of the above mentioned compliance questions were referred to Flight Standards Service for guidance, and no procedures which would have involved an agency regulatory policy review were implemented. In the Committee's review of "equivalent safety finding" procedures (Ref. FAR 21. 21(b)(1), it was noted that no agency directive presently exists which would require coordination of "equivalent safety findings" with AFS-100, even though such coordination would contribute greatly to more standardized applications of the FARs, and would provide AFS-100 with direct indications of needed regulatory changes. Regions have been reluctant to effect such procedures because of the long time delays which generally result from Washington coordination of technical policy.

Applicable Airworthiness Standards

The Model DC-10 certification history has again pointed up that the agency's regulatory machinery has seriously bogged down to the point where many of our basic airworthiness standards, in this case FAR 25, for transport category airplanes are no longer consistent with the state-of-the-art of civil aeronautical technology. This is most clearly illustrated by the fact that it was necessary to issue some thirty-three (33) special conditions for so-called "novel or unusual design features" (Ref. FAR 21.16) not envisaged the requirements of FAR 25, to define what was then considered to be an adequate type certification basis for the Model DC-10.

The need to issue such a large number of special conditions is/was not unique to the Model DC-10 airplane. A similar situation exists for most current transport and many non-transport aircraft presently undergoing certification today or which have been recently certificated. Whereas a highly disciplined process of regulatory policy development at one time did exist in which a continuous dialogue between government agencies, manufacturers, operators, flight crew and maintenance organizations and other interested persons was maintained, this capability has been severely curtailed. Consequently, the agency now resorts to ad hoc, regulatory procedures by issuance of special conditions, exemptions, defacto rules by memos, and equivalent safety findings, on a large scale to cope with current technology. This has become a vicious self-defeating cycle in which greater and greater ad hoc efforts are required as the rules become more and more out moded. Similarly, as more and more manpower is expended in ad hoc regulatory activity, less attention to the revision of the basic aircraft design airworthiness standards is possible.

FAR 25 did not, at the time of Model DC-10 type certification and does not today, adequately envisage the problems associated with possible rapid decompression. In particular, full consideration has not been given in FAR 25 to hazard levels associated with the large volumes inherent to modern wide-body transport aircraft. Furthermore, no special conditions have been issued for any wide-bodied aircraft to cover this problem on the basis of the increased volumes being a "novel or unusual" design feature. Concern over this matter was formally expressed by the Dutch civil aviation authority (RLD) during their assessment of the Model DC-10 design as early as April 1971. Neither RLD's expression of apprehension, nor the NTSB's recommendations after the AAL accident have arouse sufficient concern within the FAA to bring about positive regulatory action to correct this situation.

Specific questions relative to what regulatory changes are needed and what change would produce the most significant results can best be answered through a

process of extensive consultation with all interested parties, including recognized organizations from all quarters of the aviation manufacturing and operational industry. In addition to the detailed questions already raised regarding floor strength, venting, vital system locations, etc., a more general question might be asked regarding the degree of depressurization which should be anticipated in service, and what is the inherent capabilities in this regard in today's fleet of smaller transport aircraft (i.e., B 707, B 727, DC-8, DC-9, BAC 1-11, etc.). It is questionable that loss of a door at altitude could be tolerated on any of the modern jet transport aircraft in service today.

Corrective Action After the AAL Accident

The agency was not effective in attaining adequate fleet-wide corrective action on a timely basis after problem areas were clearly indicated by the AAL accident of June 1972. Non-regulatory procedures and agreements were used in lieu of established regulatory (i.e., FAR 39) Airworthiness Directive (AD) procedure. The procedures used in lieu of AD action, in the long run, proved to be ineffective in correcting design deficiencies on a timely basis to prevent reoccurrence of the AAL accident. The last FAA message sent to the airlines and FAA Regional Offices on June 19, 1972, stated "this telegram is an interim action only and will be superseded or augmented as further recommendation and design changes are forthcoming from the manufacturer." Notwithstanding this statement, no follow-up action was taken, either by AD or by follow-on messages to the operators, as further design improvements were made available by McDonnell Douglas.

The U.S. manufacturers of wide-body jets (i.e., McDonnell Douglas Lockheed and Boeing) have been nonresponsive to agency requests over the past three years to give serious consideration to the total rapid decompression problem. Up until the time of the THY accident, the agency was unable, or otherwise ineffective, in convincing these manufacturers to take meaningful exploratory action to come to grips with this serious safety problem.

Lastly, the agency has been less than responsive in formally answering the NTSB's published recommendations relative to the AAL accident. Significant corrective action was not implemented in the light of these recommendations, nor were equivalent FAA alternatives either identified or implemented. For example, it should have been pointed out to the NTSB that increased venting per their Recommendation A72-98, when taken alone, would not provide sufficient relief unless the floor was vented to such a degree as to dangerously reduce the fire protection integrity of the cargo compartments. More promising alternatives such as increased floor strength and increased protection for vital systems and controls under the floor in combination with

limited venting, should have been suggested to the NTSB; and, more positive action should have been taken by the FAA to attain accomplishment.

Service Difficulty Correction Programs

Review of the FAA's service difficulty correction programs associated with the Model DC-10 airplane has again pointed out that the agency has been lax in taking appropriate Airworthiness Directive (AD) action where the need for ADs are clearly indicated. This situation is by no means unique to the Model DC-10 airplane or to the Western Region. So-called "voluntary compliance" programs have become common place on a large number of aeronautical products and in most, if not all of the regions. Voluntary compliance programs have been, in fact, most commonly implemented on the smaller private and executive aircraft types, where the number of ADs issued is most likely to be considered a sales deterrent by the manufacturer.

Many complaints on this issue have been received from a number of foreign airworthiness authorities who have airworthiness responsibility over U.S. manufactured products in their respective countries; and, for the most part, the FAA has ignored these complaints.

Aircraft Certification Organization

Under present organizational structure, all aircraft certification functions except the issuance of special conditions are delegated to the regions. These functions, among other things, include findings of compliance with the applicable airworthiness standards, interpretation of the standards in many cases, findings of equivalent safety, issuance of type certificates, issuance of production certificates, and issuance of individual article airworthiness approvals. Issuance of Airworthiness Directives are also delegated to the domestic Regional Directors (European, Pacific, and Alaskan Regions excluded). This organizational structure and the associated delegations have led to de facto rulemaking by local precedent, non-uniform application of the rules between regions, and possibly, serious breakdowns in lines of communication and authority.

Extensive criticism of the FAA's aircraft certification organization has been voiced within and from outside FAA. The Brooks' Subcommittee hearings centered around inadequate control by FAA of products being approved, ineffective or untimely corrective action of service problems, and unequal treatment in application of rules. The Windsor (AAL) and Paris (THY) Model DC-10 accidents can be expected to cause a renewal of these criticisms. The current organization structure makes resolution of

these criticisms extremely difficult, if not impossible, under present manpower restrictions.

The current organizational structure encompasses five non-technical layers between each regional aircraft Engineering and Manufacturing (E&M) offices and the Headquarters E&M office (AFS-100). Multiplying this by the fact that there are twelve regional E&M offices results in a totally unwieldy organization that cannot avoid the problems noted. Additionally, while the number of man-hours required to complete design certification of a given new product has increased substantially with each new generation in aircraft design technology, the number of FAA engineers available to accomplish these tasks has held relatively constant. This fact along with the dispersion of the very limited FAA talent on hand across twelve regions has necessitated more and more delegation to private persons, i.e., D.E.R.s, D.M.I.R., D.O.A. manufacturers, etc. During the June 13, 1973, Brooks Subcommittee hearing on the FAA's delegation of aircraft certification responsibilities, the General Aviation Manufacturers Association (GAMA) recommended - "centralize aircraft engineering knowledge, skills, and authority within the FAA."

If the FAA is to keep abreast of modern aeronautical design and production technology, and the technological advances to be expected in the foreseeable future, it will be necessary for the agency to begin to move toward consolidation of more highly specialized aeronautical engineering skills into a well-disciplined, centralized aircraft design and production engineering organization. A small number of domestic and international field offices, reporting to a central office, should be retained at convenient locations to handle the routine day-by-day problems; however, all major programs and approvals should, in time, be managed and accomplished by a Central Engineering Field Office. In addition to the field offices, there should continue to be an Airworthiness Policy office, located in Washington, D.C., which has responsibility for the development of aircraft design standards and certification procedures, and which would provide a point of independent evaluation and review of controversial issues. Both the Washington located office and central field office should report to the same Headquarters office.

ACTION RECOMMENDATIONS

The following action recommendations are listed in the order of suggested implementation priority.

1. A letter should be issued from the Office of the Administrator directing all offices concerned (AFS-1 and domestic Regional Directors) to utilize AD procedures in all future cases when a change to the approved type design is needed to correct an unsafe condition that is likely to exist or develop in other products of that type. (FARs 21.99 and 39.1 refer to this subject.) The use of GENOTs or other non-regulatory means should be discontinued for this purpose unless prompt followup by appropriate AD action is also implemented. (Accomplished by AOA-1's April 9, 1974, letters to AFS-1 and all Regional Directors.)

2. The agency's AD policies should be taken under study in consultation with all interested persons to determine if regulatory or procedural changes are needed. (Accomplishment assigned to AFS-1 per AOA-1's letter of April 9, 1974.)

3. Agency procedures for dealing with findings of "equivalent safety" under FAR 21.21(b)(1) should be more clearly defined by either regulations or agency directive. The procedure should require concurrence from a central control point as a prerequisite for making such a finding to insure consistency in agency regulatory policy between regions and between projects, and to provide the agency with information necessary for implementation of needed regulatory updating.

4. An immediate in-depth technical reassessment (critical design review per HDBK 8110.4) of the Model DC-10 design should be conducted to determine if additional modifications are required to the airplane design in order to cope with rapid decompression from various causes, including the explosion in flight of small bombs. In this review, a system safety analysis should be made of the pressure cabin doors using probabilistic procedures, fault-mode analysis, consequence of failures, including human factors and operational procedures. In addition, compartment partition

structural strength and failure modes should be considered in relation to the location of vital systems. The review should consider the need to define a follow-on mandatory design modification program. This technical reassessment should be conducted by a special team of agency aircraft certification experts, staffed from within FAA (and possibly NASA) resources other than the original certification office.

5. Follow-on critical design review of all other U. S. manufactured wide-body jets, i. e., the Lockheed Model L-1011 and Boeing Model 747 should be conducted in accordance with the criteria set forth in (4) above.

6. A thorough regulatory review of the current airworthiness standards should be implemented to determine if amendments are needed relative to fuselage pressure containment and/or increased protection from the hazards associated with rapid decompression. A process of thorough consultation with all interested persons, and the intelligence gained during the critical design reviews of recommendations (4) and (5), should be utilized to the fullest extent practicable to insure that any new standards developed would serve to minimize the hazards associated with rapid decompression from whatever cause.

7. The agency's organizational structure, assignment of pertinent functions, regulatory practices, and detail procedures relative to the formulation, and issuance of safety standards and Airworthiness Directives (i. e., rule making machinery) should be assessed in-depth and improved as found necessary to insure that agency regulatory policy, which must be developed in full consonance with the Administrative Procedures Act, does not continue to fall behind the state-of-the-art in today's rapidly advancing civil aircraft design and production technology.

8. Progressive centralization of the aircraft type design certification and productive certification functions should be initiated to increase manpower effectiveness and provide more uniform application of design and production standards. AFS-1 should be directed to develop an appropriate plan as soon as practicable.

APPENDIX B

November 25, 1974

Honorable John H. Reed, Chairman
National Transportation Safety Board
800 Independence Avenue, S. W.
Washington, D. C. 20591

Dear Mr. Reed:

Following the potentially catastrophic accident involving an American Airlines DC-10 shortly after takeoff from Detroit on June 12, 1972, the NTSB forwarded Safety Recommendations A-72-97 and 98 to the FAA on July 6, 1972. As you know, the former of these recommendations pertained to certain modifications to the aft cargo door of the DC-10. This letter concerns the subject matter of A-72-98, which recommended the following:

> "Require the installation of relief vents between the cabin and aft cargo compartment to minimize the pressure loading on the cabin flooring in the event of sudden depressurization of the cargo compartment."

In a follow-up letter to the FAA, dated February 23, 1973, the Board stated:

> "... if complete venting is not possible, partial venting would be beneficial. Such venting could prevent the complete collapse of the aft cabin floor, or it could reduce the amount of floor deflection, and attendant control cable damage in a DC-10."

By letter of March 22, 1974, shortly after the Paris disaster, the Board forwarded Safety Recommendation A-74-28 to the FAA:

> "Expedite your resolution of the cabin flooring venting problem so as to incorporate the flooring modification by Airworthiness Directive at the earliest practical date."

Now, it has come to the Subcommittee's attention through the trade press, that McDonnell Douglas recently announced it is modifying the cabin design of its DC-10 to strengthen the floor by including a higher capacity venting system between the upper and lower decks and by using DC-10 freighter floor beams on all aircraft. According to reports, all DC-10's produced for delivery after late 1975 will be so modified, however, the design changes will not be retrofitted into DC-10's currently in operation.

The venting problem raises a serious question as to whether all existing DC-10's should be similarly modified. I am not taking the position that any time a manufacturer improves his aircraft a presumption is raised that the earlier version was unsafe. It appears, however, in light of previous aircraft experience and Board recommendations, that fleet-wide venting should be accomplished at the earliest opportunity.

In view of the foregoing, it is requested that the Board review this matter and advise both the FAA and the Subcommittee concerning its current position on the need for additional venting and/or floor support on all DC-10's. Furthermore, the Board is requested to address this problem as it pertains to other wide-body transports as well.

The FAA is also being requested to furnish its views to the Safety Board and the Subcommittee concerning this matter.

Your assistance and cooperation will again be appreciated.

With kind regards,

Sincerely yours,

Harley O. Staggers

HARLEY O. STAGGERS
Chairman

November 25, 1974

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

Dear Mr. Butterfield:

Following the potentially catastrophic accident involving an American Airlines DC-10 shortly after takeoff from Detroit on June 12, 1972, the NTSB forwarded Safety Recommendations A-72-97 and 98 to the FAA on July 6, 1972. As you know, the former of these recommendations pertained to certain modifications to the aft cargo door of the DC-10. This letter concerns the subject matter of A-72-98, which recommended the following:

> "Require the installation of relief vents between the cabin and aft cargo compartment to minimize the pressure loading on the cabin flooring in the event of sudden depressurization of the cargo compartment."

In a follow-up letter to the FAA dated February 23, 1973, the Board stated:

> "... If complete venting is not possible, partial venting would be beneficial. Such venting could prevent the complete collapse of the aft cabin floor, or it could reduce the amount of floor deflection, and attendant control cable damage in a DC-10."

By letter of March 22, 1974, shortly after the Paris disaster, the Board forwarded Safety Recommendation A-74-28 to the FAA:

> "Expedite your resolution of the cabin flooring venting problem so as to incorporate the flooring modification by Airworthiness Directive at the earliest practical date."

In connection with the Subcommittee's investigation following the Paris crash, certain FAA documents were made available. One such document, a letter dated February 2, 1973, from the Chief, Aircraft Engineering Division of the FAA's Western Region to McDonnell Douglas Company, requested the company to reassess the design of the DC-10 to enable it to withstand sudden depressurization of the cargo compartment. Concern is expressed in this letter over the long range safety implications of the Detroit incident.

> "Experience has also indicated that the probability of massive pressure vessel failures due to loss of non-plug cargo doors or small bomb explosions in passenger or cargo compartments may be sufficiently probable to require design consideration. ... While we recognize that it may not be feasible to completely design for all aspects of such massive failures, we believe that loss of an airplane because the floor collapsed under such conditions and disrupted vital systems, would be unacceptable. For this reason, we believe it is necessary to assess the extent of the problem on the wide body jets and determine feasible solutions for situations which constitute a threat to safety."

On February 13, 1974, a year later and shortly before the Paris crash, the Western Region expressed further concern and requested McDonnell Douglas for the technical basis for its views on the effects of explosive decompression. Copies of the Western Region letters are enclosed for your convenience.

In addition, the "Chairman's Report to the Administrator of the Ad Hoc Investigative Committee Relative to the McDonnell Douglas Model DC-10 Aircraft Certification History and Service Accidents" dated April 19, 1974, and a 1969 Failure Mode and Effect Analysis of General Dynamics, a DC-10 subcontractor, raise serious questions about the possible need to take further action to insure against floor collapse.

Now, it has come to the Subcommittee's attention through the trade press, that McDonnell Douglas recently announced it is modifying the cabin design of its DC-10 to prevent floor collapse by including a higher capacity venting system between the upper and lower decks and by using DC-10 freighter floor beams on all aircraft. According to reports, all DC-10's produced for delivery after late 1975 will be so modified, however, the design changes will not be retrofitted into DC-10's currently in operation.

The venting problem raises a serious question as to whether all existing DC-10's should be similarly modified. I am not taking the position that any time a manufacturer improves his aircraft a presumption is raised that

the earlier version was unsafe. It appears, however, in light of previous aircraft experience, Safety Board recommendations, and views within the FAA itself, that fleet-wide venting should be accomplished at the earliest opportunity.

In view of the foregoing, it is requested that the FAA review this matter and advise both the NTSB and the Subcommittee concerning its current position on the need for additional venting and/or floor support on all DC-10's. Furthermore, the FAA is requested to address this problem as it pertains to other wide-body transports as well.

The NTSB is being requested to furnish its views to the FAA and the Subcommittee concerning this matter.

Your assistance and cooperation will again be appreciated.

With kind regards,

Sincerely yours,

Harley O. Staggers

HARLEY O. STAGGERS
Chairman

Enclosures

NEED FOR GROUND PROXIMITY WARNING SYSTEMS ON PASSENGER-CARRYING AIRCRAFT

Mr. STAGGERS asked and was given permission to address the House for 1 minute to revise and extend his remarks and include extraneous matter.)

Mr. STAGGERS. Mr. Speaker, I wish to draw the attention of the Members to a situation which has concerned me and the members of our investigating subcommittee for some time—the failure of the Federal Aviation Administration to require the installation of ground proximity warning systems on large passenger-carrying aircraft.

Last Sunday a tragic air disaster took place which cost the lives of 92 passengers and crew aboard a jet aircraft approaching Dulles airport. The plane crashed into a foothill of the Blue Ridge mountains. The elevation of this peak is 1,750 feet. Ordinary procedures call for aircraft to maintain an altitude of 3,400 feet in crossing this ridge. But weather conditions were bad and visibility was very limited. There is also the additional fact that the plane was being diverted from its intended landing at National airport because of wind conditions prevailing there.

The plane carried no ground proximity warning system (G.P.W.S.). This disaster is only the latest of a long series which can be traced to the lack of such a system. On September 18 of this year, our subcommittee held a hearing on the question of why the agency of our Federal Government primarily responsible for air safety, the Federal Aviation Administration, had not made the installation of such devices mandatory on large passenger-carrying aircraft. The national transportation safety board has been urging the FAA to take this step for a number of years.

The development of the GPWS has progressed to the point where it is capable of giving a timely warning to the pilot in approximately 90 percent of the instances involving what is known as controlled flight into terrain—CFIT. This term refers to a situation wherein an aircraft is completely airworthy but, through inattention, crew distraction, through poor visibility or preoccupation with weather conditions, a plane is inadvertently flown into the ground. Surprisingly enough, this type of crash accounts for 56 percent of all crashes occurring throughout the world; that is, approximately one such crash every 20 days somewhere in the world.

A device has been available for some time which sets off a flashing red light together with an alarm and a recorded voice warning "pull up, pull up," when such a terrain strike is imminent. The device requires no input from the air crew: In normal flight conditions it will never be heard. Those of us on the subcommittee who have seen this device demonstrated will attest to the fact that the warning is both arresting and unforgetable. It cannot be ignored, nor can it be turned off except by taking immediate remedial flight correction.

Furthermore, although the device is ingenious, it is not expensive. The cost of equipping a large passenger-carrying jet, for example, runs in the neighborhood of $10,000. When we consider that such aircraft commonly carry hundreds of passengers, and cost $15 to $30 million, the cost of this device is trivial.

As I initially noted, Mr. Speaker, the National Transportation Safety Board has, for many years, urged the FAA to require the installation of such devices on commercial aircraft. The FAA's position has been that:

> Present instrumentation and procedures provide for safe and adequate terrain clearance, as long as proper flight crew discipline is maintained and appropriate flight operations procedures are followed.

But there is a flaw—a fatal flaw in this logic. Situations can and do arise wherein distractions, disorientation caused by poor visibility or other adverse weather conditions, can interfere with the flight crew's ability to follow the regular procedures. In such situations—and they frequently occur—a back-up warning system is vital. We have documented case after case wherein experienced and conscientious pilots, when confronted with weather emergencies, or other distracting situations, have lost

track of the aircraft's precise altitude, with fatal consequences. This is not an indictment of the flight crews, it is merely a recognition of the fact that they are human like the rest of us.

The only hopeful indication of some activity on the part of FAA—prior to the announcement of our subcommittee hearings last September—was the issuance of an advance notice of proposed rulemaking in April of 1973. Despite the fact that this is a vital matter affecting the safety of the air traveling public, month after month went by with nothing further done by the FAA. At the time that our subcommittee hearing was announced, a year and a half had gone by since the advance notice, without further word from the agency. My staff inquired as to the status of this matter, and were given indefinite responses.

Once the hearing was announced, however, action was forthcoming. On Monday, September 16, 1974, 2 days before our hearing, the FAA placed a notice of proposed rulemaking in the Federal Register calling for comments to be submitted over a 90-day period concerning a proposal to require installation of the G.P.W.S. device on all large passenger-carrying aircraft. The device, according to the proposed rule, would be installed over an 18-month period. Since our hearings, I have tried to influence the agency to speed up its processes. I am including in my statement copies of correspondence I have had with FAA Administrator Butterfield on this subject.

The crash last Sunday was, as I have said, the latest incident in a tragic series. Our staff examined the crash site on Sunday, and has been following this matter closely since that time. The Transportation Safety Board's inquiry is still in progress. Information available to me, however, suggests the following significant factors:

First, the aircraft was completely airworthy, with no indication of any mechanical difficulty.

Second, weather conditions were adverse, visibility was limited, and the landing site, as I mentioned earlier, had been changed from National Airport to Dulles.

Third, the plane was in a controlled descent preparatory to landing at Dulles; there is no indication of any severe downdraft or turbulence which would have forced the plane to crash.

Fourth, the plane was generally in level flight, but approximately 1,700 feet below the appropriate altitude for crossing this peak. The plane's instruments seem to have been working normally.

Fifth, finally, for reasons which perhaps we will never know, the flight crew was apparently unaware of their peril. Our information is that the crew and passengers never knew what hit them.

In short, Mr. Speaker, we have lost 92 lives in this year's worst domestic air tragedy and—it pains me to say this—I believe that that loss was unnecessary. I believe that, had this aircraft carried a ground proximity warning system, a timely warning, and an unmistakable one, would have been sounded in sufficient time to alert the pilot to avoid the peak of this mountain.

This is a strong statement, I know, but it is based on ample evidence. Furthermore, at my request, members of my staff flew over the crash site in a plane equipped with a GPWS devices. The flight path simulated, as closely as possible, the path of the plane which crashed on Sunday. I am advised by my staff that as the plane approached the mountain, retracing the steps of the TWA aircraft, that approximately 14 seconds before the estimated time of impact, the device sounded its alarm. Even half of this warning time, according to our information, would have been more than adequate to avoid this crash.

Mr. Speaker, we have developed a public record at our hearing which, to my mind, should have been sufficient to satisfy all reasonable doubts as to the necessity of installing this device. I am now publicly calling on the FAA to require its installation at the earliest possible moment, and upon the airlines to cooperate fully in this action. We have satisfied ourselves that the existing inventories and production capacity are sufficient to permit rapid deployment throughout our commercial air fleet.

For some time, the device has been used routinely on a number of foreign air carriers. There has been no known instance of a plane equipped with a ground proximity warning device being involved in a CFIT type crash. Pan American Airline, despite its pressing financial difficulties, has announced its intention of equipping its entire fleet with this device; half of the Pan Am planes have already been so equipped. The Boeing Aircraft Co. has now made this device standard on all production-line aircraft.

Congress has equipped the FAA with the regulatory authority necessary to take the action which is so desperately needed here. In the words of St. Paul: "Now is the acceptable time." The means are at hand to save lives. Let us use them.

I include the following:

CONGRESS OF THE UNITED STATES,
Washington, D.C., December 2, 1974.

Hon. ALEXANDER P. BUTTERFIELD,
Administrator, Federal Aviation Administrator, Department of Transportation, Washington, D.C.

DEAR MR. BUTTERFIELD: Following the Subcommittee's hearing on September 18, 1974, inquiring into the feasibility of requiring Ground Proximity Warning Systems (GPWS) on all commercial aircraft, I wrote you asking that every effort be made to expedite the FAA's rulemaking proceeding in this matter. I urged you to shorten the time for public comment, as well as the time for FAA evaluation of such comments, and for a reduction of compliance time should a rule be adopted requiring installation of such a device.

You thereafter advised me by letter on October 1, 1974, that you would reduce the time for public comment on the FAA's Notice of Proposed Rulemaking (NPRM) from 90 days to 60 days, thus ending the comment period on November 16, rather than December 16, 1974. Moreover, you advised that the FAA would complete its review of these comments within three months as opposed to five months originally planned. Finally, you stated that you felt the proposed 18 months installation period could not be reduced and may even be optimistic. You advised that you were informed by your technical staff that a 12-month period for installing the device would not be realistic based on previous experience with regulatory requirements for other warning systems, such as the altitude Alerting System.

Yesterday, 92 persons aboard a TWA Boeing 727 lost their lives in a mountaintop strike during a bad weather approach for landing at Dulles Airport. As you know, the plane had been diverted from its intended destination at National Airport due to the inclement conditions.

While it is too soon to positively know the cause of the crash, early indications strongly suggest that poor visibility and disorientation resulting from the bad weather could have been causative factors. It is noted that the plane crashed into the west side of a mountain with a 1,750 foot elevation approximately 20 miles west of Dulles. It is our understanding that aircraft do not descend to the 1,800 foot level until within six miles west of the airport. Moreover, there were no indications of mechanical difficulty. It would appear from this information that a GPWS may have provided the warning necessary to have avoided this disaster.

You will recall, I am sure, that testimony at the Subcommittee hearing adduced that over 50 percent of all commercial aviation accidents, or one accident every 20 days throughout the world, involve controlled flight into terrain. These are accidents which occur when an otherwise airworthy aircraft is inadvertently flown into the ground and they result from such causes as poor visibility, navigation error, visual misconception, instrument misreading and confusion. One industry study reveals that over 1,200 persons died in 1972 and 1973 alone from this kind of accident.

In light of the foregoing, I must urge you again to shorten even further the FAA's period of comment evaluation. The agency has had more than sufficient time to evaluate the concept as well as "on the shelf" equipment which is available for installation.

Furthermore, I must strongly urge that the FAA consider shortening the 18-month installation period once the rule requiring the device is adopted. In your letter of October 1, 1974, commenting on previous experience with the altitude alerting device, you note that the compliance period had to be extended because of unforeseen problems in the manufacture and distribution of the equipment. The Subcommittee has been advised by Sundstrand Data Control, Inc., the manufacturer of a GPWS presently available, that it is not production limited. It would appear that Sundstrand alone could meet the requirements of 12-month compliance period for the entire domestic carrier fleet. If subsequent circumstances appear to require an extension of the installation period, that is the proper time to consider it. In my view, we cannot afford to take an unnecessarily negative approach when lives are involved and I, therefore, believe that the earliest feasible compliance period based on current industry information should be established.

Please advise me of any further action you intend to take in this matter.

Sincerely,

HARLEY O. STAGGERS,
Chairman.

DEPARTMENT OF TRANSPORTATION,
FEDERAL AVIATION ADMINISTRATION,
Washington, D.C., October 1, 1974.

Hon. HARLEY O. STAGGERS,
Chairman, Special Subcommittee on Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: Thank you for your September 19 letter. I share your belief that the hearings provided a useful review of the present capabilities of the Ground Proximity Warning System (GPWS) and the need for installing it on all commercial passenger aircraft.

I appreciate your concern over inappropriate administrative delay and wish to assure you that final rulemaking action will

be taken on Notice of Proposed Rule Making (NPRM) 74-32 as expeditiously as possible. We have reviewed the necessity for requiring the 90-day public comment period contained in the Notice and agree that 60 days should provide an adequate opportunity for interested persons to submit written comments. Consequently, the time period for submitting comments will be reduced to 60 days. In addition, we plan to complete our review of these comments within three months.

As desirable as it may be, my technical staff advises me that a 12-month period for installing the device is not realistic based on previous experience with regulatory requirements for other warning systems, such as the Altitude Alerting System. For example, several manufacturers assured the Federal Aviation Administration that sufficient quantities of a relatively simple altitude alerting device would be available for installation during the 30 months allowed for compliance. The effective date of this rule had to be extended because of unforeseen problems in the manufacture and distribution of the equipment. Accordingly, we believe that the proposal to allow 18 months for installation of the GPWS may be optimistic.

I appreciate your interest in this matter; and if I can be of further service, please let me know.

Sincerely,

ALEXANDER P. BUTTERFIELD,
Administrator.

CONGRESS OF THE UNITED STATES,
Washington, D.C., September 19, 1974.

Hon. ALEXANDER P. BUTTERFIELD,
Administrator, Federal Aviation Administration, Department of Transportation, Washington, D.C.

DEAR MR. BUTTERFIELD: First of all, let me thank you and your staff for your appearance before the Subcommittee yesterday. I believe that the hearings provided a useful review of the present capabilities of the Ground Proximity Warning System, and the compelling need for its expeditious installation on all commercial passenger aircraft. I was pleased to note that you affirmed the FAA's agreement with this proposition, and stated the agency's position in favor of installation.

I would like to reaffirm, however, the very serious concern which I expressed yesterday during the hearing, that an inappropriate administrative delay appears to be in prospect before the air traveling public will be able to benefit from the additional safety which this device provides. Specifically, I question the necessity of allowing ninety days to receive comments on the proposed rule requiring installation of this device. I fully endorse the remarks of my colleague on the Subcommittee, Congressman Pickle, on this score. Having already gone through an advance rulemaking proceeding last year—which consumed ninety days for the submission of comments, a further nine months for FAA analysis of those comments, and a further five month period during which the FAA considered the staff analysis and recommendation for issuance of a proposed rule—it does distress me that we seem on the verge of repeating the whole administrative process all over again. I believe that the estimates provided to us by your staff, whereby the comments would not be required until December 16 with FAA analysis to continue on until April of next year, are inappropriate in view of the exhaustive review of the GPWS question which has already taken place in the industry and within the FAA itself.

I was very pleased and encouraged by your statement to us yesterday that you will review and consider shortening the announced ninety-day period for submission of comments on this question. I agree with Congressman Pickle's suggestion that this period be shortened to no more than sixty days. Frankly, it seems to me that it is unlikely that the comments to be received by the agency in response to its notice of proposed rulemaking will add substantially to the body of knowledge already in hand. On that basis, let me suggest that even thirty days would seem to be adequate under the circumstances.

Secondly, I hope that the estimate given us yesterday, whereby the FAA would take five months to review the comments in this latest proceeding, could be reduced to no more than three months. My reasons for urging this are simply that we are not dealing here with a matter which needs to be the subject of exhaustive research. We have a device presently available which is relatively inexpensive and which can be manufactured in sufficient quantities to allow for rapid deployment within the commercial air fleet.

Finally, I must question the 18-month period which the proposed rule allows for installation of the device. On the basis of our information, it seems to me that 12 months would be an ample period of time. Again, I concur with Mr. Pickle's recommendation to you on this point.

In view of all of these considerations, I urge you to announce through the Federal Register that the period for submission of comments has been reduced—at the least—to sixty days. Since the NPRM appeared only four days ago, this amendment by the FAA could not work a hardship on any interested party desiring to submit comments. Secondly, I urge you to amend the proposed rule itself so as to provide for a 12-month installation, rather than 18 months as presently provided. Finally, I urge that FAA's administrative review of the comments on the proposed rule be held to no longer than three months rather than five months, which was the estimate we had yesterday.

If you concur in these recommendations, it will result in cutting at least nine months from the process. In view of the statistics showing the rate at which CFIT accidents occur, this reduction in time could have a significant effect on air safety.

Please advise me of the action you intend to take in this matter.

Sincerely,

HARLEY O. STAGGERS,
Chairman.

BETTER SAFETY EQUIPMENT NEEDED ON COMMERCIAL AIRCRAFT

(Mr. PICKLE asked and was given permission to address the House for 1 minute and to revise and extend his remarks.)

Mr. PICKLE. Mr. Speaker, a few minutes ago the chairman of the House Committee on Interstate and Foreign Commerce, the gentleman from West Virginia (Mr. STAGGERS) addressed remarks to this body pointing out the tragedy that occurred in the Blue Ridge Mountains just west of here, when 92 lives were lost in a TWA crash. That statement was clear and unmistakable in that he felt, based on investigations, the accident might have been prevented had certain equipment been aboard that TWA plane.

There is now a ground proximity warning system being installed on many planes which we believe, if put into force immediately by the FAA, could save countless lives. It is always very difficult to say that a particular crash could have been avoided because of certain circumstances, whether it was instrument or pilot error. It is even more difficult to make those statements at an hour and time of national tragedy.

Nevertheless, a member of our investigations subcommittee staff flew this same area yesterday to test whether or not that particular equipment would have provided a warning. It is an audio-warning signal and it says, "Pull up, pull up," in five different instances if there has been a failure of either pilot error or of instrument. It is a computerized system. In this particular instance, we believe that possibly the instrument would have shown the excessive terrain closure rate in a manner that would have allowed at least a 14-second warning for that pilot to have pulled up.

We cannot be sure of that. We cannot make that as a positive statement, but it does indicate that this accident might have been prevented. Our subcommittee held hearings on this matter 45 days ago with FAA. We attempted to find out why the FAA has not insisted on this in their rulemaking procedures during the last 2 years.

They have agreed, we believe, to definitely require this as a new instrument of safety on all the commercial airplanes. We have asked them to shorten the time of the proposed rulemaking procedure so that both the notice would be shortened and so that the time for decision could be shortened. Certainly, a period of 18 months could be reduced to 12 months or less for the actual installation of this instrument.

The FAA has given cooperation in that they have reduced some of that time, but they still are not insisting that this instrument be put on in the shortest possible time. FAA is not moving fast enough.

I call upon the FAA again to take this action, and to take it quickly. During the hearings we pointed out in three or four instances the slowness with which the FAA implemented safety rules. I would like to insert at this point two or three instances to show that the FAA is very slow in the adoption of reasonable rules.

One of the things which has distressed me about the FAA's approach to some of these safety related matters is the long drawn out timetable involved.

Earlier this year, the subcommittee held a hearing on the DC–10 cargo door situation which caused the Paris crash. There we found that the FAA was put on notice almost 2 years previously by a near miss at Detroit that there was a problem with the door closing mechanism. Yet, the FAA did not issue an airworthiness directive requiring the door to be fixed until a couple of days after the crash.

Again, earlier this year the subcommittee held hearings on the subject of hazardous air cargo being carried on commercial passenger flights. At that hearing, we found out that the FAA had received authorization in August of 1973 to employ 18 individuals full-time at various FAA offices to work exclusively on hazardous materials matters. At our hearing on April 25, 1974, we heard testimony that the FAA still had not filled many of these highly critical positions, even though they were authorized months earlier.

Another matter which has come to the staff's attention involves the problem whereby, on a certain type of aircraft, it was found that pilots were deploying what are known as ground spoilers too early in the landing process. As I understand it, these devices are used to slow and settle the plane once it touched down, but they cause the plane to plummet to Earth if they are accidentally deployed in flight. The indications to me from our staff's inquiry are that the FAA proceeded very slowly to deal with this problem. In fact, after the problem first became known to the FAA in connection with a Montreal crash killing 109 in July 1970, the FAA's first response was simply to post a sign on the switch which said, "Do not deploy spoilers in flight." That was described to our staff by one aircraft safety expert as akin to putting up a sign saying, "Do not crash this airplane." Now, after another accident occurred in June 1973 at JFK Airport, due to the same cause, the matter is being addressed more realistically, but, again, after considerable lost time. Fortunately, no one of the 128 on board were killed; 8 were seriously injured.

It is my feeling that we find again that the FAA and its rules are inordinately slow and cumbersome. They are examined almost until the incident of the need is forgotten. At times, I must say that there are indications that the FAA becomes more industry oriented than they are even in timesaving procedures, and at times, it would appear, even in lives.

That is a harsh statement, but I think it is an indication that this body, this Congress, must say to FAA, "You represent the public, and take quicker action when these problems are brought to your attention."

APPENDIX D

Title 14 - Aeronautics and Space

CHAPTER I - FEDERAL AVIATION ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

[Docket No. 12762; Amdt. No. 121-114]

PART 121 - CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

Ground Proximity Warning Systems

The purpose of this amendment to Part 121 of the Federal Aviation Regulations is to require installation of an approved ground proximity warning system on each large turbine-powered airplane (turbojet and turboprop) used in operations under Part 121. These amendments also apply to air travel clubs certificated under Part 123 and to air taxi operators certificated under Part 135, when conducting operations governed by those parts with large turbine-powered airplanes.

Interested persons have been afforded an opportunity to participate in the making of this amendment by a Notice of Proposed Rule Making (Notice 74-32) issued on September 12, 1974 (published in the Federal Register on September 16, 1974; 39 F.R. 33234), as amended by Notice 74-32A, issued October 1, 1974 (published in the Federal Register on October 7, 1974; 39 F.R. 36017). Due consideration has been given to all comments presented in response to the notice. Except for editorial changes, and except as specifically discussed hereinafter, these amendments and the reasons therefor are the same as those in Notice 74-32.

Of the 31 public comments received in response to Notice 74-32, 18 favored the adoption of the proposed rule. Some commentators recommended changes that are discussed hereinafter. Several commentators made suggestions that were not within the scope of the notice, and, accordingly, those comments are not discussed, but will be retained by the FAA for future study.

In light of recent air carrier accidents involving large turbine-powered airplanes caused by inadvertent contact with the ground, the FAA believes that public interest requires the installation of ground proximity warning systems on these aircraft as soon as possible. Based on comments received and on further investigations, the FAA has determined that these systems can be developed, manufactured, and installed on all large turbine-powered airplanes operated under Part 121 by December 1, 1975. Accordingly, § 121.360, as adopted, prohibits the operation of a large turbine-powered airplane under Part 121 after December 1, 1975, unless it is equipped with a ground proximity warning system that meets the requirements of that section.

Several commentators asserted that flight crewmembers now have adequate warning of ground proximity through the use of present instrumentation, including altitude alerting systems, and appropriate inflight procedures. The FAA believes that present instrumentation and inflight procedures provide for safe and adequate terrain clearance as long as proper flight crewmember discipline is maintained and appropriate

flight operations procedures are followed. However, notwithstanding those instruments and procedures, as stated in Notice 74-32, a number of air carrier accidents involving large turbine-powered airplanes have been caused by inadvertent contact with the ground, and might have been avoided if a ground proximity warning system had been installed to give warning of the impending disaster to the flight crew.

Several commentators pointed out that the warning system should operate during non-precision approaches. The FAA agrees, and any system for which approval is sought under new § 121.360 must be capable of providing warnings during non-precision approaches.

A number of comments were received with respect to the kind of warnings to be given. One commentator suggested that a visual warning should not be required, since it could distract the pilot from taking corrective action. For the same reason, another commentator stated that the warning should not operate continuously until the hazardous condition no longer exists and should be capable of being muted or cancelled.

The FAA believes that a ground proximity warning system should provide automatic and distinct aural and visual warnings with no required input from the flight crew, and that it should operate continuously as long as a terrain hazard exists, since the cessation of the warning might lead to a mistaken belief that the hazard no longer exists. The

FAA does not agree that the continuous operation of either the visual or the aural warning will distract the pilot from taking corrective action.

With respect to comments concerning the capability of the equipment that would be required under the proposed rule, it should be noted that the equipment must be capable of providing not only a warning based on the rate of descent of the aircraft and the height of the aircraft above the terrain directly beneath the aircraft, but also a warning based on the computed height of the aircraft above the terrain along the aircraft's projected flight path. The rule, as adopted, has been clarified so that it clearly states this requirement and the other requirements for approval discussed in the preamble to Notice 74-32.

One commentator contended that turbopropeller-powered airplanes should not be required to have the proposed warning system because they do not have "sink rates" as high as those of turbojet-powered airplanes, they are more responsive to the application of power, and they are less subject to an insidious loss of altitude after takeoff. In addition, the commentator indicated that the proposed warning system requirement would cause engineering and installation problems for older aircraft. The FAA does not agree that turbopropeller-powered airplanes should

be excepted from this requirement, since a review of air carrier accidents involving inadvertent contact with the ground does not support such an exception.

One commentator questioned whether the rule as proposed would require a ground proximity warning system separate from all other aircraft systems. It was not the intent of the FAA to preclude the integration of such a warning system with other aircraft systems when compatability exists.

Certain commentators pointed out that the requirement in proposed § 121.360(a), that the ground proximity warning system provide a warning at any height less than 3,000 feet above the ground, is not appropriate in the light of the capability of radio altimeters presently in use in large turbine-powered airplanes. The FAA agrees, and § 121.360(a), as adopted, requires only that the system provide a warning at any height less than 2,500 feet.

A number of commentators urged the FAA to expedite the development of standards for ground proximity warning systems. As stated in Notice 74-32, the FAA has initiated a study to develop either a Technical Standard Order or an amendment to Part 25 establishing specific standards. The FAA expects to issue those standards in the very near future. However, pending the development of such standards the FAA intends to continue to approve the installation of ground proximity warning systems through the issuance of supplemental

type certificates after compliance has been shown with the general equipment requirements of Part 25.

The phrase "impending terrain hazard" in proposed § 121.360(a) has been changed to "imminent inadvertent contact with the ground," so as to more clearly describe the hazard for which the system must provide a warning.

Proposed § 121.360(c) would have prohibited the operation of a large turbine-powered airplane under Part 121 6 months after the effective date of the amendment unless it had been equipped with a radio altimeter that automatically provides a discrete aural warning when the airplane descends below a predetermined height between 1,000 and 500 feet above the ground. In view of the shortening of the period for compliance with § 121.360(a) to require the installation of ground proximity warning systems by December 1, 1975, proposed § 121.360 (c) has not been adopted.

In lieu of proposed § 121.360(d), a reference to new § 121.360 has been added to § 121.303(d)(2). This will prohibit the takeoff of any large turbine-powered airplane being operated under Part 121 unless the ground proximity warning system required by § 121.360 is in operable condition. However, § 121.627(c) will allow the continuation of a flight beyond a terminal point with the equipment inoperative if the minimum equipment list and procedures for the continuation of flight are included in the certificate holder's manual.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423, and 1424. Section 6(c) of the Department of Transportation Act; 49 U.S.C. 1655(c).)

In consideration of the foregoing, and for the reasons stated in Notice No. 74-32, Part 121 of the Federal Aviation Regulations is amended, effective January 13, 1975, as follows:

1. By amending paragraph (d)(2) of § 121.303 by deleting the phrase "and 121.359" and substituting therefor the phrase ", 121.359, and 121.360".

2. By adding a new § 121.360 immediately after § 121.359 to read as follows:

§ 121.360 Ground proximity warning systems.

(a) After December 1, 1975, no person may operate a large turbine-powered airplane unless it is equipped with an approved ground proximity warning system that is designed, constructed, and installed to provide a warning of imminent inadvertent contact with the ground.

(b) The ground proximity warning system required by paragraph (a) of this section must --

(1) Operate at any height less than 2,500 feet above the ground;

(2) Provide both visual and aural warnings that --

(i) Initiate simultaneously and are distinct from each warning provided by any other aircraft warning device;

(ii) Initiate automatically without any crewmember action; and

(iii) Operate continuously until the hazardous condition no longer exists; and

(3) Provide warnings based on the --

(i) Rate of descent of the aircraft (including any negative rate of climb after takeoff) in relation to the height of the aircraft above the terrain directly beneath the aircraft;

(ii) Computed height of the aircraft above the terrain along the aircraft's projected flight path;

(iii) Landing gear and flap positions of the aircraft; and

(iv) Performance capability of the aircraft.

(signed) Alexander P. Butterfield
Administrator

Issued in Washington, D. C., on DEC 18 1974

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