3. CONCLUSIONS

3.1 Findings

1. The flightcrew was trained, certificated and qualified to conduct the flight, and the flight was conducted in accordance with applicable Federal Aviation Regulations and company requirements.

2. The flightcrew was in good health and held the proper FAA medical certificates. There was no evidence that the performance of any crewmember was impaired by alcohol, drugs, or fatigue.

3. ASA maintained the airplane in accordance with applicable Federal Aviation Regulations and company Operations Specifications.

4. After the propeller blade separation, the combination of the resulting loss of left engine thrust, increased drag from a deformed engine nacelle and the three blades retained in the propeller hub and added frontal drag from external sheet metal damage degraded airplane performance preventing the flightcrew from arresting the airplane's descent or making rapid changes in its direction of flight making a forced landing necessary.

5. One of the four blades from the left engine propeller separated in flight because a fatigue crack that originated from multiple corrosion pits in the taper bore surface of the blade spar propagated toward the outside of the blade, around both sides of the taper bore, then reached critical size.

6. Because of the severely degraded aircraft performance following the propeller blade separation, the flightcrew's actions were reasonable and appropriate during their attempts to control and maneuver the airplane throughout the accident sequence, and they were not a factor in this accident.

7. Hamilton Standard's engineering decision to use the PS960A blending repair to remove ultrasonic indications caused by a shotpeened taper bore surface was technically reasonable.

8. The manner in which the unapproved extension of PS960A was documented and communicated within Hamilton Standard, and the lack of training on the extension, created confusion and led to misapplication of the blending repair to unshotpeened blades with unexplained ultrasonic indications, allowing the accident blade to be placed back into service with an existing crack.

9. The sanding marks left by the PS960A blending repair did not contribute to the initiation of the fatigue crack in the accident blade.

10. The failure to restore the taper bore surface to the original surface finish, as required by PS960A, was a factor that caused the reduction of the ultrasonic indication that allowed the blade to pass the final ultrasonic inspection and to be returned to service.

11. The borescope inspection procedure developed and used by Hamilton Standard in June 1994 to inspect returned blades that had rejectable ultrasonic indications for evidence of cracks, pits, and corrosion was inadequate and ineffective.

12. The introductory technical training to prepare the new, inexperienced workforce at Hamilton Standard's Rock Hill Customer Service Center might have been adequate; but the training initially given to technicians, who inspected blades that were returned to Rock Hill as a result of on-wing ultrasonic inspections, including the accident blade, was inadequate to ensure proficiency in the detection of taper bore corrosion or associated cracks.

13. If Hamilton Standard had recommended, and the FAA had required, repetitive ultrasonic inspections for all propellers after shortcomings were recognized and improvements were

made in the inspection process (particularly those that had already been inspected), the crack in the accident blade would most likely have been detected.

14. A combination of 2P resonance and GAG cycle stresses initiated the crack from the corrosion pits in the ASA blade and caused the crack to propagate to failure under normal operating conditions.

15. Advisory Circular AC 20-66 does not provide guidelines for adequate margin between a propeller blade's natural frequencies and its potentially coincident excitation frequencies over the life of the blade.

16. There is a potential for corrosion to develop in taper bores of the affected Hamilton Standard propeller blades.

17. The cloud ceiling precluded the flightcrew from being able to see the ground and thus to make a more successful forced landing.

18. Hamilton Standard's failure to seek FAA approval of the extension of PS960A blending repair hindered the FAA's ability to oversee Hamilton Standard's handling of the taper bore crack and corrosion problem, and led to an inadequate documentation of the extension that caused confusion and misapplication of the repair.

19. The timing of the handoff to Atlanta approach control by the Atlanta Center controller was not a factor in the accident.

20. Although the Atlanta approach controller did not issue the AWOS frequency or provide weather information, the controller performed higher priority tasks; and because the flight had to land at the nearest airport regardless of the weather, the failure to provide the CTJ weather information to the flightcrew was not a factor in this accident.

21. If the Atlanta Center had placed a call for emergency services as soon as the pilot requested, which was 10 minutes before the accident, personnel would have responded sooner, and the rescue efforts might have been more timely and therefore more effective.

22. This accident illustrates that critical information regarding time available to prepare the aircraft for an emergency landing or impact is not being considered and communicated among flight and cabin crewmembers.

23. There should be standards governing the design of crash axes required to be carried aboard passenger-carrying aircraft.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the in-flight fatigue fracture and separation of a propeller blade resulting in distortion of the left engine nacelle, causing excessive drag, loss of wing lift, and reduced directional control of the airplane. The fracture was caused by a fatigue crack from multiple corrosion pits that were not discovered by Hamilton Standard because of inadequate and ineffective corporate inspection and repair techniques, training, documentation, and communications.

Contributing to the accident was Hamilton Standard's and FAA's failure to require recurrent on-wing ultrasonic inspections for the affected propellers.

Contributing to the severity of the accident was the overcast cloud ceiling at the accident site.