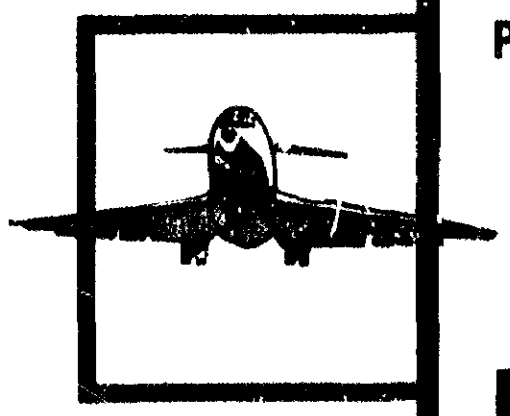
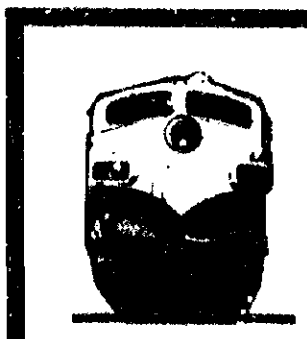
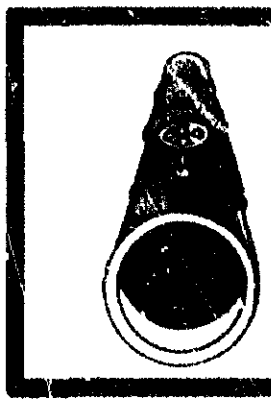
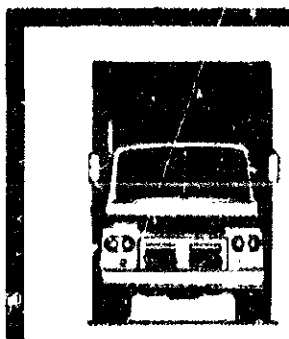
PB88-910408









NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

AIR NEW ORLEANS,
DBA CONTINENTAL EXPRESS FLIGHT 962,
BRITISH AEROSPACE 3101
(JETSTREAM 31) N331CY,
NEW ORLEANS INTERNATIONAL AIRPORT
KENNER, LOUISIANA
MAY 26, 1987

NTSB/AAR-88/06

UNITED STATES GOVERNMENT

ERRATA

THESE CORRECTIONS SHOULD BE MADE TO THE PREVIOUSLY PUBLISHED REPORT IDENTIFIED AS FOLLOWS

AIRCRAFT ACCIDENT REPORT

**AIR NEW ORLEANS,
DBA CONTINENTAL EXPRESS FLIGHT 962,
BRITISH AEROSPACE 3101
(JETSTREAM 31) N331CY,
NEW ORLEANS INTERNATIONAL AIRPORT
KENNER, LOUISIANA
MAY 26, 1987**

NTSB/AAR-88/06 (PB89-910408)

1. Delete the last three paragraphs of section 1.16.6 and replace with the following three paragraphs:

Following engine warmup, the RPM lever was placed in the full forward position, and the engine power lever was then advanced at a normal rate until the engine reached its temperature limit of 650° C. The engine power lever was then retarded and then advanced rapidly until temperature limiting was achieved. On reaching 650° C, it was noted on the test stand current meter fluctuation that the fuel bypass valve started bypassing fuel to hold the engine temperature at 650°. The engine power lever was again retarded to idle.

Next, the power lever was advanced until temperature limiting was achieved. then, with the use of test stand equipment, a simulated torque limit condition was sent to the TTL limiter, thereby establishing a simultaneous torque and temperature limiting condition. The current signal under these conditions was somewhat "noisy," however, the engine operation was normal.

The last demonstration consisted of placing the RPM lever in the full aft position which establishes 94.2 percent RPM. The power lever was advanced until temperature limiting was established, at which point the engine began to oscillate mildly with a constant amplitude. Once the power lever was retarded past the point at which temperature limiting occurred, the oscillations stopped. Next, the power lever was advanced rapidly until temperature limiting was reached, whereupon the engine began to oscillate violently with diverging amplitudes. The power lever as retarded to idle and the oscillations stopped. Lastly, the power lever was advanced slowly until temperature limiting was reached and the engine oscillation was again established. The RPM lever was then advanced to establish 100 percent RPM, whereupon the engine oscillation stopped.

2. Replace the paragraph in section 2.4 with the following paragraph:

This test engine array was then used to evaluate engine operation with the RPM lever in the full aft position while the engine power lever was advanced to the temperature limiting point. Mild to violent oscillations resulted, depending on how rapidly the power lever was advanced. The oscillations stopped when either the power lever was retarded or the RPM lever was advanced to establish 100 percent RPM. The Safety Board believes the oscillations witnessed during this test were consistent with what the crew experienced shortly after takeoff in N331CY.

3. Replace the second paragraph of section 2.5 with the following paragraph:

The Safety Board, therefore, believes that if the crew attempted a takeoff with the RPM levers below the 100 percent take-off setting and the TTL system was activated for any reason (either overtorque or overtemperature), then severe engine power fluctuations would probably result sometime in the first few moments of high-power requirement. With the reported temperature of 86° F, the engine would be temperature limited, rather than torque limited. Inadvertent activation of the TTL system, therefore, resulted in the power fluctuations. It must be noted that the activation of the TTL system is a normal, protective function of the fuel control system for this engine installation and should not be construed to be an abnormal condition. Therefore, the Safety Board believes that the flightcrew failed to advance the RPM levers to the full-forward (100 percent) take-off setting before attempting to takeoff.

4. Replace finding No. 8 in section 3.1 with the following:

An engine run on a test stand along with ground and flight tests revealed that if the RPM levers were in the taxi position or any position of 97 percent RPM or less, conditions similar to what the crew described on the accident flight would likely occur.

*U.S. GOVERNMENT PRINTING OFFICE:1990-242-320:61127

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7. Author(s)		8. Performing Organization Report No.
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15. Supplementary Notes		

16. Abstract

On May 26, 1987, at 1645 central daylight time, Air New Orleans, doing business as Continental Express flight 962, departed runway 19 at New Orleans International Airport on a scheduled commuter flight to Eglin Air Force Base, Florida. There were two pilots and nine passengers onboard at the time. As the airplane reached an altitude of between 150 and 200 feet above ground level, the crew felt a severe yawing motion and observed the engine torque fluctuate erratically. The captain proceeded to make an emergency landing in the departure overrun of runway 19. Following one bounce and final touchdown, maximum braking and full reverse thrust were applied. The airplane then rolled off the overrun, across an airport access road, through an airport security fence, through a concrete highway barrier, and across a highway. The airplane struck several vehicles on the roadway during the accident sequence. The main wreckage came to rest in a parking lot on the other side of the highway. The crew and passengers evacuated safely and there was no fire. Two passengers aboard the airplane suffered serious injuries. In addition, both pilots, seven passengers, and two occupants of ground vehicles received minor injuries. The airplane was destroyed.

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EXECUTIVE SUMMARY

On May 26, 1987, at 1645 central daylight time, Air New Orleans, doing business as Continental Express flight 962, departed runway 19 at New Orleans International Airport on a scheduled commuter flight to Eglin Air Force Base, Florida. There were two pilots and nine passengers onboard at the time. As the airplane reached an altitude of 150 to 200 feet above ground level, the crew felt a severe yawing motion and observed the engine torque fluctuate erratically. The captain proceeded to make an emergency landing in the departure overrun of runway 19. Following one bounce and final touchdown, maximum braking and full reverse thrust were applied. The airplane then rolled off the overrun, across an airport access road, through an airport security fence, through a concrete highway barrier, and across a highway. The airplane struck several vehicles on the roadway during the accident sequence. The main wreckage came to rest in a parking lot on the other side of the highway. The crew and passengers evacuated safely and there was no fire. Two passengers aboard the airplane suffered serious injuries. In addition, both pilots, seven passengers, and two occupants of ground vehicles received minor injuries. The airplane was destroyed.

The National Transportation Safety Board determines that the probable cause of this accident was a breakdown of the flightcrew coordination which resulted in their failure to comply with the Before Takeoff Checklist and advance the RPM levers to the high RPM position, and the flightcrew's failure to diagnose and remedy engine oscillations on initial climbout.

Contributing to the flightcrew's failure to advance the RPM levers before take off was the fact that both crewmembers had limited experience in the BAe-1301 and extensive recent experience in other aircraft which use RPM control lever procedures that are different from the BAe-1301.

The safety issues discussed in this report include training and checklist design. A safety recommendation was issued to the Federal Aviation Administration regarding criteria for the type size of the checklist.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

AIR NEW ORLEANS
DBA CONTINENTAL EXPRESS FLIGHT 962
BRITISH AEROSPACE 3101 (JETSTREAM 31), N33ICY
NEW ORLEANS INTERNATIONAL AIRPORT
KENNER, LOUISIANA
MAY 26, 1987

1. INVESTIGATION

1.1 History of the Flight

On May 26, 1987, about 1345 central daylight time, the captain and first officer reported for duty at the Air New Orleans station at Eglin Air Force Base, Florida. Their first flight of the day, flight 961, was scheduled to depart at 1425 for a flight to New Orleans International Airport. Flight 961 was scheduled to be in N331CY, a British Aerospace BAe-3101 (Jetstream 31) twin turbopropeller powered airplane. The flightcrew who brought N331CY into Eglin revealed that they had no difficulties with the airplane during the flight. All airplane system checks were satisfactory, including a test of the torque temperature limiting (TTL) system. This test, normally performed before the first flight of the day, was performed by this first crew with nothing unusual noted. (The TTL system is described in later portions of the report.)

Flight 961 departed Eglin Air Force Base at 1500 and landed at New Orleans International at 1600. According to the pilots, all aspects of this flight, including an engine trend monitor check at altitude, were uneventful.

The flightcrew also stated that the turnaround activities at New Orleans for flight 962 were routine. The captain stated that he did not feel rushed in any way. He remained in the airplane during the turnaround activities and performed the weight and balance calculations using an approved average weight loading schedule. According to the captain, both the weight and the balance of N331CY were within prescribed limits. The takeoff gross weight was computed by the crew to be 14,171 pounds. The first officer, who had monitored the fueling and cargo loading, stated that the fuel was evenly placed in the two wing tanks and that an additional 241 gallons were added to the existing fuel to a total of 2600 pounds.

The flightcrew received taxi clearance and taxied away from gate 14B on time at 1635. The first officer conducted the predeparture passenger briefing personally instead of over the cabin intercom. The crew stated that all taxi checklist items were performed in a routine manner using a challenge and response format. (See airplane checklist in appendix G.)

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others*	Total
Fatal	0	0	0	0
Serious	0	2	0	2
Minor/None	2	7	2	11
Total	2	9	2	13

*Ground vehicle occupants

1.3 Damage to Airplane

The airplane was demolished by impact forces. The approximate value of the airplane was $3,700,000.

1.4 Other Damage

One centerline strobe light fixture in the departure overrun of runway 19 was damaged by the airplane. Several sections of chainlink airfield boundary fence and a 28-foot length of concrete barrier running along U.S. Route 61 were also damaged or destroyed during the accident sequence. Approximately 15 motor vehicles were damaged and one vehicle was destroyed as the airplane slid to a stop. There was no fire damage to any of the vehicles or other objects. Ground damage estimates were approximately $60,000.

1.5 Personnel Information

The flightcrew was qualified to conduct the flight in accordance with existing requirements of Federal Aviation Regulations (FARs) and company policies.

The captain was hired by Air New Orleans on February 14, 1984, as a Beech BE-99 captain. He became a captain and received his type rating on the BAe-3101 on May 12, 1987. He holds airline transport certificate No. 435119893, also dated May 12, 1987, with a type rating in the BAe-3101 and commercial privileges for single- and multiengine land and sea aircraft. He also holds a flight instructor certificate (expired) for instrument instruction in single-engine airplanes. His first-class medical certificate dated May 26, 1987, was issued without restrictions. This certificate had been issued by his Aviation Medical Examiner following an examination on the morning of the accident. The Federal Aviation Administration (FAA) medical records reflect that his vision and hearing were within normal limits. No chronic or acute illnesses were reported in the captain's medical history.

The captain was qualified as both a Beech BE-99 captain and a BAe-3101 captain at the time of the accident. However, he had not flown the Beech BE-99 since upgrading to the BAe-3101 in May 1987.

From April 6, 1987, to April 11, 1987, the captain completed a 20-hour Jetstream Ground Training Program administered by Air New Orleans instructor personnel. From April 25, 1987, to May 11,1987, he received 13.2 hours of flight training in the BAe-3101. A Title 14 Code of Federal Regulations 135, 293.297, and .299 flight check encompassing 2.3 hours, administered by an FAA inspector, was completed by the pilot on May 13, 1987. Stalls and single-engine procedures were included in the flight training. On occasion, during the performance of these maneuvers, the

captain said the TTL system would activate and the instructor pilot would instruct him to reduce power slightly so that the TTL system would not bypass fuel. He stated that he had been instructed to "stay off" the TTL system and that he would not use the TTL system unless he had a performance problem.

The captain's total flying time was approximately 7,500 hours according to his personal recollection, his resume, and company records. At the time of the accident, his total time in turboprop airplanes was about 4,000 hours, 60 hours of which were in the BAe-3101 at the time of the accident. His flight and duty times for the previous 24 hours, 7 days, 30 days, 60 days, and 90 days were as follows:

	Flight Hours	Total Duty Hours
Previous 24 hours	5.0	10.8
Previous 7 days	27.2	39.7
Previous 30 days	76.8	144.7
Previous 60 days	106.7	287.4
Previous 90 days	195.6	422.6

During a postaccident interview, the captain stated that his flight training addressed the need to retard the throttles to "get off" the TTL. He stated that this was the only thing that entered his mind to do when the engine torque gauges began to fluctuate. He said he did not know why the torque fluctuations got worse when he reduced the power levers. He also stated that turning off the TTL system did not occur to him. He did not recall having been given this information during his Jetstream training.

According to his sworn testimony given on June 12, 1987, the captain stated that after the accident he had reviewed flight and ground training material for the BAe-3101, as well as course handouts and his personal notes. The captain stated that the Air New Orleans BAe-3101 training program he attended did not include reference to Section 7, page 7.7 of the British Aerospace Flight Training Guide, Jetstream 31, Issue I, titled "Engine Handling" which directed, in part, that the TTL system be deactivated upon noting erratic operation. The captain also commented that on advancing the RPM levers full forward, he would expect to see 100 percent on the engine RPM gauges.

The first officer was hired by Air New Orleans as a Beech BE-99 first officer on October 27, 1986. He was upgraded to a first officer on the BAe-3101 on May 19, 1987. He holds a commercial pilot certificate (No. 257985414) dated August 13, 1985, for airplane single- and multiengine-land instrument airplane. His first-class medical certificate dated January 8, 1987, was issued without limitations. His vision and hearing were within normal limits according to FAA documentation. According to available medical records, he had no chronic or acute illnesses.

At the time of this accident, the first officer was also qualified as a first officer in the Beech BE-99. However, like the captain, he had not flown in this type of airplane since upgrading to the BAe-3101 in May 1987.

From April 27, 1987, to May 1, 1987, the first officer completed the 20-hour Jetstream Ground Training Program administered by Air New Orleans instructor personnel. From May 11, 1987, to May 17, 1987, he was given 3.6 hours of flight instruction in the BAe-3101. The flight training records show that he did not receive the following training: Engine Failure on Takeoff, Steep Turns, Slow Flight, and Stalls. On May 19, 1987, he completed a 14 CFR 135.293 competency check in the BAe-3101 (1.6 hours in duration) administered by the company's chief flight instructor and check airman on the BAe-3101. The competency check form (FAA No. 8410-3) shows that he was tested on these maneuvers during the check flight.

The first officer's total flight time, as indicated from a combination of his personal comments, resumes, and company records, was about 3,000 hours. His total time in turboprop airplanes was about 600 hours, 18 of which were in the BAe-3101. The balance of his turboprop time was in the Beech BE-99.

During the course of sworn testimony given by the first officer on June 12, 1987, he said that he "was under the impression that when you were on the [TTL] limiters that you would not have substantial. . . power." He also stated that one would not take off on the limiters.

A company flight training form, dated May 11, 1987, indicated that the first officer received 0.7 hour of flight training in the BAe-3101 on that date. However, his crew duty sheet covering this date, as well as a company scheduling crew time sheet, indicated that he did not fly on May 11. Sworn testimony given by him revealed that he did fly on May 11, but had omitted to enter the flight on the crew duty and flight time record.

The first officer's flight and duty times for the previous 24 hours, 7 days, 30 days, 60 days, and 90 days as obtained from company records were as follows:

	Flight Hours	Total Duty Hours
Previous 24 hours	1.4	2.5
Previous 7 days	14.9	25.5
Previous 30 days	57.8	152.5
Previous 60 days	179.0	341.3
Previous 90 days	295.7	535.5

1.6 Aircraft Information

N331CY, a British Aerospace Company 3101 (sometimes referred to as a BA-3100 or a Jetstream 31), was certified and maintained in accordance with applicable Federal regulations. It was being operated by Air New Orleans, Inc., under a 10-year lease program with the British Aerospace Company.

The airplane was type certificated in the United States under the Bilateral Airworthiness Agreement with the United Kingdom in accordance with 14 CFR Part 21, "Certification Procedures for Products and Parts," Section 21.29, "Issue of Type Certificate: Import Products." The certification basis under which the airplane was certificated is 14 CFR Part 23 and Special Federal Aviation

Regulation No. 41. The approved flight manual for the airplane, dated April 23, 1987, listed the following torque limitations:

Max Permissible --04.5% - 5 minutes
Continuous Range --100% to 104.5%
Max Continuous --100%

The airplane was equipped with two Garrett AiResearch model TPE-331-10 engines and two Dowty Aerospace Corporation model R333/4-82-F/12 propellers.

The airplane had accumulated 147.2 operating hours since manufacture. It was placed on a Part 135 operating certificate with Air New Orleans on May 8, 1987, 19 days before the accident, with a total operating time of 31.8 hours.

Maintenance records revealed that the airplane had fuel flow gauge problems starting with the replacement of the left fuel flow gauge on May 7, 1987, at a total time of 28.3 hours. On May 12, 1987, at 48.4 hours, the right fuel flow gauge fluctuated between 150 and 500 pounds per hour. The discrepancy was noted on the deferred maintenance list. The minimum equipment list for this airplane states that it may be flown with an inoperative fuel flow gauge.

The first and only 100-hour maintenance check was performed on May 18, 1987, at 84.3 total hours. A "zero time" hour meter was installed during the inspection. Also on this date, a discrepancy was listed describing an exhaust gas temperature (EGT) indicator on the left engine that read excessively high for an auto start. Corrective action was noted as "swapping leads" on the single red line unit. A left and right engine compensating resistor check was also performed with no abnormalities noted. On May 23, 1987, the right fuel flow gauge discrepancy, which had been placed on the deferred maintenance list earlier, was signed off by Air New Orleans maintenance personnel as "OPS check OK in flight" with no other corrective action listed. There were no other maintenance items noted in the airplanes' logbooks or company's records that pertained to this accident. Finally, there were no outstanding airworthiness directives or service bulletins noted in the records.

The flightcrew procedures checklist removed from N331CY was marked "7th Revision." It was in typewritten form and laminated in glossy clear plastic. (A reproduction of the checklist is included in appendix G.) The notation "CR" adjacent to some items on the checklist refer to "captain response."

1.7 Meteorological Information

According to the National Weather Service (NWS), recorded observations for the time frame of this accident are as follows:

1650--Record Observation: sky cover 4,500 feet scattered, 25,000 feet scattered; visibility-7 miles; temperature-86° F. dew point-66° F; winds out of 140° at 11 knots; altimeter setting 30.05 inches Hg; remarks-thunderstorms to the east and northwest, rain showers to the northwest.

1654--Special Observation: sky cover 4,500 feet scattered, 25,000 feet scattered; visibility-7 miles; temperature-86° F, dew point-66° F; winds out of 110° at 13 knots; altimeter setting 30.15 inches Hg; remarks-thunderstorms to the east and northwest, rain showers to the northwest.

ATIS information DELTA was being broadcast at the time of the accident, and it called for a ,600-foot scattered sky cover, a visibility of 7 miles, a temperature of 84°F, and winds out of 130° at 12 knots. The altimeter setting was 30.03 inches Hg.

Transmissions from the tower revealed that at 1641:26, the winds were out of 140° at 12 knots; at 1647:07, they were out of 160° at 13 knots; and at 1648:13, they were also out of 160° at 13 knots.

There were no NWS Airman's Meteorological Information reports, Significant Meteorological Information (SIGMET) reports, or convective SIGMETs in effect for the New Orleans local area at the time of this accident.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

There were no communications difficulties.

1.10 Aerodrome Information

New Orleans International Airport (Moisant Field) is certificated in accordance with 14 CFR Part 139. The airport has three primary runways: 10-28; 01-19; and 06-24. Runway 01-19 is a 150-foot wide by 7,000-foot-long asphalt grooved surface. The airport has a low level windshear alert system (LLWAS) that is monitored by FAA personnel in the air traffic control (ATC) tower. No LLWAS alerts were evident during the time of the accident.

1.11 Flight Recorders

The airplane was not equipped with a cockpit voice recorder or a flight data recorder, nor was either device required by current Federal regulations.

1.12. Wreckage and Impact Information

The wreckage scatter pattern began with tire skidmarks in the overrun of runway 19. The distance between the first tire skidmark and the final resting point of the main wreckage was about 1,100 feet. The initial skidmarks stopped after about 100 feet. A damaged runway centerline strobe light was located about 35 feet beyond the end of the first left gear skidmark. The tire skidmarks began again about 400 feet beyond the initial touchdown point and continued to the end of the paved overrun for runway 19.

Tire marks for all three landing gear were evident in the grass beyond the overrun and continued through a low gravel embankment along the airport access road. Just beyond this embankment, propeller strikes, which continued across the access road, were found in the ground. About 45 feet beyond the embankment, the airplane had passed through a 6-foot high chainlink fence. A piece of the left wingtip was located near this fence. The airplane had impacted a 2-foot-10-inch-high concrete barrier on the near side of a four-lane paved highway (U.S. Route 61). A large portion of the underbelly baggage pod straddled this damaged barrier. (See figures 1 and 2.)

The airplane had skidded across the highway and had stopped in the corner of a paved parking lot. Pieces of the airplane adjacent to the main wreckage included the propellers, landing gear, and other smaller components. In addition, a large fuel spillage occurred in the area from the fuselage and wings.

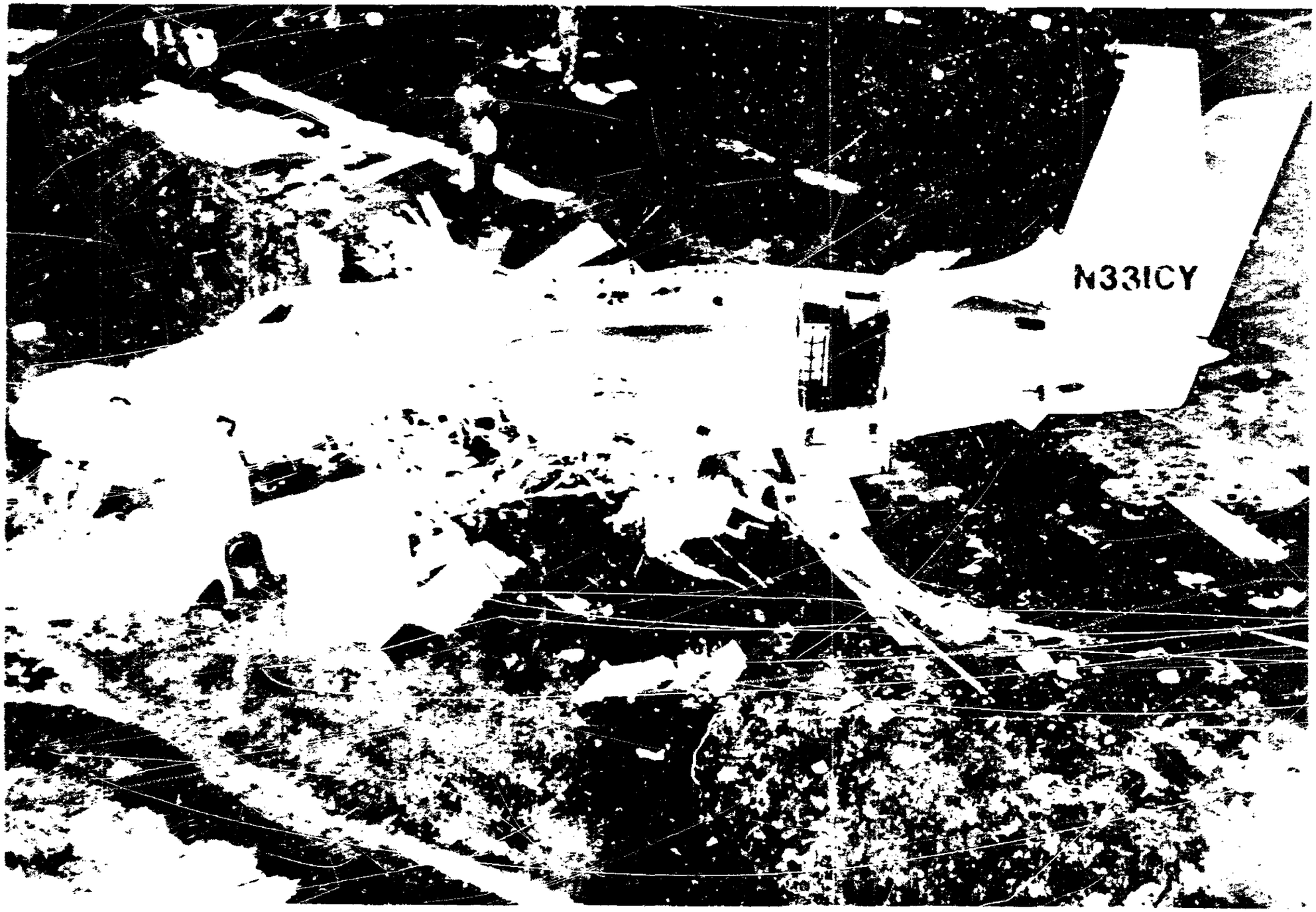
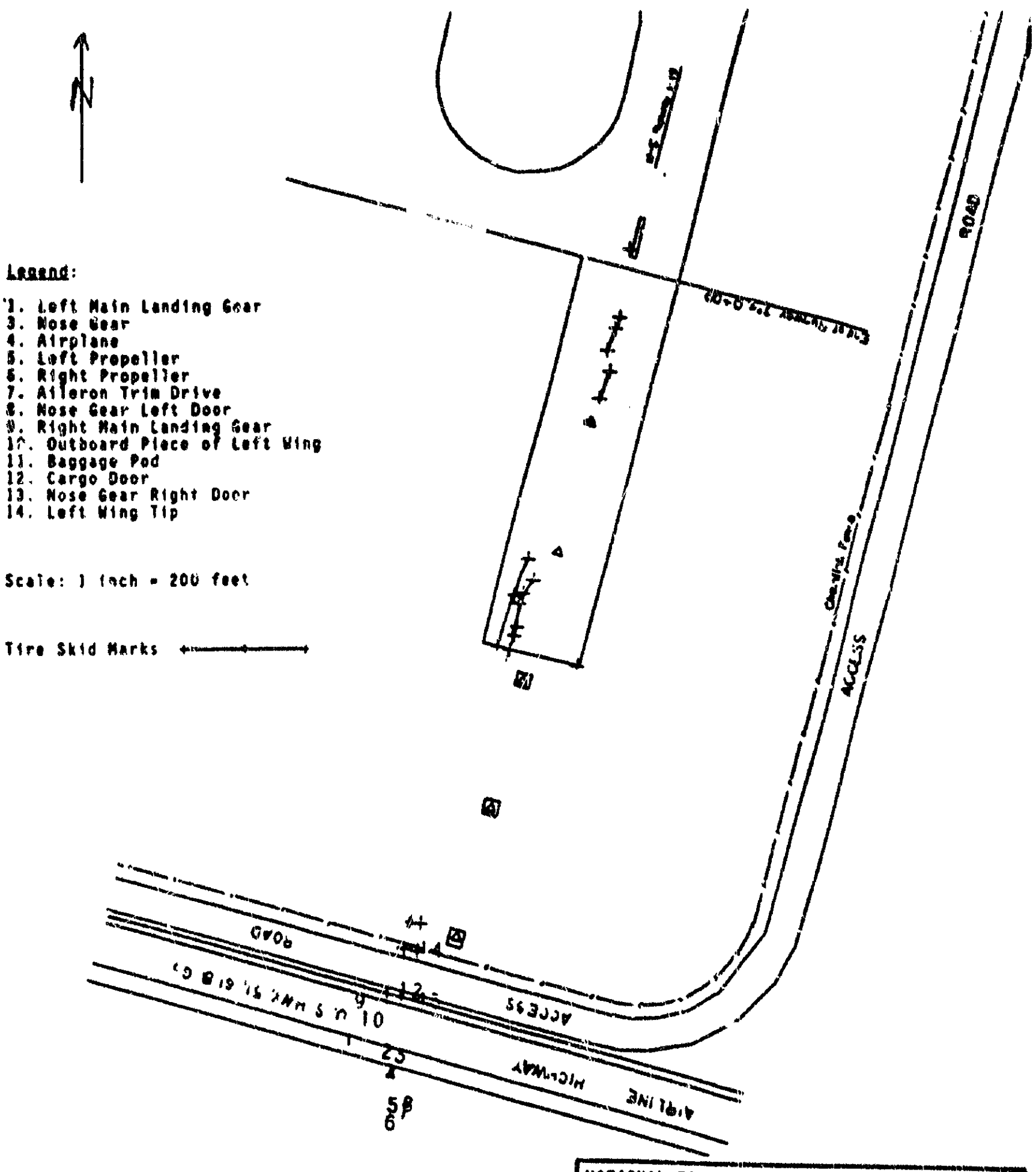


Figure 1.--Left view of wreckage.



Legend:

1. Left Main Landing Gear
3. Nose Gear
4. Airplane
5. Left Propeller
6. Right Propeller
7. Aileron Trim Drive
8. Nose Gear Left Door
9. Right Main Landing Gear
10. Outboard Piece of Left Wing
11. Baggage Pod
12. Cargo Door
13. Nose Gear Right Door
14. Left Wing Tip

Scale: 1 inch = 200 feet

Tire Skid Marks ←——→

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C.

WRECKAGE DISTRIBUTION CHART

Aircraft: BAC, Jetstream 31, N331CY
Operator: Air New Orleans, FLT 962
Location: New Orleans Int. Airport, La
Date: May 26, 1987

Attachment II

Figure 2.--Wreckage diagram.

The fuselage came to rest on its right side pointing in a direction of approximately 150° magnetic. Although the fuselage was intact, the left side had split open near the left wing root. The cabin door and the sliding windows in the cockpit were intact and functional.

The right wing was intact, but had separated from the fuselage at the wing root. Its location was slightly aft of where it had formerly been attached to the fuselage. This wing exhibited leading edge damage and scratch marks on its underside that corresponded to a chainlink fence pattern. The right engine was still attached to the wing; however, the engine mounts were broken and the propeller had been broken off.

Much of the left wing had also been torn from the fuselage, but was still connected to the main spar carry-through structure. The outer portion of the left wing, however, was located about 30 feet from the main wreckage. The left aileron and trim tab were still attached to the left wing; the left engine was still attached to the inboard portion of the left wing.

The empennage was still attached to the fuselage and was intact. All empennage control surfaces were attached and relatively undamaged. Both engines and propellers as well as other components were removed for additional off-site examination (see Section 1.16, Tests and Research).

1.13 Medical and Pathological Information

Blood samples for toxicological testing were obtained from each pilot at Alton Ochsner Hospital following the accident. The samples were sent to the Center for Human Toxicology, University of Utah, for analysis. No drugs were detected in either specimen.

Each crewmember stated that he was in good health and was not experiencing physiological discomfort or psychological stress before the accident. Each elaborated by stating that he had slept normally the night before the accident and had enjoyed sufficient time off during the 72-hour period before the accident. They had worked standard day and evening flight and training schedules during the days and weeks before May 26, 1987.

Seven passengers and both crewmembers sustained minor injuries. These injuries were limited to sprains, minor cuts, contusions and abrasions. Two passengers were seriously injured with spinal fractures of their L-1 vertebrae. Two other individuals on the ground received minor injuries.

1.14 Fire

There was no inflight or postimpact fire.

1.15 Survival Aspects

This accident was survivable due to the amount of occupiable space retained during the impact sequence, the low level of decelerative forces that existed throughout the accident sequence, and the lack of a postcrash fire in spite of the fact that both fuel tanks were ruptured.

The airplane seating configuration consisted of a two-place cockpit and 19 passenger seats. The passenger seats were arranged in seven rows of single seats on the left side and six rows of double seats on the right side. The airplane cabin had two emergency exits: the main entry door in the aft left side of the passenger cabin and an overwing exit at row 4 on the right side. The cockpit had a sliding emergency exit window on each side.

The airplane exterior was heavily damaged with considerable distortion of the fuselage. The position of the right wing and engine along with the door frame damage prevented the use of the

right overwing exit. The left rear exit (the main entry door) and both sliding windows in the cockpit were not damaged and were fully operable.

The cockpit was intact. The instrument panel was in its normal position with no evidence of secondary impact by the crew. The rocker switch panel below the instrument panel was dented inward on the lower edge. The captain's seat was intact but partially separated from the floor. The first officer's seat was intact and fully attached to the floor. The cockpit floor angles were 39° right roll and 2° nose down.

The passenger cabin floor measured at the main cabin door was rolled to the right 50° and rotated 8° nose down in relation to a level attitude. The aisle/floor was severely deformed inward and upward in the area adjacent to the emergency exit (row 4). The right sidewall areas at seat locations 4BC, 5BC, and 6BC were buckled inward. The right sidewall distortion began at row 2 and continued aft to row 6. The front and rear aisle legs of the seat 4BC had separated from the seat pan and the sidewall attachment had separated at the track. Passenger seats 1BC, 4A, 6BC, and 7A had not separated at the attachment point separations. All other passenger seats experienced some attachment point separations. The main luggage compartment in the aft cabin was intact; however, an air conditioning duct had detached from the sidewall of the compartment.

Evacuation of the airplane began seconds after it came to rest. The captain exited from the left cockpit window. Although he reported difficulty in releasing his seatbelt/shoulder harness, he attributed the difficulty to the fact that he was leaning into the buckle at the time. The first officer attempted to exit through the main cabin but could not do so because of passengers attempting to exit and displaced seats. The first officer then returned to the cockpit and exited through the left cockpit window.

The main cabin door was opened without difficulty from the inside of the airplane by a passenger. Due to the roll angle of the fuselage, the lower hinge point for this door was about 3 1/2 feet off the ground. All passengers exited by themselves through the main cabin door with the exception of the two people with back injuries. They were helped off the airplane through the main cabin door by another passenger.

Crash/fire/rescue personnel were notified of the accident by the control tower almost immediately after the accident occurred (1645). The Kenner, Louisiana Fire Department declared a "20A alarm" (aircraft accident) at 1649. A fire truck was on scene by 1651 followed shortly by the crash truck from the airport fire department. A blanket of foam was laid over the spilled fuel and electrical switches inside the airplane were turned off by the Kenner Fire Department fire chief. Fire protection operations were secured at 2330.

Medical response to the accident scene was provided by East Jefferson Emergency Medical Services. The initial request for ambulance assistance was made at 1647, and two ambulances were at the accident scene by 1651. A third ambulance reported to the site at 1734. These vehicles were used to transport 13 persons to three area hospitals.

1.16 Tests and Research

1.16.1 BAe Take-off Distance Calculations and Fast Taxi Tests

At the request of the Safety Board, a series of calculations were accomplished by British Aerospace engineers to determine the distance and time required for a BAe-3101 to reach a speed of 107 knots with the RPM levers set at 94 percent, RPM/73 percent torque (taxi RPM and torque setting), and at 100 percent RPM/96.5 percent torque (takeoff RPM and torque setting). The conditions (airplane weight, field elevation, temperature, etc.) used in the calculations were as close as possible to the conditions on the day of the accident.

Fast taxi tests with two BAe-3101s were accomplished to confirm the mathematical methodology of the calculations. The fast taxi tests were conducted up to 90 knots indicated airspeed. Taxi tests up to an assumed rotation speed of 107 knots were considered too dangerous to attempt.

It was calculated that with a 2 to 3-knot headwind, the airplane would require 2,940 feet to reach 107 knots at 94 percent RPM/73 percent torque and 2,120 feet to reach 107 knots at 100 percent RPM/96.5 percent torque. It was further calculated that with a 7-8-knot headwind it would require 2,750 feet to reach 107 knots at 94 percent RPM/73 percent torque and 1,980 feet to reach 107 knots at 100 percent RPM/96.5 percent torque.

At 1650 on the day of the accident, the winds were measured to be out of 140° at 11 knots, yielding a headwind component of approximately 8 knots.

1.16.2 BAe-3101 Ground Engine Run/Flight Tests

A series of three ground engine run/flight tests were conducted by British Aerospace Company to investigate the response of the Garrett TPE 331 engine when subjected to engine power lever movements with the engine at varying rotational speeds. The tests were conducted from maximum engine RPM to the minimum RPM achievable in flight. The flight testing examined conditions under which the engine was both torque and temperature limited, including the transition from torque to temperature limiter operation and vice versa.

Three aircraft which had successfully completed the BAe production test schedule were used for these tests. The aircraft used during the second flight was equipped with a trace recorder to record the following parameters: fuel flow, torque, exhaust gas temperature, engine revolutions per minute (in percent), bypass valve current, and beta pressure. A total of four test flights were flown and both engines on the aircraft were tested on each flight. During takeoff and initial climb on the first two flights of the series, the friction control for the RPM levers fully released leaving only the static friction within the system to maintain the selected lever position. There was no evidence of RPM lever movement or RPM decay throughout the takeoff roll or the initial climbout.

In general, large engine power (torque and RPM) oscillations can be generated by setting the RPM in the range from minimum propeller governing RPM to low flight RPM and advancing the power lever to invoke the temperature limiting function of the TTL system. The oscillations could also be stimulated by reducing engine RPM with the RPM lever when the power lever was fully advanced. From a review of the current traces recorded on the second flight, it would appear that the oscillations did not commence until the TTL bypass valve was actually bypassing fuel.

Two of the three ground engine run/flight tests indicated that engine instability occurred if the following conditions were present:

- the TTL was on and the power lever was advanced so that the TTL bypass valve was bypassing fuel; or
- the engine RPM was below 95.5 percent (outside the flight range);

The power fluctuations, which were proportional in severity to the extent of the advancement of the power lever into the limiter range could be stopped by anyone of the following actions:

- retarding the power levers below the limiter activation point;

- advancing the RPM lever to give RPMs above 95.5 percent (into the flight range); or
- turning off the TTL.

According to the bypass current trace recorded on the second test flight of this series, these power fluctuations did not begin until the TTL bypass valve was actually bypassing fuel.

During one of the flight tests, it was found that instability can occur at engine RPMs as high as 97.5 percent (within the low-flight range but not at 100 percent, the required takeoff setting). Further testing indicated that instability was a function of outside air temperature--the higher the temperature the higher the RPM setting at which the instability occurs. In this case, the engine is temperature limited rather than torque limited. That is, it will reach the temperature limit before it reaches the torque limit.

During one flight test, it was noted that once large amplitude oscillations were established, the engine produced a "banging" noise. The British Aerospace Company determined that this noise was either engine surging or gear train noise.

1.16.3 Engine Examination and Teardowns

The Garrett AiResearch TPE-331-10 engines were removed from the airplane and revealed relatively minor and almost symmetrical damage. Both gear box assemblies were detached from their engine power sections. The plenum chamber forward drain valve was separated from the cases of both engines. A very small amount of water and a few small "hair-like" fragments of foreign material were found in the main fuel filter housings of both engines. Lubricating oil from the right engine oil tank had escaped due to a rupture along a welded seam on the forward lower side. This rupture appeared to have occurred during the impact sequence.

Both engines were disassembled, and all component parts were examined for evidence of mechanical failure or malfunction. Damage noted to the internal component parts of both engines was similar. The damage included foreign object damage to the first stage compressor impeller blades, compressor and turbine assembly rub marks with resultant metal spray deposits in the turbine sections, and a small quantity of dirt and debris in the various air passages of the engines. Additionally, the high-speed pinion gear shafts were sheared, as were the starter-generator drive shafts. The examination of the engines determined that there was no damage to the engines to indicate a malfunction before the airplane landed.

1.16.4 Propeller Examination and Teardown

The Dowty model R333/4-82-F/12 propeller is a four-bladed, constant-speed, variable-pitch, flange-mounted, left-hand tractor prop. It is a reversing and feathering type with the pitch-changing mechanism hydraulically operated toward fine and reverse pitch and mechanically assisted to coarse and feathering pitch by coil springs and blade counterweights.

An external examination of the propellers revealed that both exhibited almost symmetrical damage. The four blades of each propeller were bent rearward and twisted slightly opposite of their normal rotation. All blade tips contacted the ground after the nose gear collapsed. The forward faces of all blades revealed scratch marks indicative of contact with a concrete surface. Scratch marks corresponding to a chainlink fence were noted on the forward faces of some of the blades. The blades of both propellers were loose in their hubs, were separated from their pitch-change mechanism inside the hubs, and could be rotated individually to acute angles of pitch. The counterweights of some blades were separated but were found elsewhere in the wreckage area.

The beta tube for propeller No. 1 was not recovered at the accident site. The condition of the piston seals was satisfactory. A small trace of oil was found on the forward face of the piston. The condition of the inner and outer feather spring and the reverse spring was also satisfactory. There were no impact marks visible on the cylinder wall or on the piston surface. The piston was resting at the start latches. There was no damage on the piston, but the normal piston and start latch contact impression were visible. When the piston was released from the start latches, it was free to move to the coarse-pitch position. All hub bolt expansion measurements for this prop were within specified tolerances.

The prop hub on this propeller was split and examined also. The outer bearing split positions on blades Nos. 1, 2, and 3 were nearly in line with their respective painted hub indexes. The outer bearing split position of the No. 4 blade had moved 10° counterclockwise.

The crosshead inner flange forward faces exhibited heavy denting relative to impact with operating pin sleeves. A serviceable propeller, used to reconstruct/simulate the preimpact blade angle, established that the dents would result from impact when the blade angles were in excess of the maximum nominal reverse position.

The front portion of the pitch change beta tube of the No. 2 propeller, which was broken off between the forward and the aft seal, was removed from the crosshead. The condition of the forward seal of the beta tube was satisfactory. The condition of the outer and the inner seal and the condition of the outer and inner feather spring along with the reverse spring were satisfactory.

There were no impact marks on the cylinder wall/piston. The piston was found positioned at the start latches. The piston surface was in contact with one latch and exhibited moderate chipping damage which occurred when the piston was forced toward coarse pitch. The damaged surface on the piston was in line with the heavily damaged piston of the No. 1 propeller blade. No trace of oil was found on the forward face of the piston. All hub bolt expansion measurements for this propeller were within specified tolerances.

The prop hub was split and examined. The outer bearing splits found were correctly aligned with their respective painted hub index lines except for the No. 3 propeller blade where the split was noted to be 90° out of position.

The crosshead was intact and there were no visible signs of bending on the flanges or the journals. The crosshead inner flange forward faces exhibited heavy denting from impact with the operating pin sleeve. In order to identify and locate this dented position in relation to the blade angles, the position was reconstructed/simulated on a set of serviceable blades and crosshead. It was established that the dents would result from impacts when the prop blade angles were in excess of the maximum nominal reverse position.

1.16.5 Fuel Test Results

The airplane's fuel tanks were ruptured and most of the fuel was spilled; however, a small amount remained in the right wing tank. A sample from this source and from the transit refueler tank from which the airplane had been refueled were examined by Analysis Laboratories, Inc., of Metairie, Louisiana. Results revealed that the fuel supply was not contaminated.

1.16.6 Right TTL Computer and Right Fuel Bypass Valve Test

The right TTL computer and the right fuel bypass valve were installed on a test engine for an operational check. The components from the right engine were selected for testing because a right TTL frequency oscillatory check performed earlier yielded a very high frequency oscillatory output signal (higher than that of the left TTL computer). This signal was produced by the TTL computer

when simultaneous torque and temperature limiting conditions were met during the bench check. Following installation of these two components, the fuel control unit of the test engine was physically reset to match that of the fuel control unit from the right engine on N331CY. The right fuel flow was slightly high at the flight idle position on the right engine of N331CY. The engine was then started and the TTL system was observed to operate satisfactorily at all specified test points. The very high frequency oscillatory output signal produced by the TTL computer produced no adverse effects on engine operation.

Following engine warmup, the RPM lever was placed in the full-forward position, and the engine power lever was then advanced at a normal rate until the engine reached 100 percent RPM, resulting in normal indications. The engine power lever was then retarded and then jammed hard to its forward stop. Rapid acceleration to 100 percent RPM occurred. On reaching this speed, it was noted by the test stand volt meter fluctuation that the fuel bypass valve started bypassing fuel to hold the engine speed at 100 percent. The engine power lever was again retarded to idle.

During the next portion of the test, the RPM lever was retarded to its low-speed (taxi range) position and the engine power lever was again advanced at a normal rate until 94.2 percent RPM was reached. All indications were normal. Normal torque limits could not be reached on the test stand due to ambient conditions, therefore, simulated torque from the test stand operator's panel was applied until the torque limit was reached. At that time, the test engine started surging violently and continued to do so until the simulated torque was reduced or until the RPM lever was placed in the full-forward (flight range) position.

The violent surging occurred when the torque limit was reached with the RPM lever in any position other than the full-forward position. Also, when the engine power lever was jammed hard to its forward stop, the fuel bypass valve volt meter fluctuated considerably, and the engine surged violently unless the RPM lever was in its full-forward high-speed position.

1.17 Additional Information

1.17.1 Air New Orleans-Operations and Training

Air New Orleans was issued air carrier operating certificate No. AT 76-00 on May 17, 1985. The operating certificate was issued again on February 26, 1986, and again on July 9, 1986, as a result of corporate name changes. Air New Orleans, Inc., currently does business as Air New Orleans, Continental Express, and Alabama Express.

As of May 26, 1987, the airline operated eight Beechcraft BE-99s and four BAe-3101s. The organization conducted 117 daily flights into 12 cities in Louisiana, Alabama, and Florida. In 1986, the airline carried 103,600 passengers.

In the 6 months before May 26, 1987, the airline underwent a major operating expansion. Toward the latter part of 1986, Air New Orleans had eight Beech BE- 99s and employed 48 pilots. As of mid May 1987, the airline had four additional airplanes (BAe-3101s) and employed 82 pilots. The British Aerospace equipment was under long term lease agreement, and the airplanes arrived in pairs. The first two arrived during the latter part of January 1987 and the second two in mid May 1987.

The airline's flight training instructional personnel were initially trained by British Aerospace. The majority of this training was conducted at the airline's training operations facility in Birmingham, Alabama. According to the chief pilot, the airline used the crew operating procedures devised by British Aerospace as contained in sections 7 and 8 of the British Aerospace Flight Training

Guide. Section 7, "Engine Handling," addresses erratic torque or EGT indications and outlines the following procedure to be used in the event of erratic indications of torque and/or EGT:

1. Retard the [engine] power lever on the affected engine(s) until torque and EGT are both below limits.

2. Switch off the propeller synchrophase system.

3 Switch off the TTL computer of the affected engine(s).

4. Control the engine manually to ensure that torque and temperature limits are not exceeded.

The FAA-approved flight manual for N331CY as well as the British Aerospace Company Jetstream 31 Crew Manual, Volumes 1 & 2 did not contain this procedure at the time of the accident. British Aerospace, however, submitted a proposal on April 29, 1986, to the British Civil Aviation Authority (CAA) to include this procedure in the flight manual. Following the accident, on June 24, 1987, BAe added a proposed checklist item to confirm 100 percent RPM before takeoff to this proposal. In addition, on October 30, 1987, British Aerospace published a service newsletter outlining the proposed changes to the flight manual. The proposal was approved by the CAA and the FAA and published as a flight manual amendment on January 29, 1988.

When the Safety Board interviewed the Air New Orleans chief pilot on June 13, 1987, he stated that company pilots were instructed to use a takeoff power setting of 100 percent torque or 650° EGT, whichever occurs first, and that at no time would he intentionally operate on the TTL or exceed 100 percent engine torque. Lastly, Air New Orleans had no formalized cockpit resource management or crew coordination training within its FAA approved training program.

1.17.2 FAA Surveillance

Flight Standards District Office (FSDO) No. 67B, located in Birmingham, Alabama, holds the operating certificate and has primary surveillance responsibility for Air New Orleans, Inc. FSDO 67B is a satellite facility of FSDO 67A in Atlanta, Georgia. At the time of the accident, FSDO 67B's certification and surveillance responsibilities included 24 Part 135 air taxi operators, 7 Part 141 approved flight schools, 7 Part 133 external load operators, 103 Part 137 agricultural operators, and Air New Orleans, Inc.

FSDO 67B was authorized three maintenance personnel and three operations inspector personnel. At the time of the accident, the FSDO had three maintenance inspectors, one of whom was a trainee assistant. One of the maintenance inspectors was also acting as the office manager. Since February 13, 1987, the FSDO had operated with one operations inspector. The principal operations inspector (POI) assigned to Air New Orleans went on sick leave on that date, and as of the date of the accident has remained in this status. He had not been replaced as POI for the airline. Additionally, for at least several months before May 1987, there was a vacant operations inspector position at the FSDO. The sole operations inspector at the FSDO in addition to his regular duties had assumed the duties and responsibilities assigned to the inspector on sick leave. Neither operations inspector assigned to the FSDO was qualified in the BAe-3101. Before May 26, 1987, FAA personnel at FSDOs 67A and 67B were not aware of the existence of the British Aerospace Flight Training Guide.

The initial proving flights on Air New Orleans BAe-3101 were conducted by qualified FAA operations inspectors from FSDOs in Columbia, South Carolina, and Atlanta, Georgia.

Work Program Management System information generated by FSDO 67B revealed that there had been 14 operations and 5 maintenance inspections performed on Air New Orleans Inc., during the 12 months before May 26, 1987.

2. ANALYSIS

2.1 General

The flightcrew of flight 962 was certificated and qualified for the flight in accordance with Federal regulations and Air New Orleans Inc., company policies and procedures. They were in good mental and physical health before the accident and well-rested before the flight. The airplane was maintained and inspected in accordance with Federal regulations and the approved maintenance program of the airline. The weather was scattered clouds at 4,500 and 25,000 feet with surface winds out of the southeast at 10 knots and was not considered a factor in this accident. In addition, the aerodrome navigation and communication facilities played no part in the accident sequence of events.

2.2 The Airplane, Propellers, and Powerplants

There was no evidence to indicate that there were mechanical problems with the airframe, systems, or any component relating to the airframe itself before the crash landing. All the damage resulted from the impact sequence during which the landing gear was torn off and when the airframe struck numerous objects including a fence, motor vehicles, and a concrete barrier before sliding to a stop. Consequently, the Safety Board concludes that there was no preimpact failure or malfunction of the airplane structure in this accident.

Both powerplants were so severely damaged during the accident sequence that it was not possible to conduct test runs of the engines. Both engines were disassembled to determine whether an internal malfunction could have caused one or both engines to fluctuate in power output. The teardown inspections of the engines revealed that the type and degree of damage seen was indicative of both engines operating normally at the time of impact. No preimpact damage or malfunction was evident. No record of preaccident engine problems existed with the exception of several fuel flow indicator discrepancies which the Safety Board believes were due to the fuel flow gauge itself and not because of engine malfunction.

The teardown examination of the propellers did not reveal any preimpact failures or anomalies. The condition of the disassembled propeller hub parts appeared normal except for damage due to impact forces. It is estimated that the blade angles at the time of initial impact were at or near the starting latch positions on both propellers. (This determination was made by matching counterweight impact marks on the hub port faces.) The numerous impact marks within the propeller hubs precluded a determination of exact blade angle at impact; however, all eight of the propeller blades sustained severe bending, abrasion, and twisting. This severe damage is evidence that the propellers were rotating under power when the blades struck the ground.

The Safety Board concludes that both engines, the propellers, and their various accessories were operating as designed until the initial impact with the ground.

2.3 Engine Torque/Temperature System Tests

In an effort to determine if the TTL computers had caused the engine power fluctuations cited by the flightcrew, both TTL computers were bench tested. The TTL computer from the left engine tested within manufacturer's specifications; however, the right TTL computer, produced a very high frequency oscillatory output signal at certain test points. Thus, if either computer was going to cause power fluctuations, it most likely would have been the right one. Therefore, the right engine TTL computer, along with its associated fuel bypass valve were installed on another TPE 331 engine for evaluation. During a test run of the engine, the very high frequency oscillatory output of the TTL computer in question, although a genuine anomaly, did not affect engine acceleration or steady-state operation in any discernible way. The Safety Board concluded that although the TTL computer

in question did not bench test within factory specifications, it could not have caused abnormal engine operation as described by the flightcrew.

2.4. Test Stand Engine Operation with RPM Levers in Various Positions

This test engine array was then used to evaluate engine operation with the RPM lever in positions other than full forward (the proper position for takeoff and other flight regimes). If the engine power lever was at 94.2 percent (with an additional torque limit signal introduced) and the RPM lever was in any position other than the full-forward position, the engine would oscillate violently and would continue to do so until the additional simulated torque limit signal was reduced or until the RPM lever was placed in the full-forward position. The Safety Board believes the results of this test are consistent with what the crew experienced shortly after takeoff in N331CY. In addition, with the RPM lever and engine power lever in their full rearward positions (taxi regime), surging resulted when the engine power lever was advanced rapidly toward its forward stop.

2.5. BAe-3101 Ground Run and Flight Tests

Ground runs and flight tests performed by British Aerospace engineers clearly showed that engine instability (power oscillations) can be induced through the mishandling of the engine power and/or RPM levers on this airplane. The instability experienced during the tests matched and probably exceeded that described by the N331CY crew. The tests proved that the instability can be induced by either setting the RPM in the range from minimum propeller governing RPM to low-flight RPM and advancing the engine power lever far enough to invoke either the torque or the temperature limiting function of the TTL system or by reducing engine speed by retarding the RPM lever out of approximately 100 percent with the engine power lever fully advanced.

The Safety Board, therefore, believes that if the crew attempted a takeoff with the RPM levers below the 100 percent take-off setting and the TTL system was activated for any reason (either overtorque or overtemperature), then severe engine power fluctuations would probably result sometime in the first few moments of high-power requirement. With the reported temperature of 86° F, the engine would be termperature limited, rather than torque limited. With the RPM lever set below 100 percent, as airspeed increased during the takeoff and initial climb, the propeller blade angle would be increased by the propeller governor to maintain the RPM selected by the RPM lever. In order to support that engine speed at higher blade angles, the fuel control would gradually increase fuel flow to the engine until at some point the exhaust gas termperature would reach the temperature limit and cause the TTL to bypass fuel. This bypassing of fuel initiated the power fluctuations. It must be noted that activation of the TTL system is a normal, protective function of the fuel control system for this engine installation and should not be construed to be an abnormal condition. Therefore, the Safety Board believes that the flightcrew failed to advance the RPM levers to the full-forward (100 percent) take-off setting before attempting a takeoff.

The take-off roll of 3,500 feet as recalled by the captain, and subsequent flight test results are consistent with a takeoff attempted with the RPM levers not in the full-forward position. Because of this, the Safety Board examined the possible reasons that the flightcrew attempted the takeoff with the RPM levers improperly set.

2.6 Training on the TTL System Provided by BAe to Air New Orleans

The Safety Board is concerned that the British Aerospace Company possessed information concerning the TTL system in the BAe-3101 that was not made available for use by Air New Orleans or other U.S. operators. Specifically, the British Aerospace Flight Training Guide, Jetstream 31, Issue 1, contained a procedure to eliminate erratic torque and/or EGT indications. In short, the procedure specified that the engine power lever be retarded until torque or EGT are below limits and then

switch off the propeller synchrophase system. The next steps are to switch off the TTL computer of the affected engine and to manually control the engine to maintain torque and EGT limits.

Had the crew of flight 962 been aware of and had been trained to use this procedure, it is conceivable that the accident would not have occurred. Because of the findings of flight tests conducted as part of this investigation, it is evident that switching off both TTL computers would probably have eliminated the torque fluctuations that caused the accident. The flightcrew's inability to diagnose and remedy the engine oscillation in a timely fashion under the existing circumstances made an accident inevitable.

The Safety Board is also convinced that the flightcrew involved in this accident did not have a good understanding of the purpose of the TTL system on the BAe-3101. The captain, when asked what he would do if he encountered TTL system activation, stated that although he was confident in the system, his flight training addressed the need to retard the power levers to "get off" the TTL. The first officer stated that "when you were on the limiters that you would not have substantial. . . power."

These statements indicate to the Safety Board that some Air New Orleans BAe-3101 pilots require a better understanding of the TTL system. This is especially true because a normally operating TTL system can cause power fluctuations if the power and/or RPM levers are misset during takeoff or flight. A sufficient understanding is now provided through the expanded explanation of the TTL system's operation and idiosyncrasies in the approved flight manual for this airplane.

2.7 Flightcrew Performance of Pretakeoff Duties and Prior Experience

Although the flightcrew indicated that the engine RPM levers were advanced immediately before takeoff while the airplane was taxiing into position for takeoff, the preponderance of the evidence indicates that they were either advanced to a position less than full forward or were not advanced at all. The Safety Board believes that the flightcrew's failure to advance the RPM levers properly was unintentional. Therefore, the Safety Board examined other conditions and circumstances of the flight to determine if any of them may have contributed to this oversight. One of the circumstances considered was the possible adverse effects of the flightcrew's interaction with the air traffic controller and the possibility that the pilots rushed their pretakeoff duties to comply with instructions for an immediate takeoff.

The comments by the local controller, such as ". . . be ready for an immediate [takeoff]," "...be ready to roll [as] soon as the Transtar nine rotates," and ". . .be up on power, be ready to go..." may have induced a sense of urgency to the pilots such that they rushed their completion of the checklist and predeparture tasks. However, about 47 seconds elapsed from the time the flight notified the controller that it was ready to depart and the issuance of the departure clearance. Also, the pilots testified that they had completed the checklist before reaching the hold line for the runway with the exception of the last item of advancing the RPM levers.

The captain further stated that he personally advanced the RPM levers, rather than the first officer, even though company procedure required the nonflying pilot to advance the RPM levers. Interestingly, the captain stated that his action was precipitated by the controller's instructions to be ready for an immediate takeoff. He also stated that all checklist items were completed and the airplane was on the runway at a stop before the takeoff clearance was issued. It is apparent, however, that all checklist items were not completed, in that the RPM levers were not advanced to the takeoff position. A policy of strict adherence to checklists not only includes fully complying with each item on the checklist, but also includes having the proper crewmember comply with each item. Having a crewmember short-cut a checklist by doing things assigned to another crewmember, however well-intentioned the reason, can lead to error. This is especially true when the crewmember using the checklist is not familiar with it or the aircraft that it governs.

Based on the above information, the Safety Board cannot rule out the possibility that the flightcrew's efforts to comply with ATC instructions expeditiously may have contributed to their failure to achieve a proper take-off configuration and their failure to recognize this condition.

Achieving a safe, orderly, and efficient flow of traffic in the control ATC system requires a high degree of cooperation between pilots and controllers. Often in day-to-day operations, each party attempts to accommodate instructions and requests of the other to their mutual benefit. This appears to be the case in this exchange between the local controller and the pilots of flight 962. Notwithstanding the questionable appropriateness of the controller's repeated instructions, the Safety Board is concerned that the pilots may have unintentionally diverted their attention in making their takeoff expeditiously, and thereby, jeopardized the safety of that operation. Although nonstandard phraseology by air traffic controllers cannot be condoned, the Safety Board believes it is essential that pilots maintain a proper balance between complying with ATC instructions and requests and the manner of exercising their responsibility and authority for the safe operation of their aircraft.

The Safety Board believes that the flightcrew's operating experience in this airplane type was limited and contributed to the accident sequence. The lack of experience of the first officer is especially relevant. He was responsible for reading the checklist, and, in accordance with its last item, was responsible for advancing the RPM levers to the take-off position

At the time of the accident, the captain had accumulated only about 47 hours of flight experience in the BAe-3101, excluding 13 hours of training, and he had received his type rating only 2 weeks before the accident. The first officer had accumulated less than 15 hours of flight experience in the aircraft, excluding 4 hours of training, and had completed a competency check only 1 week before the accident. The Safety Board believes that this limited experience was among the factors that probably contributed to the accident.

The flightcrew had considerable recent experience in the Beech BE-99, another twin-engined turboprop airplane with different take-off power setting procedures. This difference may have contributed to the failure of the crew to properly set the RPM levers to the take-off position before takeoff. The checklist and take-off procedures for the Beech BE-99 differ from that of the BAe-3101 in that they do not include or require adjustment of any power quadrant controls during completion of the final items of the checklist before taking off. In a Beech BE-99, the RPM levers are set to the take-off position before the airplane even leaves its parking space. By contrast, in the BAe-3101, advancement of the RPM levers is the last item on the checklist before taking off. Given the fact that this crew was relatively inexperienced in the BAe-3101, it is logical to conclude that when they experienced even mild stress or apprehension, they may revert back to recent habit patterns and begin the takeoff believing that the RPM levers already had been properly positioned. The Safety Board believes this may have been the case in spite of the captain's statement that he had advanced the RPM levers.

This aspect was especially true for the captain because, on this flight, it was not one of his duties to push the RPM levers forward, even though in this case, he stated that he had done so. The Safety Board believes that the captain may have touched the RPM levers (thinking they were already fully forward) or he may have even advanced the levers to a position that he thought was fully forward. The Safety Board does not believe, however, that either crewmember positioned the levers to fully-forward position before the take-off roll began.

In summary, the Safety Board believes that the flightcrew's failure to advance the RPM levers to the take-off position resulted from the combined adverse effects of (1) their limited familiarity with the BAe-3101 airplane because of their low time-in-type; (2) the habit interference which resulted from their recent and extensive experience in the BE-99 airplane which uses RPM control

procedures that are different from the BAe-3101 airplane; and (3) their efforts to respond expeditiously to their ATC clearance for takeoff. Although it was not possible to determine positively that these factors, in combination, led to the inapropriate crew performance, the Safety Board finds the foregoing evidence for this explanation persuasive.

2.8 Checklist Design

The Safety Board is concerned by the design of the company normal procedures checklist used by the flightcrew on the day of the accident. The checklist, an amalgam of manufacturer's and operator's items that addresses the needs of the company, was in its seventh revision at the time of the accident. Earlier versions were not available to the Safety Board. Frequent revisions of checklists for newly acquired aircraft are understandable, but the fact that this one had been changed seven times between January and May 1987 suggests to the Safety Board that its original design and approval may have been inadequate and may have caused confusion among flight crews.

The checklist retrieved from N331CY was typewritten and laminated in glossy clear plastic. (See appendix G.) According to the *Human Engineering Guide to Equipment Design*,1/ the typeface on the Air New Orleans checklist is 57 percent smaller than that recommended by human engineering criteria. This smaller typeface reduces the legibility of the print even under optimum conditions. Although there was no evidence that checklist legibility was a factor in this accident, the Safety Board believes that under other operational circumstances, this deficiency could compromise the intended purpose of this device. Therefore, the Safety Board believes that the FAA should take action to verify that aircraft checklists are designed to comply with accepted human engineering criteria. In regard to the surveillance of air carrier checklists by the FAA, FAR Part 121 checklists are formally examined and actually stamped as approved by the appropraite principal operations inspector. FAR Part 135 checklists only have to agree with the FAA-approved training program for the applicable commuter airline. There is no "formal" approval of checklist changes, however, the duty to see that the checklist agrees with the training program lies with the POI.

2.9. FAA Surveillance

The Safety Board believes that FAA surveillance of Air New Orleans during a critical time of company expansion and retraining in a new aircraft type was probably inadequate. FSDO 67B was operating with only one operations inspector from February 13, 1987, to the date of the accident, a period of more than 3 months. The fact that one principal operations inspector was performing his duties as the main governmental point-of-contact for Air New Orleans in addition to his regularly assigned duties could have led to such things as his nominal approval of a poorly designed checklist, his inadequate familiarity with available flying training materials, and his lack of perception concerning weak crew knowledge of critical aircraft systems at Air New Orleans. The Safety Board understands that personnel manning levels within the FAA vary at times, but in this case, temporary assignment of a less-burdened operations inspector from another FSDO qualified to fly the BAe 3101 perhaps would have alleviated the identified problems at Air New Orleans.

1/ *Human Engineering Guide to Equipment Design*, (Revised Edition), Edited by Harold Van Cott and Robert Kinkade, American Institutes for Research, Washington, D.C., 1972.

2.10 Corrective Actions

As a result of this investigation, the BAe-3101 Flight Manual now contains a specific requirement to confirm an RPM setting of 100 percent before taking off. In addition, the flight manual now includes an expanded explanation of takeoff torque and what to do if takeoff torque cannot be achieved during a takeoff. The flight manual now also includes procedures on how to deal with torque fluctuations in flight.

3. CONCLUSIONS

3.1 Findings

1. The airplane had experienced no previous significant powerplant, TTL system, fuel control, or propeller malfunctions.

2. The flight crew had relatively little flight experience in the BAe-3101.

3. The captain and the first officer had approximately 3,540 and 580 hours of experience, respectively in the Beech 99. The Beech 99 pretakeoff checklist differs from that of the BAe-3101.

4. Air New Orleans offers no cockpit resource management or crew coordination training as part of its FAA-approved training program.

5. Although the design of the Air New Orleans BAe-3101 checklist did not conform to accepted human engineering design criteria for legibility, this condition was not a factor in this accident.

6. The examination of the engines revealed that the engines were functioning normally before the airplane crashed.

7. Engine and propeller teardowns revealed nothing that could account for the engine torque oscillations.

8. An engine run on a test stand along with ground and flight tests revealed that if the RPM levers were in the taxi position or any position other than the take-off (100 percent) position, conditions similar to what the crew described on the accident flight would likely occur.

9. British Aerospace was in possession of a procedure to alleviate TTL problems in flight that was not known to the Air New Orleans crews nor was this procedure known or approved by the FAA.

10. The engine RPM levers were either advanced to a position less than full forward or they were not advanced at all before take off, indicating a lack of checklist discipline on the part of the aircrew.

11. The flightcrew's efforts to respond expeditiously to ATC clearance for take-off may have contributed to their failure to position the engine RPM levers fully forward.

12. The principal operations inspector for Air New Orleans performed as POI as an added assignment to this regular duties and was the only POI assigned to FSDO 67B for approximately 3 months preceding the accident due to personnel shortages at the FSDO.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was a breakdown of the flightcrew coordination which resulted in their failure to comply with the Before Takeoff Checklist and advance the RPM levers to the high RPM position, and the flightcrew's failure to diagnose and remedy engine oscillations on initial climbout.

Contributing to the flightcrew's failure to advance the RPM levers before take off was the fact that both crewmembers had limited experience in the BAe-3101 and extensive recent experience in other aircraft which use RPM control lever procedures that are different from the BAe-3101.

4. RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board recommended that the Federal Aviation Administration:

> Issue an Advisory Circular to commercial operators recommending the use of a procedural checklist that incorporates human engineering design criteria for size and style of print. (Class II, Priority Action) (A-88-72)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ JAMES L. KOLSTAD
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 31, 1988

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified on May 26, 1987, that Continental Express flight 962 had crash landed after takeoff from New Orleans International Airport. A full investigation team was sent from the Washington, D.C. headquarters. Safety Board specialists were assigned to chair groups in the following areas for investigation: survival factors, structures/systems, propellers, operations/weather, air traffic control, human performance, laser transit, powerplants/maintenance records, and light bulb analysis.

The following parties were designated to participate in the field phase of the investigation: the Federal Aviation Administration, Air New Orleans, British Aerospace Company, Dowty Aerospace Corporation, and Garrett Turbine Engine Company.

2. Public Hearing

A public hearing was not held in conjunction with this investigation.

APPENDIX B

PERSONNEL INFORMATION

Captain Edward Paul Horil

Captain Horil, date of birth December 14, 1957, was employed by Air New Orleans on February 14, 1984, as a Beech BE-99 captain. He was upgraded to captain and received his type rating on the BAe-3101 on May 12, 1987. Captain Horil holds airline transport pilot certificate No. 435119893, dated May 12, 1987, with a type rating in the BAe-3101 and commercial privileges for single- and multiengine land and sea aircraft. He also holds a flight instructor certificate (expired) for airplane single-engine instrument airplane instruction. His first-class medical certificate dated May 26, 1987, was issued without restrictions.

First Officer Robert S. Bradshaw

First Officer Bradshaw, date of birth May 18, 1960, was employed by Air New Orleans as a Beech BE-99 first officer on October 27, 1986. He was upgraded to a first officer on the BAe-3101 on May 19, 1987. First Officer Bradshaw holds commercial pilot certificate No. 257985414 dated August 13, 1985, with the ratings and limitations of airplane single- and multiengine land instrument airplane. He also holds flight instructor certificate No. 257985414 dated March 27, 1986, with the ratings and limitations of airplane single-engine instrument airplane. His first-class medical certificate, dated January 8, 1987, was issued without limitations.

Air Traffic Controller Stephen T. Jubb

The New Orleans international airport tower local controller that cleared flight 962 for takeoff, Stephen Jubb, was a full performance level (FPL) control specialist employed by the FAA since February 27, 1983. He attained FPL status on April 17, 1987, and was medically qualified to hold his position. He is a single-engine land rated aviator, although he was noncurrent at the time of the accident.

APPENDIX C

AIRCRAFT INFORMATION

British Aerospace Company 3101 Jetstream, manufacturer's serial number 742, was leased from British Aerospace during May 1987 by Air New Orleans. It was assigned U.S. registration number N331CY. The airplane was manufactured under 14 CFR 23 and was issued a Standard Airworthiness Certificate in the normal category. As of the date of the accident, the airplane had accumulated 147.2 operating hours.

Two Garrett AiResearch TPE-331-10 turbopropeller engines, serial numbers P-63175C (left) and P-63174C (right), and two Dowty Aerospace Corporation R333/4-82-F/12 propellers, serial numbers DRG/9433/86 (left) and DRG/9678/86 (right) were installed. Four Dowty 660709317-23 propeller blades were installed in each prop hub.

APPENDIX D

AIR TRAFFIC CONTROL TRANSCRIPT

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: Transcription concerning the accident involving ANL962 BA14 on May 26, 1987 at 2145 UTC

Date: June 3, 1987

From: K. R. Friar
Manager, Moisant ATC Tower

Reply to Attn of

To: This transcription covers the time period from May 26, 1987, 2132 UTC to May 26, 1987, 2150 UTC.

Agencies making transmissions	Abbreviation
Delta 747	DL747
Moisant ATC Tower GC/LC	TWR
Piedmont 380	P1380
Midway 183	MID183
N626 Mallard	N626
Continental 195	CO195
Continental 117	CO117
Transtar 896	TST896
Southwest 443	SW443
Air New Orleans 910	ANL910
Air New Orleans 962	ANL962
American 345	AA346
Eastern 679	EA679
New Orleans Approach Control West Radar	WR
New Orleans Approach Control South Radar	SR
U.S. Air 54	AL54
Air New Orleans 948	ANL948
N5833F	33F

2133:17	CO117	Roger
2133:21	TST896	Transtar eight ninety six ready to push it back
2133:25	TWR	Transtar eight ninety six roger that advise ready to taxi
2133:27	TWR	Midway one eighty three cross runway one zero
2133:31	MID183	One eighty three roger
2133:33	TWR	Piedmont three eighty follow Midway cross runway one zero taxi to one nine
2133:35	PI380	Cleared to cross Piedmont three eighty
2133:38	TWR	Southwest four forty three make your center right turn taxi to the ramp stay with me
2133:42	SW443	Ah four forty three roger
(2134)		
2134:10	TWR	Midway one eighty three you follow the Delta seven ah make it a D C eight
2134:14	MID183	Roger Midway one eighty three
2134:16	TWR	Mallard six two six you're radar contact report level with your cruising altitude
2134:18	N626	Six two six roger
2134:42	TWR	Continental one seventeen runway one nine taxi into position and hold
2134:44	CO117	Position and hold one seventeen
2134:59	SW443	Ah ground Southwest four forty three we're going to hold right here a few minutes for the gate if that's all right sir
(2135)		
2135:02	TWR	Yeah that will be fine four forty three
2135:08	ANL910	Ground Air New Orleans nine ah ten is ready for taxi
2135:13	TWR	Air New Orleans nine ten taxi to runway one nine and hold short of one zero clear the left side of the ah taxiway as you go out eastbound

2135:22	ANL910	Qkay we'll go to the left side here and hold short of one zero going to one nine nine ten
2135:25	TWR	Thank you
2135:30	ANL910	We're front or behind Southwest here
2135:33	TWR	In front of Southwest and ah close to the grass
2135:37	ANL910	Okay
2135:39	TWR	Southwest four forty three just go ahead and hold it there for the ah Beech Airliner and Eastern
2135:42	TWR	Eastern six seventy nine taxi to the ramp
2135:45	TWR	Continental one seventeen runway one nine cleared for takeoff
2135:47	CO117	Cleared for takeoff Continental one seventeen
2135:49	TWR	American three forty six runway one nine taxi into position and hold
2135:53	AA346	Position and hold one nine American three forty six
2135:58	TWR	Eastern go ahead and taxi to the gate there Eastern six seventy nine what's what's your gate today
(2136)		
2136:03	EA679	Ah we're going to ah twelve it looks like
2136:06	TWR	Number twelve go ahead and taxi to the ramp the airliner is going to wait for you
2136:07	EA679	Okay
2136:08	TWR	Okay
2136:13	N33F	And ah Moisant Tower five eight three three fox ready for depart departure one zero
2136:17	TWR	Five eight three three fox roger runway ah one zero taxi into position and hold traffic departure runway one nine
2136:21	N33F	Taxi into position and hold
2136:22	UNK	American three forty six ready for taxi

2136:26	TWR	American three forty six runway one nine cleared for takeoff
2136:30	AA346	Cleared for takeoff one nine three forty six
2136:33	TWR	Eastern six eighty two runway one nine taxi into position and hold
2136:38	EA682	Position and hold Eastern six eighty two
2136:38	TST896	Transtar eight ninety six ready to taxi
2136:42	TWR	Transtar eight ninety six give way to Eastern taxi to runway one nine hold short of one zero the Southwest (unintelligible) will hold for you
2136:47	TST896	One nine hold short of two eight roger
2136:51	TWR	Continental one seventeen contract departure good day to you sir
2136:52	CO117	Continental one seventeen good day
2136:53	TWR	Mallard six two six clear the TCA with a Southwest departure radar service is terminated frequency change is approved have a nice week
2136:58	N626	Okay see you later
(2137)		
2137:04	TWR	So long now New Orleans nine ten cross runway one zero taxi to one nine
2137:06	ANL910	Nine ten
2137:09	ANL962	Ground Air New Orleans nine ah sixty two is delta taxi
2137:12	TWR	Air New Orleans nine sixty two taxi to one nine hold short of one zero and just follow the ah Transtar (pause) D C nine off your left
2137:15	ANL962	Ah follow Transtar hold short of one zero
2137:18	TWR	Thank you
2137:19	TWR	Southwest ah four forty three taxi to the ramp
2137:22	SW443	To the ramp four forty three
2137:23	TWR	Eastern six eighty two runway one nine cleared for takeoff

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2137:25	EA682	Cleared for takeoff Eastern six eighty two
2137:26	TWR	Transtar eight ninety six cross runway one zero
2137:27	TST896	Eight ninety six roger cross
2137:28	TWR	New Orleans nine sixty two follow the D C nine cross runway one zero
2137:30	TWR	New Orleans nine sixty two follow the D C nine cross runway one zero
2137:32	ANL962	Nine sixty two
2137:39	TWR	Delta seven forty seven heavy runway one nine taxi into position and hold
2137:41	DC747	Position and hold runway one nine Delta seven forty seven heavy
2137:44	AA346	Want American on departure
2137:50	TWR	American three forty six yes sir so long
(2138)		
2138:12	TWR	Centurion three three fox trot turn right heading one nine zero runway one zero cleared for takeoff
2138:16	33F	That's a right turn one nine zero five eight three three foxtrot (unintelligible)
2138:22	UNK	(Unintelligible)
2138:24	UNK	So long
2138:40	WR	The winds here are one
2138:50	WR	And contact the Houston Center one two seven point niner
2138:53	UNK	Left to two six zero three seven eight good day what you need
2138:59	TWR	West right turn to two fifty three three fox off ten going to Lafayette
(2139)		
2139:00	WR	Approved

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2139:01	TWR	Thank you
2139:03	TWR	Centurion three three foxtrot turn right heading two five zero
2139:12	33F	Right two five zero
2139:13	TWR	Roger
2139:14	TWR	Delta seven forty seven heavy traffic just at the intersection of two runways and a cent ces Cessna Centurion in a right turn heading westbound fly runway heading one nine cleared for takeoff
2139:20	DL747	Okay cleared for takeoff seven forty seven heavy
2139:23	TWR	Centurion an ah three three foxtrot make the turn a tight right turn heading two five zero sir
2139:32	33F	Ah make a right turn two five zero visually
2140:00	TWR	Two five zero keep the turn tight
2140:01	TWR	Midway one eighty three caution turbulence runway one nine taxi into position and hold check the winds are four zero degrees at thirteen
2140:03	MID183	Into position and hold Midway one eighty three
2140:28	TWR	Seven forty seven heavy Centurion just off the departure end heading southwest bound you still have him in sight
2140:33	DL747	Delta seven forty seven ah okay yeah he's crossing right in front of us
2140:38	TWR	He's heading southwest bound if you need ah swing over to the left that's approved contact departure twenty five five
2140:52	DC747	Okay we still got him
2140:53	TWR	Roger
2140:54	TWR	Three three foxtrot contact departure twenty five five
2140:58	33F	Twenty five five three three fox
(2141)		
2141:17	AL54	Tower U S Air fifty four is with you on a visual for one nine

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2141:19	TWR	Midway one eighty three the wind one four zero at twelve runway one nine cleared for takeoff
2141:22	MID183	Okay one eighty three here we go
2141:26	TWR	U S Air fifty four runway one nine cleared to land wind one four zero at twelve
2141:29	AL54	Cleared to land U S Air fifty four
2141:31	TWR	Piedmont three eighty runway one nine taxi into position and
2141:34	PI380	Into position Piedmont three eighty
2141:36	TWR	Air New Orleans nine ten follow the Piedmont seven three into position hold runway one nine
2141:39	ANL910	In position one nine nine ten
2141:45	ANL910	Ah I think nine ten will wait
2141:47	TWR	New Orleans nine ten ah roger follow Piedmont position and hold runway one nine
2141:48	ANL910	And think we can wait a minute
(2142)		
2142:01	TWR	You want a minute behind the seven thirty seven
2142:04	ANL910	Yeah we'd like that after he leaves
2142:06	TWR	Well that's that's what I wanted you to do
2142:09	TWR	Piedmont three eighty runway one nine cleared for takeoff
2142:12	PI380	Cleared to go Piedmont three eighty
2142:19	TWR	Midway one eighty three contact departure so long
2142:23	PI380	Three eighty so long
2142:35	ANL948	Air New Orleans nine forty eight ready to go in sequence
2142:37	TWR	New Orleans nine forty eight roger and Air New Orleans nine ten runway one nine taxi into position and hold
2142:38	ANL910	Nine ten is going into position one nine

2142:41	TST896	Transtar eight ninety six we're ready
2142:42	TWR	Transtar eight ninety six ah roger (pause) eight ninety six follow the Beech ah airliner for runway one nine be prepared for immediate departure
2142:44	TST896	Roger we're ready
2142:45	TWR	Thank you Air New Orleans nine ten runway one nine cleared for takeoff
2142:48	ANL910	Cleared to go one nine nine ten on the roll
2142:53	TWR	South local
2142:55	SR	Yes
2142:57	TWR	Left turn to one ah
(2143)		
2143:01	ANL962	Moisant Tower New Orleans nine sixty two ready one nine in sequence
2143:03	SR	Left to one thirty approved
2143:05	TWR	Thank you very much
2143:07	TWR	Air New Orleans nine ten cleared for takeoff left turn heading one three zero
2143:09	ANL910	One thirty on the heading we're on the roll nine ten
2143:10		(Unintelligible)
2143:12	TWR	Piedmont three eighty contact departure good day
2143:14	PI380	Good day
2143:16	ANL962	Moisant Tower Air New Orleans nine sixty two ready one nine in sequence
2143:18	TWR	Air New Orleans nine sixty two roger up to hold short be ready for an immediate
2143:22	ANL962	(Unintelligible) nine sixty two
2143:27	ANL948	Ah New Orleans nine forty eight is ready in sequence

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2143:29	TWR	Nine forty eight thank you sir Transtar ninety six keep your eyes traffic you're following heading runway one nine cleared for takeoff
2143:39	TST896	Transtar eight ninety six rolling
2143:40	TWR	New Orleans nine sixty two position and hold be ready to roll soon as the Transtar nine rotates
2143:43	ANL962	Nine sixty two position and hold
2143:45	TWR	Air New Orleans nine ten left turn to one three zero start the left turn now contact departure one twenty three eight five good day to you sir
2143:50	ANL910	Ah going to departure now nine ten good day
2143:55	TWR	Air New Orleans nine forty eight you hold short for landing traffic
2143:56	ANL948	Nine forty eight we'll hold short
2143:59	TWR	Nine sixty two be up on power be ready to go after departure be runway heading
(2144)		
2144:03	TWR	Air New Orleans nine sixty two runway one nine cleared for takeoff
2144:07	ANL962	Cleared for takeoff nine sixty two runway one nine
2144:12	N800	Moisant Tower Cessna ah five one eight zero zero ready to go
2144:15	TWR	Five two one eight zero zero Moisant Tower ah roger runway one zero at the intersection taxi into position and hold traffic departing on runway one nine
2144:24	TWR	U S Air fifty four you're cleared to land traffic is a jetstream rolling midfield
2144:28	AL54	U S Air fifty four
2144:29	TWR	Transtar eight ninety six contact departure so long
2144:31	TST896	Goodnight

2144:50	TWR	Air New Orleans nine sixty two
2145:00	UNK	Oh
2145:02	AL54	U S Air fifty four is going around
2145:04	TWR	U S Air fifty four roger
2145:12	TWR	U S Air fifty four climb and ah maintain two thousand one hundred correction just maintain fifteen hundred feet and enter right down
2145:20	AL54	Fifteen hundred feet (unintelligible) U S Air fifty four
2145:24	TWR	U S Air fifty four a right downwind runway one zero and you're cleared to land runway one zero
2145:28	AL54	Okay right downwind we're cleared to land one zero U S Air fifty four
2145:32	TWR	Affirmative
2145:38	TWR	New Orleans nine forty eight just hold it there
2145:45	TWR	Runway nineteen is closed we just had a crash
2145:46	N800	Moisant Tower Cessna five one eight zero zero ready for takeoff ah holding on one zero
2145:50	TWR	Cessna eight two zero taxi off the runway sir
2145:52	N800	Eight zero zero
2145:53	TWR	U S Air fifty four runway one zero cleared to land ah advise me when you turn base
2145:58	AL54	Okay we're starting a base turn at this time U S Air fifty four
2146:00	TWR	U S Air fifty four affirmative
2146:06	TWR	Transtar eight ninety six contact departure
2146:57	AL54	Sorry about all that noise over the tower there
2147:00	TWR	Say again please

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2147:03	AL54	That's U S Air fifty four sorry about all that noise on going around like that
2147:07	TWR	Quite alright U S Air fifty four you're cleared to land the wind one six zero at one three
2147:18	TWR	No one nine stay off of one nine
2147:22	UNK	Yes sir
2147:40	TWR	Air New Orleans nine forty eight we're ah going to close one nine plan on runway one zero now ah (pause) Continental one eighty three can you make a one eighty
2147:50	CO183	Negative
2147:51	TWR	Alright Air New Orleans nine forty eight ah taxi down runway one nine call ground one two one point nine
2147:55	ANL948	Ah nine forty eight
2147:58	TWR	Continental one ninety three follow the jetstream (pause) contact ground one two one point nine
(2148)		
2148:05	CO183	Okay Continental one eighty three
2148:08	DL929	Moisant Tower Delta nine twenty nine ah ten miles north of the field for one zero
2148:13	TWR	Delta nine twenty nine Moisant Tower runway one zero cleared to land wind one six zero at one three
2148:19	DL929	Delta nine twenty nine cleared to land runway one zero
(2149)		
2149:02	TWR	U S Air fifty four contact ground point nine when off the runway
2149:05	AL54	U S Air fifty four
2149:20	TWR	Cessna eight zero zero taxi into position runway one zero and hold intersection

2149:28	N800	Eight zero zero into position and hold
2149:47	TWR	Cessna eight zero zero maintain one thousand five hundred runway one zero fly runway heading cleared for takeoff
2149:54	N800	(Unintelligible) cleared for takeoff and maintain one point five zero (unintelligible)
2150:00	TWR	That's correct sir

----------END OF TRANSCRIPT----------

*The clock on the 20 channel magnasync recorder was not operating at the time of the accident because the recorder was shut down for maintenance, and when it was returned to service, the timing device was inoperative. Times on the transcript were obtained by using the accident time of 2145 UTC and working back by the use of stopwatch from the accident time.

APPENDIX E

GARRETT EXPLANATION OF THE OPERATION OF THE TPE 331 ENGINE WITH THE RPM LEVER IN THE LOW POSITION

Garrett Turbine Engine Company
A Division of The Garrett Corporation
111 S. 34th ST.
P.O. BOX 5217
PHOENIX
ARIZONA 85010
Tel: (602) 231-1000
Telex: 667337 GARRETT PHX

October 5, 1987

Refer to:
PI:PBB:0559:100587

Mr. Robert Benzon
Air Safety Investigator
National Transportation Safety Board
AI-30
800 Independence Avenue, S.W.
Washington, D.C. 20594

Subject: **ACCIDENT - BAe 3101, N331GY, KENNER, LA, MAY 26, 1987**

Dear Bob:

Please find attached a copy of "Operation of TPE331 with Speed Lever Low" write-up. The request for this write-up was made from Mr. Ron Schleede during our technical review meeting in Washington, D.C., on August 25, 1987, for the referenced accident.

If you have any questions or need anything else, please don't hesitate to contact me.

Sincerely,

Peter B. Baker
Senior Product Safety Engineer
Product Integrity

PBB:jd
Enclosure

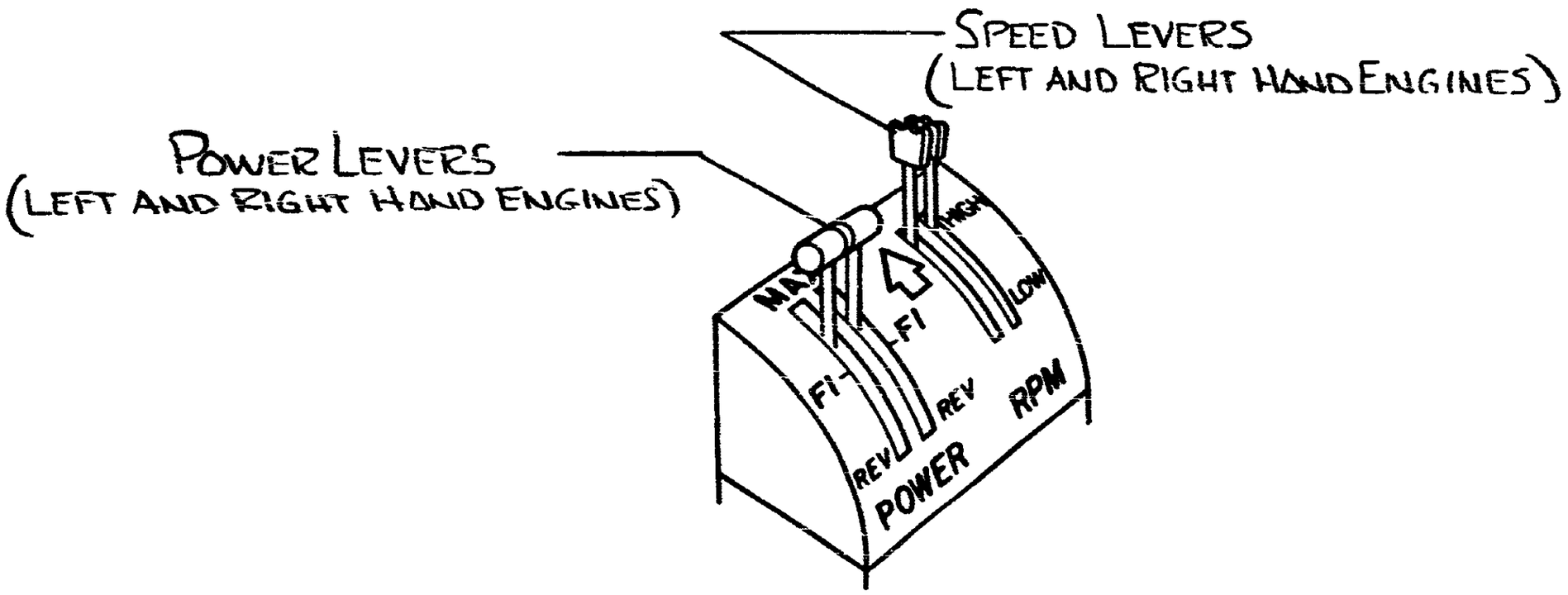

SPEED LEVERS
(LEFT AND RIGHT HAND ENGINES)
POWER LEVERS
(LEFT AND RIGHT HAND ENGINES)
MAX
HIGH
LOW
FI
FI
REV
REV
RPM
POWER

FIGURE 1

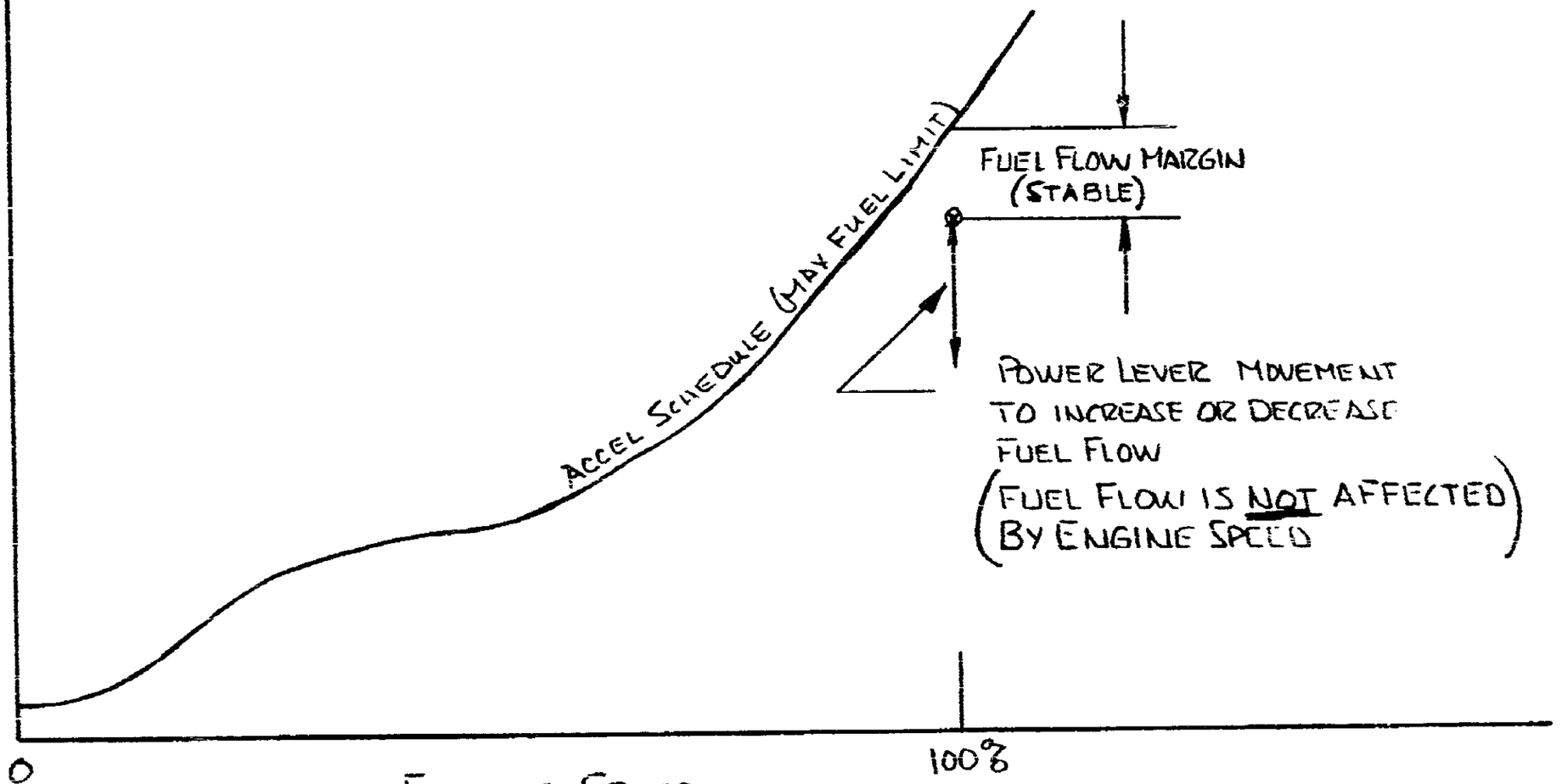

FUEL FLOW
SCHEDULE (MAX FUEL LIMIT)
ACCEL SCHED
FUEL FLOW MARGIN
(STABLE)
POWER LEVER MOVEMENT
TO INCREASE OR DECREASE
FUEL FLOW
(FUEL FLOW IS NOT AFFECTED
BY ENGINE SPEED)
0
100%
ENGINE SPEED

FIGURE 2

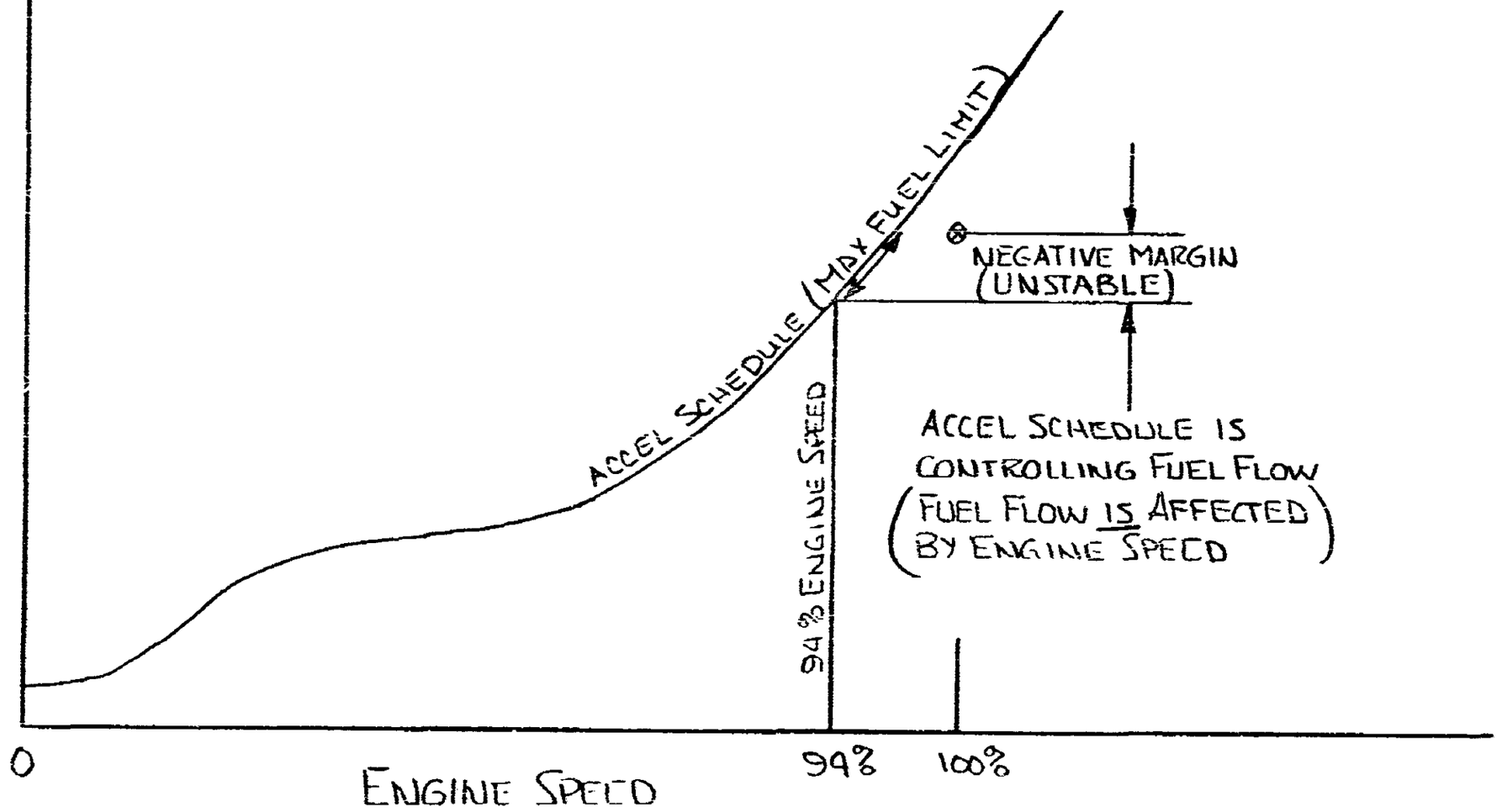

FUEL FLOW
ACCEL SCHEDULE (MAX FUEL LIMIT)
NEGATIVE MARGIN
(UNSTABLE)
ACCEL SCHEDULE IS
CONTROLLING FUEL FLOW
(FUEL FLOW IS AFFECTED
BY ENGINE SPEED
94% ENGINE SPEED
0
99%
100%
ENGINE SPEED

FIGURE 3

APPENDIX F

GARRETT TURBINE ENGINE COMPANY
TEST REPORT
TORQUE/TEMPERATURE LIMITER S/N 56-1615

Garrett Turbine Engine Company
A Division of The Garrett Corporation
111 S. 34th ST.
P.O. BOX 5217
PHOENIX
ARIZONA 85010
Tel: (602) 231-1000
Telex: 667337 GARRETT PHX

July 27, 1987

Refer to:
PI:PBB:0549:072787

Ms. Mary Jean Pyatt
National Transportation Safety Board
Aviation Accident Division (AI-30)
800 Independence Avenue, S.W.
Washington, D.C. 20594

Subject: **TEST REPORT, TORQUE/TEMP. LIMITER S/N 56-1615**

Dear Jean:

Please find enclosed a copy of the test report for the prop stand testing of the torque/temp. limiter off the right-hand engine from the Air New Orleans accident.

If there is anything else you need, let me know.

Sincerely,

Peter B. Baker
Senior Product Safety Engineer
Product Integrity

PBB:jd
Enclosure

A Half Century of Leadership

from the Garrett General Airline Services Company engine "bank." P-63117 is a Model 513H engine and Engine P-63175C, the accident engine, is a Model 514H. The difference between the two engine models is the 514H has the necessary hardware for an engine "auto-relight" system, and the 513H does not. The accident aircraft was not set up to utilize this "auto-relight" system; therefore, it was not in operation at the time of the accident. For purposes of this test, the operation of the 513H and the 514H model engines are identical.

A Sanborn strip chart recorder was used to record the following parameters:

Channel	Parameter	Range
1.	SRL Temp.	600 to 700°C
2.	Compensated EGT	400 to 600°C
3.	Engine Speed	80 to 105%
4.	Fuel Flow	300 to 550 pph
5.	Torque	4 to -1 volts DC
6.	Bypass Valve Current	0 to 100 ma
7.	Beta Pressure	0 to 500 psig
8.	PCD at FCU	0 to 150 psig

SRL - Single Red Line
EGT - Exhaust Gas Temperature
PCD - Pressure, Compressor Discharge
FCU - Fuel Control Unit

The following components from engine P-63175C were installed on or connected to the test engine and its systems.

Component	Part No.	Serial No.
SRL Computer	2118042-2	75-468
Torque/Temp Limiter	949594-8	56-1615
Bypass Valve	897457-3	1249

The test points used to evaluate the torque temp limiter stability at takeoff conditions were as follows: (Points 1 and 2).

1) Engine speed 100%. Temp. Limit (650°C SRL)

   a) Advance power lever (P/L) slowly to temp. limit.

   b) Advance P/L rapidly to temp. limit.

2) Engine speed 100%. Simultaneous torque and temp. limits.

Note: The torque limit signal to the torque/temp. limiter was induced via test stand equipment as the ambient conditions at the time of the test were such that actual engine torque limit could not be achieved.

a) Advance P/L slowly to torque/temp. limit.

b) Advance P/L rapidly to torque/temp. limit.

RESULTS

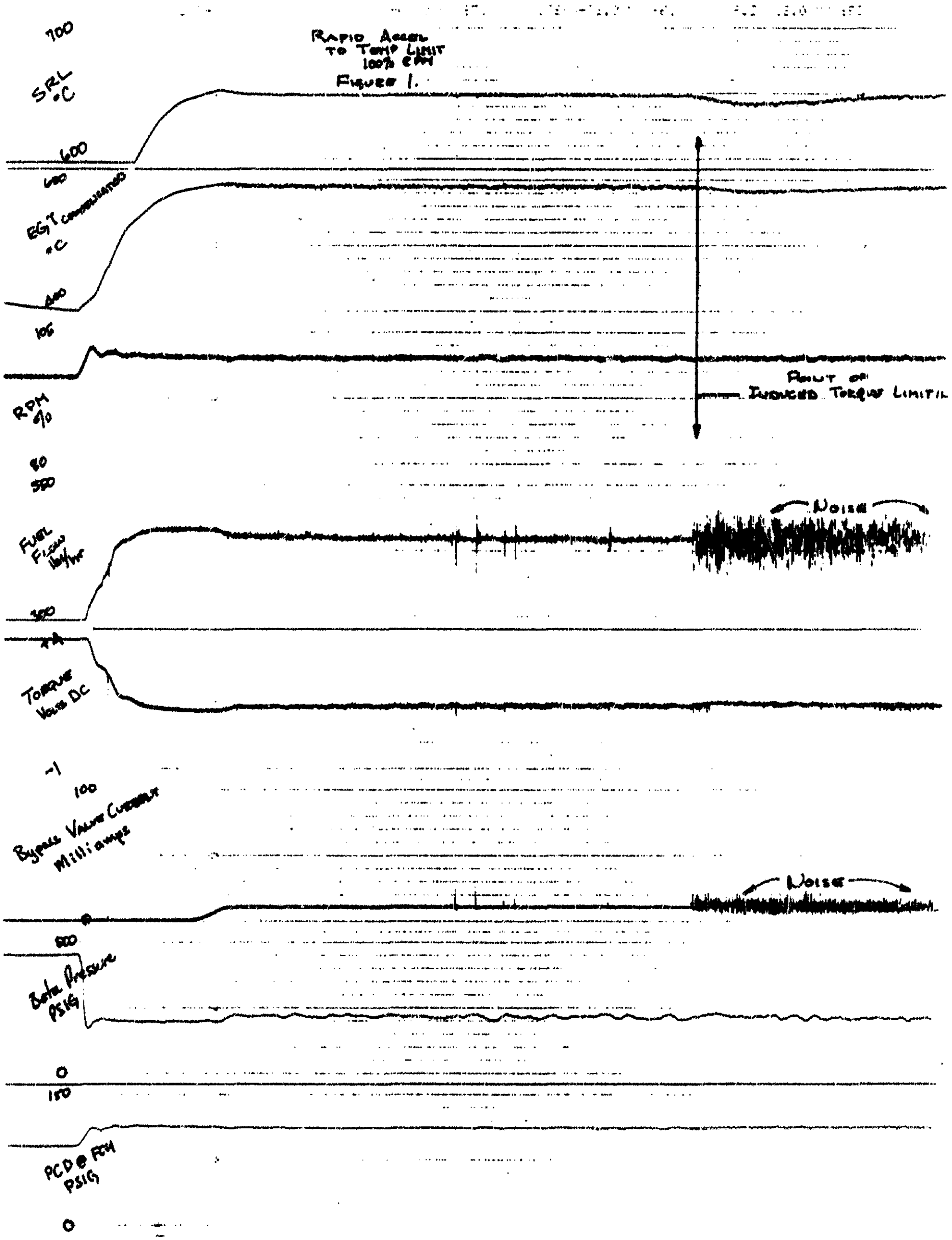
The first engine condition set was engine RPM, 100%, and a temp. limit of 650°C. At this point, all engine parameters were stable. Next, the P/L was advanced from the minimum position to the maximum position, ensuring that temperature limiting was achieved. Figure 1 shows that the SRL temperature stabilized at 650°C 4 seconds after the initiation of the temp. limiting function (shown on the trace as a rise in bypass valve current). All parameters at this point were stable.

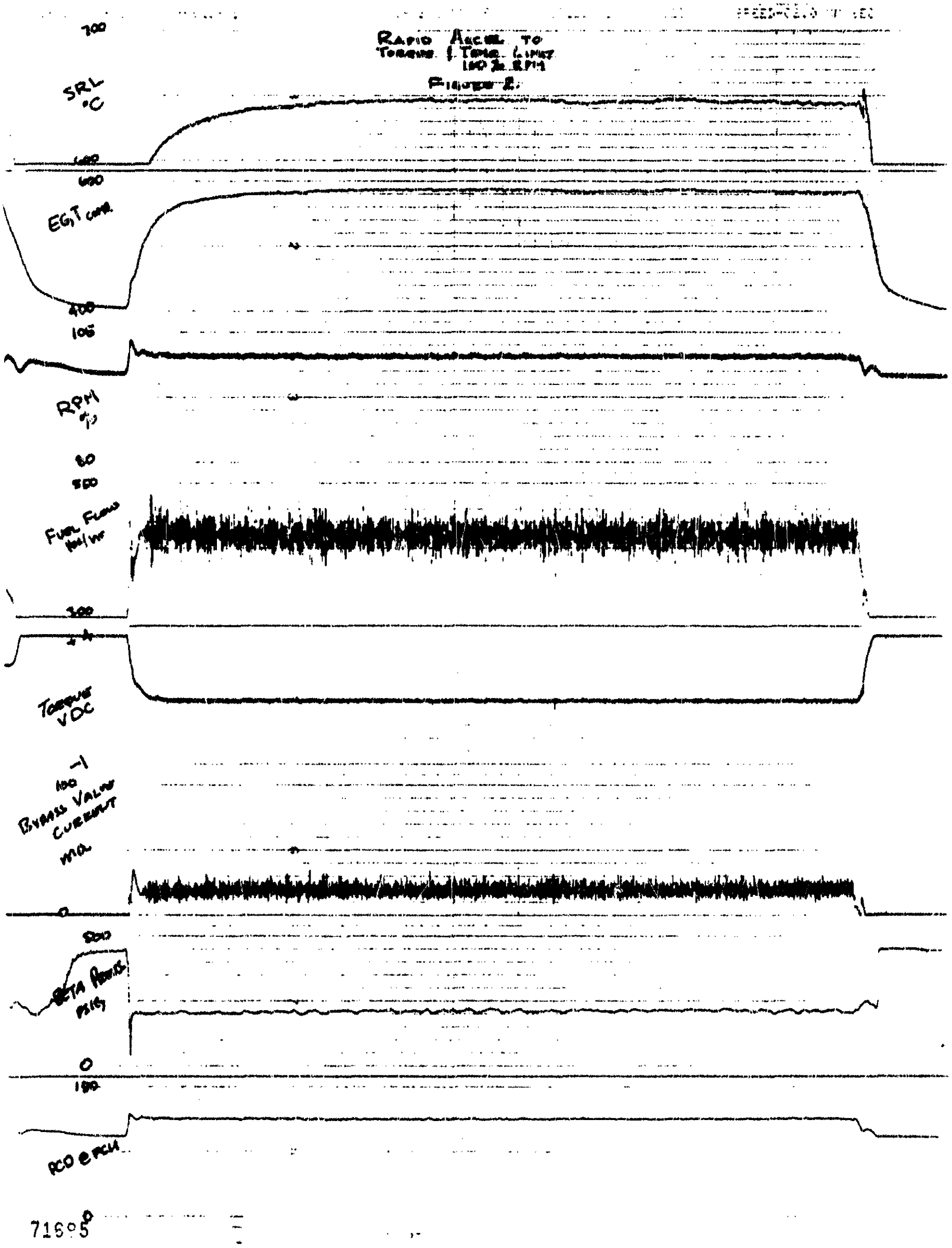
Next, at 100% RPM, both torque and temp. limiting conditions were established. When the torque limit signal was induced, the signal from the limiter to the bypass valve became noisy as did all the other parameters, most notably the fuel flow. Engine operation, however, remained stable during slow accelerations and rapid accelerations (Figure 2).

CONCLUSIONS

With the engine speed at 100% and at either a temp. limiting point or a simultaneous torque and temp. limiting point, the engine operation was stable. Therefore, the high frequency ocillatory output from the torque/temp. limiter had no effect on engine operation.

Peter B. Baker
Senior Product Safety Engineer
Product Integrity


700
SRL °C
600
500
EGT Corrected °C
400
100
RPM %
80
350
Fuel Flow lbs/hr
300
+4
Torque Volts DC
-1
100
Bypass Valve Current Milliamps
0
800
Delta Pressure PSIG
0
150
PCD @ FCH PSIG
0
RAPID ACCEL TO TEMP LIMIT 100% RPM
Figure 1.
Point of Induced Torque Limiting
Noise
Noise


RAPID ACCEL TO
FIGURE 2.
700
SRL °C
600
EGT CONT.
400
105
RPM
80
500
FUEL FLOW
300
TORQUE VDC
-1
100
BYPASS VALVE CURRENT
MA
0
5000
BETA ANGLE
0
180
PCO & PCH

71605

APPENDIX G

AIR NEW ORLEANS BAe 3101
FLIGHT CREW CHECKLIST
(7TH REVISION)

BAE-31 NORMAL PROCEDURES CHECKLIST — **Seventh Revision**

BEFORE STARTING (* - First flight of the day)
1. Prop Start Locks/Fuel Caps/Pulot Covers - CHECKED L/R
2. Circuit Breakers - CHECKED
3. Door Handle - SHUT
4. Battery Master - AS REQUIRED/VOLTAGE CHECKED
5. Parking Brake - 700 PSI/SET
*6. Left/Right Skirt Panels - CHECKED/SECURED
7. Fans/Frame/Ond Mat - OFF
*8 Fire extinguisher/Hyd Pump Handle - CHECKED/ON BOARD
*9. Emergency Hyd Selector - NORMAL
10. Trims - SET (0)
*11. Feather Levers - TEST/OPEN
12. Power/RPM Levers - GROUND START/TAXI/FULL & FREE
13. Pressurization/Temps Panel - SET
*14. Battery Temps - TEST/CHECK
15. ITT - LESS THAN 200°
16. Fuel Quantity - CHECKED
17. Cap Panel - CHECKED/TEST
*18. L.P. Cocks - TEST/OPEN
19. SRL/TYL - ON
*20. Fuel Crossfeed - TEST/NORMAL
21. Boost Pumps - ON
22. Generators - OFF EXTERNAL PWR/ON INTERNAL PWR
23. Avionics Master - OFF
24. Emergency Lights - TEST/NORMAL
25. External Lights - AS REQUIRED

BEFORE TAXI
1. Generators - ON
2. Battery Master - INTERNAL
3. Amp/Volt Meters - CHECK LOADS/SHARING
4. Ground Power - REMOVED AND CLEAR
5. Chocks - REMOVED
6. Avionics Master - ON
7. Windshield Heat - WARM
8. Fans/Frame - AS REQUIRED
9. Flow Selectors - ON
10. Hyd Pressures - CHECKED (4 at 2000 PSI)
11. Start Locks - REMOVED
12. Taxi/External Lights - AS REQUIRED

BEFORE TAKEOFF
1. Passenger Briefing - COMPLETE
2. Cabin Signs - ON
3. Air/Gnd Switches - AIR
4. Oil Cooler Flaps - AS REQUIRED
5. Radar - STANDBY
CR6. Brakes/HAS - CHECKED WITH TAXI
CR7. Flight Instruments/Sperry Horizon - CHECKED/SET
CR8. Oxygen - NORMAL/PRESSURE
CR9. D V Window - SECURED L/R
CR10. Engine Instruments - NORMAL
CR11. Fuel Quantity - TOTAL XX POUNDS
CR12. Avionics - SET/CLEARANCE BRIEFING
CR13. Seat Belts/Harness - FASTENED L/R
CR14. Airframe/Eng. Prop De-Ice - CHECKED & TESTED
CR15. Flaps - SET/TESTED
CR16. Gust Locks - REMOVED
CR17. Flight Controls - FREE/CORRECT
CR18. Stall Protection - TESTED/ON
CR19. Cap Panel - SRL/BETA
CR20. APR - TESTED/ARM AS REQUIRED
*CR21. TTL - TESTED
CR22. V Speeds/Captain's Briefing - COMPLETE

BEFORE TAKEOFF (FINAL ITEMS)
1. Windscreen Heat - ON
2. Pitot Heat - ON
3. Transponder - ON
4. Oil Cooler Flaps - CLOSED/TEMPS NORMAL
5. Lights - AS REQUIRED
CR6. Ice Protection - AS REQUIRED
CR7. Flow Selectors - OFF
CR8. Speed Levers - HIGH WHEN CLEARED

ONE INCH

TAKE-OFF SPEEDS
TAKE-OFF

WEIGHT LB	V1 KT	V2 KT
15000	110	113
14500	109	112
14000	108	111
13500	107	110
13000	106	109
12500	105	108
12000	104	107
11500	103	106
<11000	102	105

APPENDIX H

BAe AND FAA PAPERWORK INVOLVING FLIGHT MANUAL CHANGES

BRITISH AEROSPACE AIRCRAFT GROUP CIVIL DIVISION

SERVICE NEWSLETTER

TYPE: JETSTREAM

JSNL-GEN 082

VARIANT:

TITLE: JETSTREAM 3100: GARRETT TPE331-10- HANDLING

NOTICE TO PILOTS

This newsletter is published to explain three important changes which are being made in the Flight Manual.

1) A Specific Requirement to Confirm RPM at 100% Before Take-off

There have been reports of pilots attempting to take-off with the RPM levers inadvertently set at TAXI. With the RPM levers so positioned the engine remains under the control of the propeller governor low setting. When the POWER levers are advanced the RPM will only rise to approximately 94% and the temperature limiter will be invoked much earlier than in the 100% RPM case. This will give a significant reduction in aircraft performance and may lead to serious power oscillations. In order to guard against this, an additional check is being inserted in the Flight Manual. This will require specific confirmation of 100% RPM when the power levers are advanced for take-off.

2) Confirmation of the Torque to be used for Take-off

There has been some confusion due to the various terms used in the Flight Manual to describe the torque value needed for take-off. The basic technique is very simple - for every take-off, power levers should be advanced to give the take-off torque. This take-off torque varies with ambient temperature and pressure altitude and is found from a chart in the Flight Manual. For operators using Water Methanol, there is an additional chart giving Water Methanol take-off torque. This take-off torque must be achieved to guarantee aircraft performance - if it is not achieved, the take-off must be abandoned. When it is achieved, further advancement of the power levers is not necessary and may cause operation of the temperature limiter when the indicated temperature reaches Red Line during the later take-off stages. If a rolling take-off is being made then the take-off torque should be achieved within ten seconds of starting the take-off. The various terms used in the Flight Manual are being standardised to remove any confusion.