3. CONCLUSIONS

3.1 Findings

1. The crewmembers were certificated and qualified for the flight.

2. The aircraft was certificated, equipped, and maintained in accordance with FAA requirements, except for the inoperative CVR.

3. The runway was wet, but there was no standing water.

4. Runway 6R was the only runway available for takeoff. Two 12,000-ft runways, the use of which could have made a successful rejected takeoff possible, were not available to wide body aircraft.

5. Lineup for takeoff began about 166 ft from the approach end of runway 6R. The flightcrew used the minimum lineup distance and established takeoff thrust as required by company procedures.

6. The captain promptly rejected the takeoff at or below 152 kns (V_1 speed was 156 kns) after hearing a loud "metallic bang" and feeling a "quivering" of the aircraft.

7. The captain responded to the emergency by first applying brakes and then applying maximum reverse thrust on all engines. Ground spoilers actuated when thrust levers were moved to the reverse thrust positions.

8. Reverse thrust began about 5.8 sec after V_1 was reached and peaked 3 to 8 sec after the engines began to spool up for reverse thrust. Reverse thrust was maintained above 100 percent N_1 on all three engines during the reversal sequence.

9. Reverse thrust was maintained on the center and the right engine until just before the aircraft stopped beyond the end of the runway. Reverse thrust on the left engine ceased when that engine was torn from the aircraft, 100 ft beyond the end of the runway.

10. The first tire failed at the No. 2 tire position about 6,300 ft from the departure end of runway 6R. The tire failed because of a thrown tread. The carcass blew about 4,520 ft from the departure end of the runway.

11. The second tire failed at the No. 1 tire position about 4,480 ft from the departure end of runway 6R. Fatigue in the ply structure may have been caused by long-term overload since the tire was mounted on an axle with a tire of a different brand which had less sidewall stiffness. The tire blew out because of an overload.

12. The third tire failed at No. 5 tire position about 3,400 ft from the departure end of runway 6R. Pieces of the wheel rim from either the No. 1 or the No. 2 wheel hit the tire and caused it to blow out. This blow out affected further the aircraft's braking capability. Also, the left main landing gear might not have collapsed if No. 5 tire had been available to distribute load on the overrun area.

13. The tires on the aircraft may have been operated in the over-deflected condition, since the average inflation pressure was less than the optimum pressure for maximum gross weight.

14. The aircraft left the departure end of runway 6R at a speed of about 68 kns.

15. The aircraft slid to a stop about 83 sec after the start of the takeoff. It came to rest about 664 ft beyond the departure end of runway 6R on a heading of 008°.

16. The aircraft could not be stopped on the available runway because of the partial loss of braking effectiveness attributed to failed tires and a wet runway surface.

17. Dynamic hydroplaning conditions were not present.

18. Runway 6R had acceptable friction characteristics according to current FAA suggested criteria for the Mu meter; however, the Mu meter data could not be used to estimate aircraft stopping performance.

19. During the 4-year period between the grooving of runway 6R/24L and the day of the accident, the airport operator did not make the friction surveys suggested by the FAA. The FAA and the airport operators did not have ready access to equipment or trained personnel required to conduct periodic friction surveys.

20. No FAA procedures or data are available to aircraft operators or flightcrew to relate degraded runway friction conditions to changes in allowable aircraft takeoff weights, decision speeds, and stopping distance.

21. The current FAA rejected takeoff requirements for aircraft certification, aircraft operations, and pilot training do not address wet runway, slippery runway, or tire failure conditions.

22. It was not possible to determine accurately from performance analyses if the full braking capability of the aircraft was achieved during the initial phase of the rejected takeoff.

23. In its 1977 report on rejected takeoffs, the FAA concluded that aircraft safety could be improved by accounting for wet/slippery runway conditions and tire improvements.

24. Flightcrew simulator training for rejected takeoffs is inadequate because of the lack of FAA requirements for wet runway considerations in those simulators and for rejected takeoff training at the maximum takeoff gross weights and decision speeds encountered in normal operations.

25. The landing gear attachment structure failed and caused the left wing fuel tank to rupture.

26. Fire may have started before the aircraft left the runway surface.

27. The evacuation was started promptly and almost simultaneously throughout the cabin.

28. The 1L exit was opened with the slide/raft handle in the disarm position.

29. Slide/rafts at exits 2L, 3L, and 4L burned immediately after they were deployed.

30. All slide/rafts on the right side were deployed and used.

31. The overwing ramp for the 3R slide/raft malfunctioned.

32. The slide/raft at 1R failed from radiant heat damage; the girt bar supporting fabric failed at 4R because of overload or uneven load; all other slide/rafts burned.

33. The evacuation was completed using the emergency rope which hung from the first officer's side window.

34. The first crash-fire-rescue unit was on the scene fighting the fire in about 90 sec from the initiation of the rejected takeoff.

35. Two passengers died of burns and smoke inhaltion after exiting through the 3R exit.

36. Evacuation time was approximately 5 minutes.

3.2 Probable Cause

The National Transportation Safety Board determined that the probable cause of the accident was the sequential failure of two tires on the left main landing gear and the resultant failure of another tire on the same landing gear at a critical time during the takeoff roll. These failures resulted in the captain's decision to reject the takeoff.

Contributing to the accident was the cumulative effect of the partial loss of aircraft braking because of the failed tires and the reduced braking friction achievable on the wet runway surface which increased the accelerate-stop distance to a value greater than the available runway length. These factors prevented the captain from stopping the aircraft within the runway confines.

The failure of the left main landing gear and the consequent rupture of the left wing fuel tanks resulted in an intense fire which added to the severity of the accident.

4. SAFETY RECOMMENDATIONS

As a result of this accident, the Safety Board, on September 6, 1978, recommended that the Federal Aviaiton Administration:

"Assess current tire rating criteria, as used by the Tire & Rim Association and as interpreted by airframe designers and Federal Standards, in terms of compatibility of tire, airframe, and intended operation to assure that adequate margins are provided for all normal conditions. (Class II, Priority Action) (A-78-67)

"Upgrade Technical Standard Order C-62b to reflect current engineering practices and operational conditions in both the specifications for performance standards and certification test requirements. (Class II, Priority Action) (A-78-68)

"Insure that the tire is compatible with the airframe by considering this compatibility during the airplane certification. Tire loads which result from design peculiarities and normal variations in maintenance and operational practices must be considered. (Class II, Priority Action) (A-78-69)

"Issue a new Technical Standard Order to specify performance standards and qualification test requirements for retreaded tires. (Class II, Priority Action) (A-78-70)