Michelle E. Bernson
Chief Engineer
Air Safety Investigation
Commercial Airplanes

The Boeing Company
P.O. Box 3707 MC 07-32
Seattle, WA 98124-2207

15 June 2012
66-ZB-H200-ASI-18661

Mr. Bill English
Investigator In Charge
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington DC 20594-003
Via E-mail: bill.english@ntsb.gov

BOEING

Subject: Boeing Submission for Omega Aerial Refueling Services 707 N707AR Takeoff Accident at Point Mugu Naval Air Station, California – 18 May 2011

Reference: NTSB Tech Review Meeting on 9 May 2012

Dear Mr. English:

As requested in the reference meeting, please find enclosed a copy of The Boeing Company's submission on the subject accident. This submission is being sent only to you, and it is our understanding that you will distribute it to the NTSB board members.

We would like to thank the NTSB for giving us the opportunity to make this submission. If you have any questions, please don't hesitate to contact us.

Best regards,

[redacted]

Michelle E. Bernson
Chief Engineer
Air Safety Investigation

Enclosure: Boeing Submission to the NTSB for the subject accident

Submission to the
National Transportation Safety Board
for the

Omega Aerial Refueling Services
707 N707AR Takeoff Accident
Point Mugu Naval Air Station, California
18 May 2011

The Boeing Company
15 June 2012

INTRODUCTION

On May 18, 2011 at 5:27 pm Pacific Daylight Time (PDT), a modified Boeing 707 registration N707AR, operated by Omega Aerial Refueling Services (OARS) as flight 70, crashed on takeoff from runway 21 at the Point Mugu Naval Air Station, California (KNTD). The airplane impacted beyond but adjacent to the departure end of the runway and was destroyed by the impact forces and by post-impact fire. The three flight crewmembers received minor injuries.[1]

Submission Abstract

- The Boeing Company, as the airplane manufacturer, is an invited party to the investigation and provides technical and operational assistance to the National Transportation Safety Board (NTSB) in their investigation.
- The conclusions presented in this submission are based on factual information received from the NTSB, Boeing expertise, the use of analytical tools and a methodical investigation process.
- The #2 engine and pylon departed the left wing shortly after liftoff and struck the #1 engine inlet cowling leading to a significant loss of thrust on the left side of the airplane.
- The #2 engine pylon mid spar fitting had a pre existing fatigue crack which had propagated to a critical length prior to or during the accident flight takeoff.
- The original mid spar fittings had not been replaced with a more fatigue resistant design although such replacement was documented in the aircraft's maintenance records and required under an FAA Airworthiness Directive.
- Omega had been accomplishing the required inspections until it was noted and interpreted that the fittings had been replaced with the newer versions.

[1] NTSB Operations Factual Report, dated October 7, 2011

BOEING ASSISTANCE WITH THIS INVESTIGATION

The National Transportation Safety Board (NTSB) is conducting the investigation into the OARS 707 accident. Assisting the NTSB in its investigation are the Federal Aviation Administration, Omega Air Refueling Services, Inc., US Navy, Boeing, Pratt and Whitney, and other designated parties.

As the manufacturer of the 707 airplane, Boeing's specific role in this investigation has been to provide technical information regarding the airplane design and operation to assist the NTSB.

Furthermore, the NTSB invited all parties to submit proposed findings to be drawn from the factual information established during the course of the investigation. Boeing has responded to the NTSB invite with this document, which -

- Provides an assessment of the factual information and other pertinent data.
- Identifies knowledge gained from the investigation.
- Identifies conclusions and recommendations supported by the knowledge gained from the investigation.

BOEING ASSESSMENT

The Boeing assessment of the accident is based on the facts as documented in the NTSB's factual reports. These reports are observations of the airplane wreckage and accident site.

ACCIDENT FLIGHT

The flight was scheduled under a contract with the United States Navy to conduct refueling operations at a location off the California coast in a designated area. Two items were listed for deferred maintenance; neither of which involved the engines or the pylons.[2]

Based on witness video[3] and an examination of the wreckage path, it is evident that the #2 engine and pylon departed the left wing shortly after takeoff. The video shows the engine and pylon travelling outboard and up before falling back towards the ground.

Examination of the #1 engine inlet cowl noted a large depressed area on the inboard side. This cowl was found approximately 620' from the start of the debris field whereas the #1 engine and pylon were found approximately 2900' from the start of the debris field. There were no terrain features or objects on the ground which could have produced the depression in the #1 inlet cowl.[4] These facts are indicative that the #2 engine, once it departed the wing, traveled outboard and struck the #1 engine cowl causing it to separate from its engine mounting.

---

[2] NTSB Operations Factual Report dated 07 October 2011, page 11

[3] NTSB Powerplants Factual Report Attachment 1

[4] NTSB Powerplants Factual Report dated 6 October 2011, page 4.

Boeing understands that the loss of an inlet cowl significantly degrades the engine's ability to produce thrust under otherwise normal operation.

MID SPAR FITTINGS

A field examination of the accident airplane's pylon to wing attach structure revealed that the inboard mid spar support fitting exhibited a fracture face featuring a dark colored smooth thumbnail area consistent with fatigue.[5] A later detailed examination by the NTSB confirmed the thumbnail region as that caused by a propagating fatigue crack.[6]

There are two basic versions of the mid spar fitting. Whereas both are manufactured from a low alloy, high strength steel, the original version was completely chrome plated and featured shaped radii on its external corners of .38". Boeing service history shows that this older fitting design is susceptible to fatigue cracking associated with the small radii and chrome plating in a high stress area. Boeing reported to the NTSB that in service inspections have found more than 45 cases of cracked fittings. There have been several cases of in-flight engine separation directly related to a fractured fitting. In 1975, a newer redesigned version of the fitting became available. This design features larger, 1" corner radii and chrome plating common only on the pivot lug bore. Both of these features were implemented to increase the fatigue life. To date, Boeing has not received any reports of fitting cracking associated with this newer fitting design.

Boeing released a service bulletin in 1977 (707-3183, rev 1) to conduct a periodic detailed visual inspection of the older fittings as installed on the inboard engine pylons and, as terminating action, replace the fittings with the newer design. This bulletin was subject to an FAA Airworthiness Directive AD-77-09-03.

The accident airplane was manufactured in 1969 with the older fitting design installed. Review of the accident airplane's maintenance records noted that the AD had been 'completed' in 1983 (as marked with a 'C' in the AD compliance paperwork); this implied that the original fittings had been replaced.[7] This review also indicated that Omega continued to conduct the service bulletin inspections of the fittings from the time they acquired the airplane in 1994 until June, 2003 with nil defects noted.[8] As that time, Omega noted the 'complete' status of the AD and thus discontinued the inspections.[9]

Examination of the accident airplane revealed that the installed fittings were of the older design with the smaller radii and 100% chrome plating coverage.[10]

---

[5] NTSB Structures Factual Report dated 27 October 2011, page 4.

[6] NTSB Materials Laboratory Factual Report no. 11-098 dated 21 Oct. 2011, page 5

[7] NTSB Maintenance Records Report, dated 9 November 2011, page 9

[8] NTSB Maintenance Records Report, dated 9 November 2011, page 10

[9] NTSB Maintenance Records Report, date 9 November 2011, page 10

[10] NTSB Materials Laboratory Factual Report No. 11-098 dated 21 Oct. 2011, page 5

KNOWLEDGE GAINED DURING THE INVESTIGATION (Findings)

The following knowledge gained is pertinent to drawing conclusions:

- Shortly after liftoff, #2 engine and pylon separated from the left wing.
- The #2 engine and pylon travelled outboard and struck the #1 engine inlet cowl causing the cowl to separate from the engine.
- Absent its inlet cowl, there was a significant loss of thrust from engine #1.
- The departure of the #2 engine and the resultant damage to the #1 engine led to a significant loss of thrust on the left side of the airplane.
- The #2 engine pylon mid spar fitting had a pre existing fatigue crack which had propagated to a critical length prior to or during the accident flight takeoff.
- The midspar fittings installed on the accident airplane were of an older, less fatigue resistant design.
- Boeing released a newer version of the midspar fitting in 1975 which have proven more fatigue resistant.
- Inspection and replacement (as terminating action) of the fittings was mandated by the FAA in 1977.
- Service history involving the older fitting design has shown it to be susceptible to fatigue cracking and fracture. In service inspections have found over 45 cracked fittings.
- Omega had been accomplishing the required inspections until it was noted and interpreted that the fittings had been replaced with the newer version.

CONCLUSIONS

Boeing believes that the evidence supports the following conclusion for the accident:

The accident occurred because the engine #2 pylon midspar fittings had not been repeatedly inspected or replaced with a more fatigue resistant design contrary to a maintenance records which indicated that the fittings had been replaced by a previous owner of the airplane. This caused an in-flight separation of the #2 engine and pylon which travelled outboard striking the #1 engine resulting in separation of the #1 inlet cowl. The resultant loss of thrust from both engines degraded the airplane's performance such that the crew elected to abort the flight.

RECOMMENDATIONS

Boeing recommends that operators incorporate the actions as outlined in Service Bulletin 707-A3537 (noted below).

BOEING ACTIONS

As a result of this accident, Boeing –

- Released Alert Service Bulletin 707-A3537 which calls for inspection and application (if not already present) of the 'droop stripe' to all four engine pylons. In addition, this bulletin calls for the inspection of pylon #2 and #3 midspar fittings for the presence of the newer design of the fitting. If the older fitting design is installed, this bulletin instructs operators to remove and replace it with a newer design fitting.