PARTY SUBMISSION OF SUNJET AVIATION, INC.

TO THE

NATIONAL TRANSPORTATION SAFETY BOARD

LEARJET 35, N47BA

OCTOBER 25, 1999

ABERDEEN, SOUTH DAKOTA

DCA-00-MA-005

SUBMISSION OF SUNJET AVIATION, INC.

Learjet 35, N47BA
Aberdeen, South Dakota
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I. INTRODUCTION

The purpose of this submission is to provide the National Transportation Safety Board with Sunjet Aviation's analysis and conclusions regarding the circumstances and causes of the crash of N47BA.

There has been an extensive investigation which has yielded a great deal of information and analysis. There does not appear to be any question that a loss of pressurization caused the crew and passengers to lose consciousness due to lack of oxygen and/or cold. The questions which remain unanswered are what caused the loss of pressurization and what was the nature of the loss such that the flight crew did not respond.

This submission does not attempt to re-analyze data which has already been closely reviewed. Instead, this submission seeks to focus on what conclusions can and cannot be made from the data, and to address some of the unfounded allegations raised by various people interviewed during the investigation.

I. CABIN ALTITUDE WARNINGS

The investigation conducted of this accident, although developing a large body of data, does not identify any clear pressurization problem on the accident aircraft or a specific cause of a pressurization problem. The NTSB is charged with finding the probable cause of accidents. On

occasion, a probable cause cannot be determined because the factual basis for reaching a determination as to cause is just too thin to move beyond speculation. Speculating, perhaps incorrectly, potentially leads to a worse disaster as operators rely on a potentially erroneous conclusion concerning safe operation of the aircraft type.

Given the fact that a lack of pressurization seems to have occurred, the temptation to speculate is great. However, the known facts eliminate many of the obvious conclusions which may be considered. The most significant fact is that the cabin altitude warning was sounding on the CVR during the final half hour of flight, and then turned off as the aircraft descended - incontrovertible evidence that the alarm was working.

Assuming the extremely unlikely event that the professional flight crew forget to activate the pressurization system[1] or that it simply failed to work at all, it seems unlikely the flight crew would fail to notice the raising cabin altitude as the aircraft climbed, and it is inconceivable that the flight crew would ignore the cabin altitude alarm when it went off as the cabin altitude reached 10,000 feet, a level to which the crew would have ample time to respond to whatever problem existed or just to make an emergency descent for which they were trained.

An additional factor is the existence of the passenger oxygen system designed to deploy oxygen masks for passengers when the cabin altitude exceeds 13,500 feet. Even making the

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[1] Given that the aircraft's cabin altitude warning was not sounding when the aircraft was at 23,400 feet [Radar Data Study], when the co-pilot made the last transmission from the aircraft, cabin altitude must be presumed to be below 10,000 feet at that time. The Learjet analysis and the test flight [Airworthiness Group Factual Report, Attachments XVII, XVIII, and XXI] indicate that a lag of such a large amount between cabin pressure and actual altitude is unlikely, given the normal venting to the atmosphere in the Learjet. Thus the known facts confirm that the pressurization system was probably on and functioning, at least up to 23,400 feet.

unlikely assumption that the flight crew would ignore the cabin altitude warning beginning at 10,000 feet of cabin altitude, it would seem unlikely that the passengers or crew would ignore the deployment of the passenger oxygen masks, which is controlled by a solenoid independent of the cabin altitude warning.[2] With the cabin altitude warning blaring, the sudden drop of the passenger masks would certainly prompt action by at least some of the passengers. Thus, even if it is assumed the crew failed to use their own oxygen masks, one or more of the passengers would likely have donned his mask, and would have been able to respond to the collapse of the flight crew. Common sense would dictate that a passenger seeing the flight crew collapse would have take some action such as radio calls or to otherwise cause the aircraft to depart from its steady flight path. There is no evidence of any such action.

Of course, a slow pressurization leak or closure of the bleed air valve even at some higher altitude would still give the flight crew ample time to respond as the cabin altitude alarm would signal the problem while the cabin altitude was still at 10,000 feet and would soon thereafter cause the passenger oxygen masks to deploy.

The alternative theory would be some type of explosive or very rapid depressurization, which incapacitates the flight crew and passengers so rapidly that no action can be taken. Such a failure explains why the flight crew apparently took no action, not even to disconnect the autopilot or call ATC.

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[2] The assumption here is that the passenger oxygen mask solenoid was operating properly. Sunjet understands the NTSB is testing the passenger mask solenoid, but is not yet aware of the results. If it was operating, then dropping of the masks would certainly have been an additional warning of a significant problem growing more significant. If the solenoid was not operating properly, then a known pressurization system failure occurred, and further investigation of the cause and consequences needs to be completed.

The facts strongly suggest that whatever occurred happened in a very short period of time [Radar Data Study]. The co-pilot's last voice transmission occurred at 13:27:18, when she acknowledged clearance to 39,000 feet when the aircraft was at 23,200 feet. At that time the co-pilot's response gives no indication of trouble or incapacitation. (Further, although the transmission is brief, the loud aural cabin altitude warning was not sounding.) Three minutes later at approximately 13:30:43 and 30,200 feet, the aircraft initiated a six degree course change, which indicates the flight crew was still in control of the aircraft since the change would have required a pilot to manually adjust the autopilot. Approximately three minutes later at 13:33:36 with the aircraft at 36,400, N47BA did not respond to voice calls from ATC. Thus whatever overcame the flight crew occurred in a very short time, probably between 13:30 and 13:33.

A catastrophic structural failure would seeming create a significant and unique noise signature in the cabin such that the CVR would contain evidence of the failure. Yet no such significant noise signature is heard, even with the help of sound spectrum analysis.

The result is that whatever event or failure occurred was subtle enough not to leave a sound signature, yet was capable of overcoming the pilots either by sheer speed of the decompression or by masking the true nature of the emergency. Unfortunately there is no direct factual evidence of such a failure and Sunjet Aviation believes the NTSB should not speculate as to a cause where one is not known. However, historical evidence suggests areas where a single failure can lead to multiple failures, including a loss of pressurization which might not be noticeable until too late to react.

II. AGING AIRCRAFT/ELECTRICAL MALFUNCTION

A. Aging Wiring

Dangerous anomalies in aircraft wiring have been examined by the NTSB since 1983, including incidents in which electrical system failure occurred. As indicated in the September 15, 1999 Hearing before the Committee on Transportation and Infrastructure Subcommittee on Oversight and Investigations, since 1983, the NTSB had investigated at least 22 cases in which electrical wiring was cited as a cause or factor in an aircraft incident. Most involved electrical fires, but not all.

As Bernard Loeb, Director of Aviation Safety, NTSB testified on September 15,1999 to the Subcommittee on Oversight, Investigations, and Emergency Management, Committee on Transportation and Infrastructure, U.S. House of Representatives, when the protective layer of insulating material on a wire is compromised, the conductor is exposed, leading to the potential for electrical system malfunction caused by arcing or short circuit. Captain Paul McCarthy, Executive Air Safety Chairman, Air Line Pilots Association, then echoed the same concern, noting that notwithstanding the level of incorporated redundancies,[3] since wires run throughout the aircraft and are often bundled together, when these "faults" occur, a chain of events can be set in motion, ultimately triggering problems, if not outright failure, of various systems and their components.

The issue is so significant that in March, 1998, the FAA formed the Aging Non-Structural Systems team which, in July of that year, published findings which included examples

[3] While circuit breakers are the primary device for guarding against electrical malfunctions, it does not provide protection from arcing faults.

of deterioration of wiring, connecters, and clamps with contamination of wire bundles. The Clinton administration directed that a group be formed to probe the safety of aging wire in aircraft, nuclear power plants, and the space shuttles. The Aging Aircraft Program within the FAA has been running since 1988. The Aircraft Wiring and Inert Gas Generator Group (AWIGG) is also concerned about the effects of the aging on all types of insulation used for aircraft wiring and the serious problem of wire degradation. The International Aviation Safety Group and Aging Transport Systems Rulemaking Advisory Committee (ATSRAC), charged by the FAA with investigating the condition of wiring and older aircraft, shares similar concerns.

There are many types of insulating coatings on aircraft wiring, e.g. poly vinyl chloride, aromatic polyimide light weight (known as Kapton), aliphatic polyimide light weight, crosslinked ethylene-tetra, hybrid teflon polymide light weight, and each is known to have particular characteristics: for example, when burned, certain wire types are known to produce harmful gases and smoke, some deform, some age prematurely, some have nonuniform thickness, some are susceptible to arc tracking, etc. The further issue, however, is that wire ages and is caused to age by various elements and factors and in the process, it deteriorates. This can set off a chain of events that lead to a variety of unintended outcomes, irregularities, and even disastrous results.

This is compounded by the fact that through advances in things such as maintenance and technology, aircraft longevity has been prolonged. Useful aircraft life is now being extended to a point where aircraft are flown well in excess of originally-contemplated hours. For example, the wiring on the TWA 800 aircraft was designed for maximum of flying life of 60,000 hours. It had 93,303 hours.

Frequent maintenance and inspection cannot reveal all potential problems. As an example, due to the bundling of wires, their location, and the fact that literally hundreds of miles can typically go into today's commercial airliner, detecting and diagnosing wire irregularities is difficult. The same would hold true as to smaller aircraft. ATSRAC has indicated that it is generally accepted that visual and nonintrusive inspection of only 25 percent of the wiring on board an aircraft is possible. Inadvertent or unintended rough handling of wire bundles during maintenance or modifications can accelerate the cracking of wires' insulation and its deterioration. This eventually could lead to a wire anomaly and resulting consequences. ATSRAC has also indicated that presently there is no system which can accurately report on the condition of an aircraft's wiring.

The Gates Learjet model 35 involved in this accident was manufactured in 1976.[4] Older aircraft, even when properly maintained, are particularly susceptible to wire irregularities. It has been determined that the aging of wiring and conditions to which it is exposed is directly related to the failure of its insulation. Captain McCarthy indicated that the aircraft wiring aging rate is primarily affected by four areas:

1. Vibration: this is not constant throughout the aircraft and varies greatly based upon factors such as location and how the wires are intermingled: the mixing wires of different types in the same bundle has been shown to be detrimental to wire life since the harder coating on one wire can cut through the other when it is subjected to vibration.

[4] Operational Factors/Human Performance Factual Report, p. 13.

2. Moisture: most insulation material is a complex polymer. Moisture accelerates changes to the polymer thereby decreasing the insulating qualities. This can occur in a very short amount of time.

3. Temperature: elevated temperatures have been shown to increase the aging rate as do continual temperature variations and extremes (called "thermal cycles"). This thermal cycling is compounded by the fact that insulation on wiring is subjected to heat generated both by the wire itself and the surrounding equipment as well.

4. Configuration/location: each aircraft is different from another and it is usual for the same wire running on different aircraft to differ somewhat. For example, some wires withstand tight radius bends better than others. Furthermore, the manner in which wire is clamped and bundled is important in that it adds stress and strain on the insulator. Some wires accept these circumstances better than others, but all these elements affect the aging rate of the wire. This is compounded yet again with the location of the wiring which in turn is influenced by the vibration, moisture, heat and other physical stresses on the wire itself. These stresses lead to wire deterioration and cracking which, when heat and moisture are introduced, in turn lead to adverse consequences such as arc tracking, electrical failures and other unforeseen events.

Last year, NASA grounded all three space shuttles due to wiring problems and concerns, aborting one planned launch. In 1987 the US Navy ordered the removal of the most vulnerable wiring from its planes and the issue is very much scrutinized by the Armed Forces.

The potential role of the aircraft's wiring in the October 25, 1999 accident should not be overlooked. Although the pressurization system operates on solenoids, independent of electrical controls to regulate the cabin pressure, electrical controls remain connected to various parts of

the pressurization system. The Learjet 35 involved here has been for many years subjected to extremes of both heat and moisture as it has been operated out of Texas and Florida. The extent to which aging wiring may have contributed to this accident cannot be measured directly. However, a short in the modulating valve control panel, leading to anomalous operation of the bleed air system, is a scenario that can explain the apparently conflicting factual evidence.

B. Electrical Malfunctions Which Could Depressurized Learjet 35's In Flight

1. Modulating Valve Control Box

The Modulating Valve Control Box on a Learjet 35 modified pursuant to AMK 76-7[5] controls the bleed air available to the cabin. N47BA had only a single modulation control valve box, which was shared between the two engines. (Later model Learjet 35's, after Serial no.107, contain dual modulation control valve boxes.) A short due to aging wiring and/or work done pursuant to AMK 76-7 could cause a complete disruption of bleed air to the cabin.

If, due to a short, power flowed to pins L and K on P286 or in the control box, P217 and P218 would be energized. As a result, the flow control valve would close, bleed air check valves would close and air flow to the cabin would be cut off. This type of failure would be consistent with the finding during the field investigation that the flow control valve was very nearly closed at the time of impact.[6] Any attempt to use the aircraft emergency pressurization would be in vain as the bleed air would be terminated at the source.

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[5] AMK 76-7 relocated the cabin air distribution flow control valve. This modification had been accomplished on N47BA.

[6] Although impact forces and recovery work may have caused the post-accident condition of the flow control valve, it was found in the nearly closed position during the field investigation [Airworthiness Factual Report].

The flight crew would be confronted with a cabin altitude problem with little or no warning as to the nature of the problem. Bleed air and master warnings would not illuminate due to the type of failure. Thus, the first indication of the problem would be the cabin altitude warning, and, without any bleed air, the cabin altitude would ascend rapidly. As noted in the FAA Special Certification Review Team Report [Airworthiness Factual Report, Attachment XIX], at the time of this accident the Learjet fight manual called for first trouble shooting the problem when a cabin altitude aural warning sounded, and subsequently donning oxygen masks [See SCR Report, Finding 4].[7] Thus, despite following prescribed procedures, the flight crew might have been overcome before they donned their oxygen masks, as the cabin altitude rapidly ascended.

2. Squat Switch

Similarly a short due to aging wiring could have shorted the squat switch relay panel, giving an inadvertent aircraft-on-the-ground indication. The system would then open the outflow valve to relieve cabin pressure, thus causing a depressurization in flight.

III. UNFOUNDED ALLEGATIONS CONCERNING SUNJET OPERATIONS

Included as an attachment to the Operational Factor/Human Performance Factual Report is a summary of a telephone interview of Colon Webb.[8] At the time of the accident, Mr. Webb

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[7] This finding lead to the FAA issuing an Airworthiness Directive mandating a change in Learjet flight manual, requiring donning of oxygen masks before trouble shooting in the case of a cabin altitude warning.

[8] As Mr. Webb states in his interview, rather than participate in the professional investigation of the accident where allegations are checked against the known facts, within a few days of the accident he contacted the local TV station to air his allegations without waiting to see if the allegations were in fact true or correct.

was a disgruntled former ground school instructor who felt Sunjet Aviation had not allowed him to fly enough and refused to qualify him as a Part 135 pilot. In fact, Mr. Webb was a pilot that Sunjet Aviation did not feel was qualified to be a Part 135 pilot for Sunjet Aviation, and, therefore, Mr. Webb's flying experience was limited to occasional Part 91 operations, as he acknowledges in his interview.

Some of the things stated by Mr. Webb in his interview say a great deal about the significance of his allegations. As he acknowledged, his piloting skills and knowledge were such that he failed to get his Certified Flight Instructor (CFI) three times before he finally was able to get the rating. Further, Mr. Webb made allegations of pulling the circuit breaker on the Hobbs meter as a regular occurrence, but he does not even know where the Hobbs meter is located on the Learjet, as he erroneously stated the Hobbs meter was on the left side of the airplane [See Operational Factors/Human Performance Factual Report, Attachment 17].

Mr. Webb notes the FAA found that a pilot overflew an Airworthiness Directive, suggesting there might be some pattern to this. The incident he refers to did happen, however, the suggestion of some pattern of improper action is totally inappropriate. As the FAA investigation uncovered, a pilot on a trip which was extending longer than planned, properly called to determine if an engine oil change was going to be required. A mechanic checked the manual on the aircraft/engine and, as a result, determined that the trip could be finished. However, the mechanic forgot to check outstanding applicable Airworthiness Directives, which put a shorter time limit on the engine oil change. As a result, the aircraft was operated slightly beyond the AD requirements as the aircraft completed its trip. Rather than demonstrating a problem with Sunjet Aviation's operation, the incident demonstrates the employees were aware

of and sensitive to maintenance requirements. The fact that the mechanic made an mistake and forgot to check applicable ADs in no way suggests a problem with Sunjet Aviation's procedures or an effort by Sunjet Aviation's employees to avoid the requirements.

With regard to allegations that aircraft discrepancies were not logged, the extensive Discrepancy Logs for N47BA belie any basis for such allegations, and the evidence in the record provides no evidence of a policy of not reporting discrepancies.[9] Further, there are no corroborating facts or statements which suggest the Director of Maintenance was being forced to sign off discrepancies as completed without the necessary maintenance work. Rather, the statement again reflects Mr. Webb's lack of knowledge concerning Sunjet Aviation. At Sunjet the Director of Maintenance was a supervisory/administration position, and the Director was not authorized to sign off discrepancies. Sunjet Aviation's approved Repair Station Manual, Section V, specifically lists those individuals who were authorized to sign off repair work, generally the certified mechanics and inspectors.

Mr. Webb's allegation that the accident aircraft had "pressurization problems" is simply untrue and unfounded. The limited write-ups on N47BA prior to the accident are well documented. The July 1999 trip to which Mr. Webb refers, where the aircraft supposedly would not pressurize, is simply unfounded. As the investigation of this accident demonstrates, neither the pilot of that flight nor the passengers reported any pressurization problems, nor did Mr. Webb as he acknowledges in his statement. This is hardly a case of an aircraft with a history of

[9] Typically, Mr. Webb is confused and misinformed about Sunjet policies. Pilots did use *pads to note* questions they wanted to ask a mechanic. However, by requirement and practice, discrepancies were noted on the appropriate FAA approved sheet.

"pressurization problems."

Mr. Webb's allegation that Sunjet normally operated with flight crew oxygen masks unplugged is contradicted by the factual record with regard to N47BA. The wreckage of the oxygen mask receptacle and the bayonet fixture on the masks demonstrates that the masks were plugged in at the time of the crash [Airworthiness Factual Report, ¶ 6.0].

Lastly, Mr. Webb's allegation that pilots were encouraged or pressured to "pad" their flight hours is again refuted by the factual record here. Mr. Webb claims the first officer from N47BA was asked to pad her hours to 1500, when she only had 500 hours. The statements of friends and other pilots who knew the first officer describe her as an enthusiastic pilot intent on making aviation a career [See Attachment 1 NTSB Factual Report on Operational Factors/Human Performance]. Further, the Factual Report shows Ms. Bellegarrigue had flown continuously as a flight instructor and charter pilot for six years prior to joining Sunjet Aviation, during which time she would have had ample time to accumulate 1500 hours and certainly would have had many more than 500 hours.

IV. CONCLUSIONS

A. Findings:

1. N47BA was manufactured by Learjet in 1976

2. N47BA made a routine departure from Orlando, Florida at approximately 13:19 (UTC)

3. At 13:27:18 the co-pilot of N47BA acknowledged clearance to 39,000 feet, when the aircraft was at 23,200 feet

4. At 13:27:18 the co-pilot gave no indication of problems and did not sound incapacitated in any way or to any extent

5. At 13:27:18, the cabin altitude alarm could not be heard during the co-pilot's transmission to ATC

6. At 13:27:18 and before, the aircraft's pressurization system was operating

7. At 13:30:43, while at approximately 30,400 feet, the aircraft initiated a course change of six degrees

8. At 13:33:38, when the aircraft was at approximately36,400 feet, ATC attempted unsuccessfully to contact N47BA

9. The Cockpit Voice Recorder reflects that during the last half hour of the flight the cabin altitude warning was sounding continuously, until the aircraft descended.

10. Sound Spectrum Analysis cannot confirm whether the aircraft pressurization system was operating or not

11. At the time of the accident, Learjet's flight manual called first for trouble shooting by the flight crew, when the cabin altitude warning sounded, prior to donning oxygen masks

B. Probable Cause

The probable cause of this accident was incapacitation of the flight crew due to decompression of the aircraft in flight.

A contributing cause of this accident was the age of the aircraft, including its wiring and electrical components, potentially leading to unknown failures and faults.

SUNJET AVIATION, INC.

Date: 10/10/00

CERTIFICATE OF SERVICE

On this date, a true and correct copy of the Party Submission of Sunjet Aviation, Inc. was mailed, First Class postage pre-paid, addressed to:

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SUNJET AVIATION, INC.

DATE: 10/10/00