Docket No. **SA-516**

Exhibit No. **22F**

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

ADDENDUM II TO MAIN WRECKAGE FLIGHT PATH STUDY

(10 pages)

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, DC

June 9, 2000

ADDENDUM II TO MAIN WRECKAGE FLIGHT PATH STUDY

By Dennis Crider

A. ACCIDENT: DCA-96-MA-070

Location:	East Moriches, New York
Date:	July 17, 1996
Time:	2031 Eastern Daylight Time
Airplane:	Boeing 747-131, N93119

B. GROUP IDENTIFICATION

No group was formed for this activity.

C. SUMMARY

On July 17, 1996, at 2031 EDT, a Boeing 747-131, N93119, crashed into the Atlantic Ocean, about 8 miles south of East Moriches, New York, after taking off from John F. Kennedy International Airport (JFK). The airplane was being operated on an instrument flight rules (IFR) flight plan under the provisions of Title 14, Code of Federal Regulation (CFR), Part 121, on a regularly scheduled flight to Charles De Gaulle International Airport (CDG), Paris, France, as Trans World Airlines (TWA) Flight 800. The airplane was destroyed by explosion, fire, and impact forces with the ocean. All 230 people aboard were killed.

D. DETAILS OF THE INVESTIGATION

PURPOSE OF ADDENDUM

This addendum investigates the effect of a change in breakup timing on the simulations. The following event timing was explored.

Outboard Wing Panel Failure	34 seconds after the initial event
Wing Center Section Failure	38 seconds after the initial event

OUTBOARD WING PANEL FAILURE

Aerodynamic characteristics during the four seconds of crippled flight without the outboard wing panels cannot currently be modeled with precision. Accordingly, the affect of the outboard wing panel failure was modeled simply by multiplying the lift from the nose off table by the area ratio of wing area without the outboard panels to the wing area. The change in pitching moment was modeled by simply multiplying this lift loss by the distance between the wing quarter chord and the approximate center of pressure of the outboard wing panel. Drag was increased somewhat to account for the reduction in aspect ratio and the new rough tip shape.

WING CENTER SECTION FAILURE

After the center section fails the wreckage no longer has a stable lift vector. At this point, the remaining wreckage becomes purely ballistic and can be treated as a moving mass with only drag and weight forces modifying the flight path.

SIMULATION RESULTS

As discussed in Addendum I to this report, the aerodynamics characteristics for a 747-100 without the forward fuselage at high angle of attack are not precisely known. Accordingly, an uncertainty range was established for the aerodynamic coefficients.

Rather than develop a simulation for all combinations of aerodynamic tolerances, a range of effects was established using a combination of tolerances to establish a “fast” and “slow” simulation. The “fast” simulation consists of the maximum nose down aerodynamic pitching moment coupled with minimum drag and lift. The “slow” simulation consists of the minimum nose down aerodynamic pitching moment coupled with maximum drag and lift.

Addendum I to this report discussed uncertainty in the time that the forward fuselage departed. Addendum I refined this uncertainty to approximately 3 to 5 seconds after the initial event.

As described in the original study, tilting the lift vector maneuvered the simulation. All parameters and procedures not mentioned in this addendum remained unchanged from the original report.

Simulations were run with the new wing failure timing for the best match cases from Addendum I. The best match cases from Addendum I consisted of the fast simulations utilizing each of the three radar sets with the 20:31:15.2 nose departure time and the fast simulation utilizing the JFK radar with a 20:31:17.2 nose departure. The results for fast simulations utilizing each of the three radar sets with the 20:31:15.2 nose departure time are presented in figures 1 to 5.

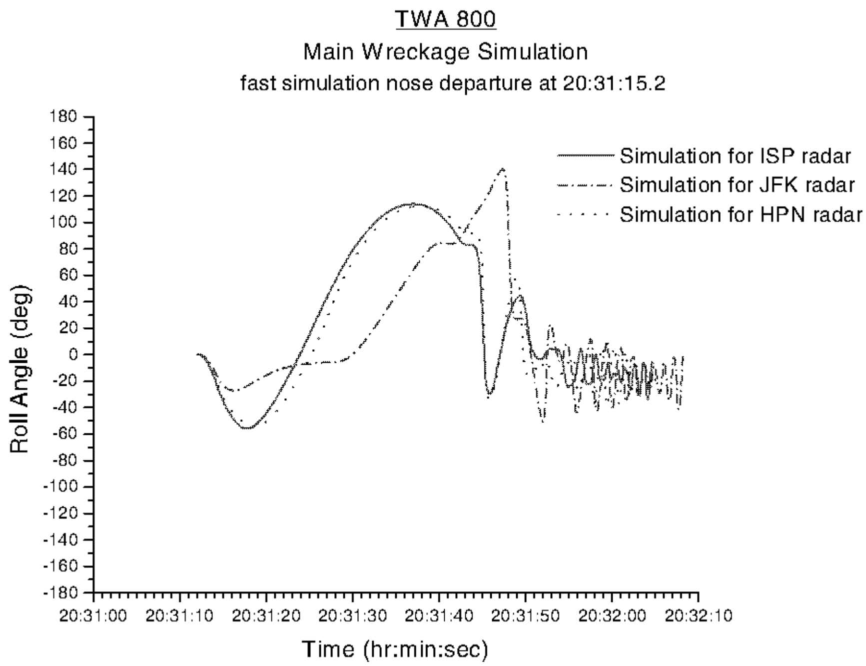

Figure 1; Roll angles for fast simulations

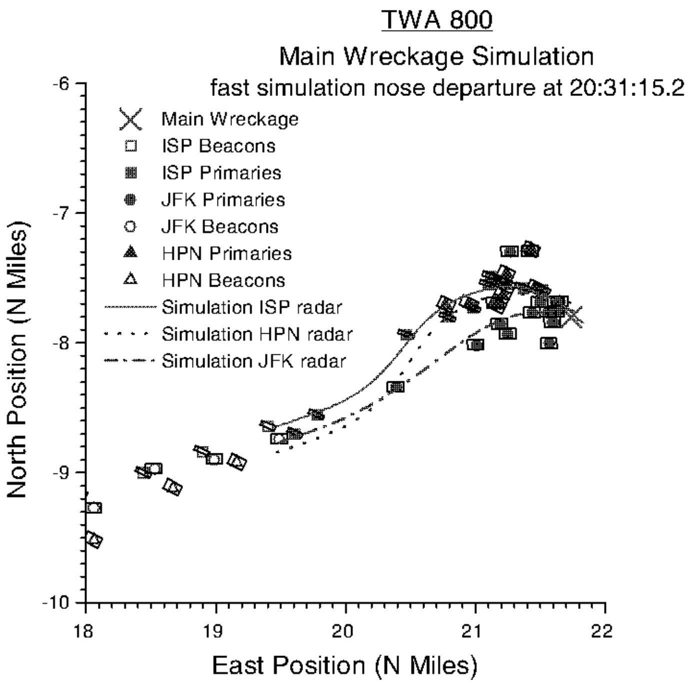

Figure 2; Map view of for fast simulations

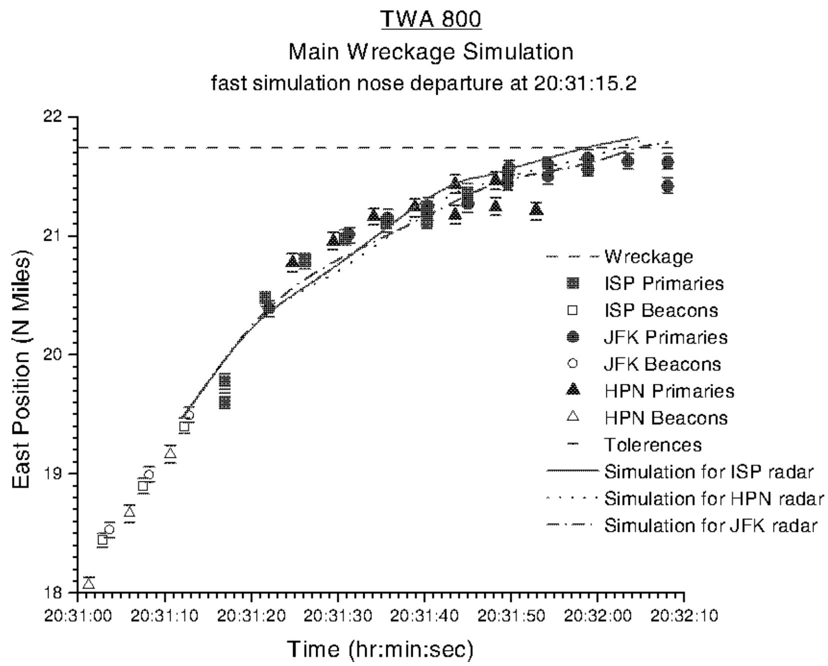

Figure 2; East positions for fast simulations

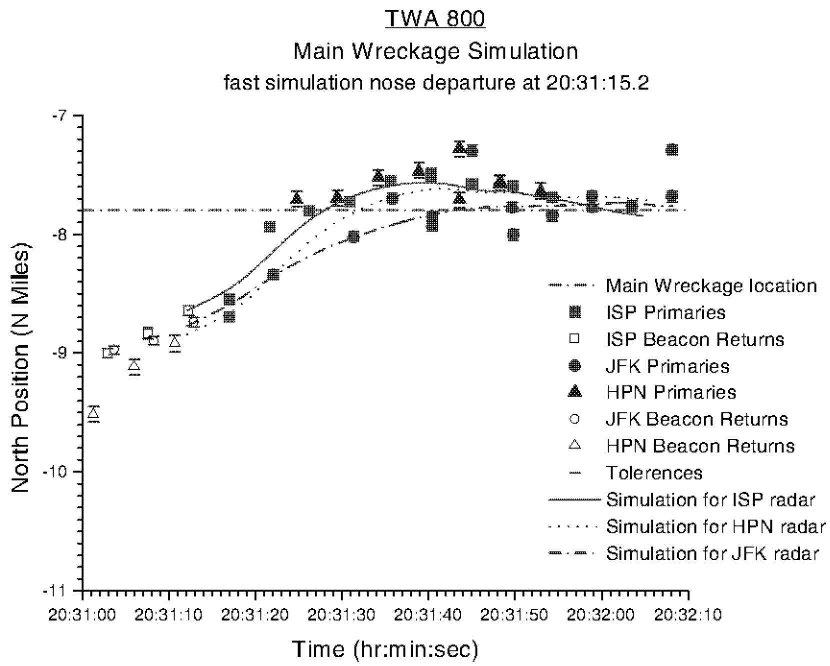

Figure 3; North positions for fast simulations

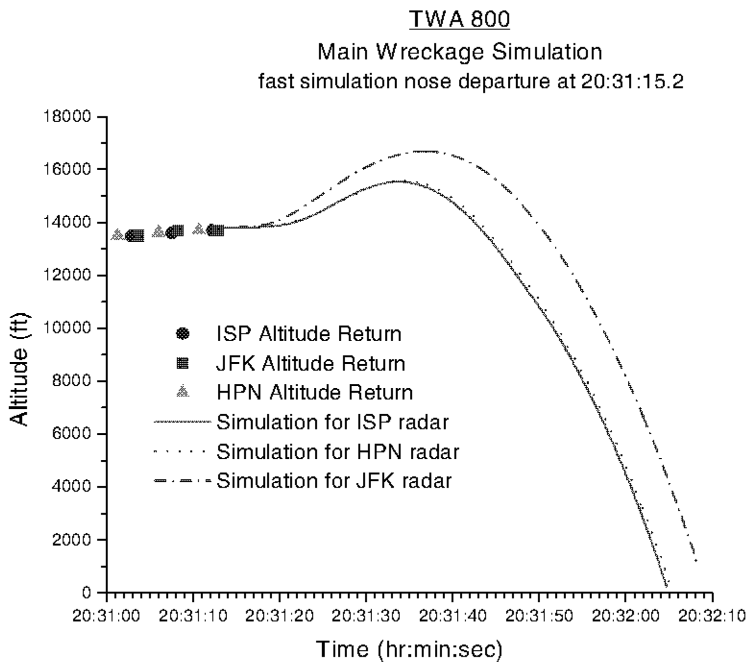

Figure 4; Altitudes for fast simulations

LATER NOSE SEPARATION TIMING

The results for fast simulations utilizing JFK radar with the 20:31:17.2 nose departure time are presented in figures 6 to 10.

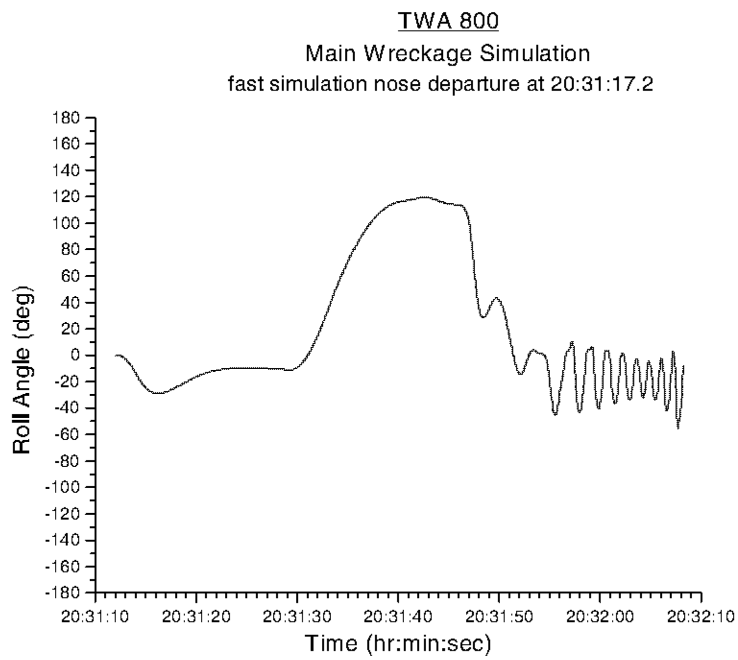

Figure 5; Roll angle for nose off at 20:31:17.2

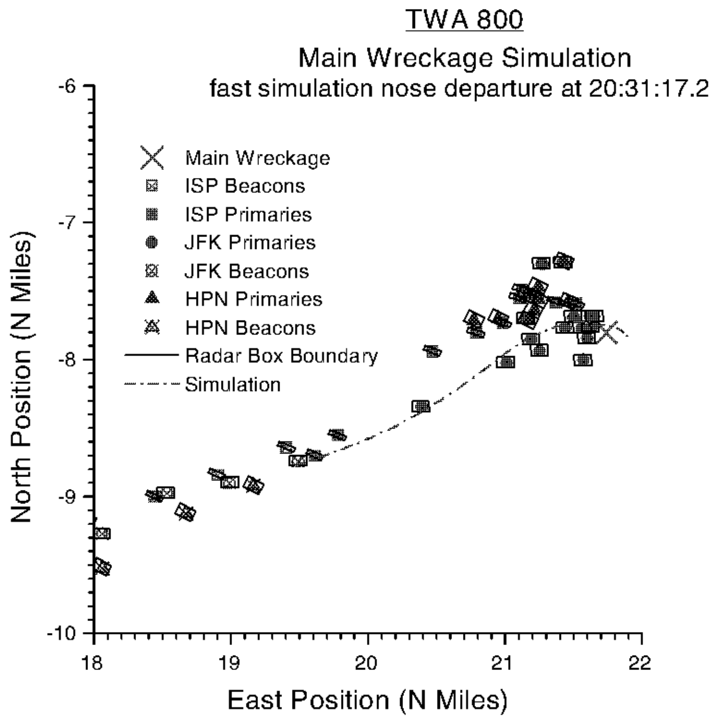

Figure 6; Map view of nose off at 20:31:17.2

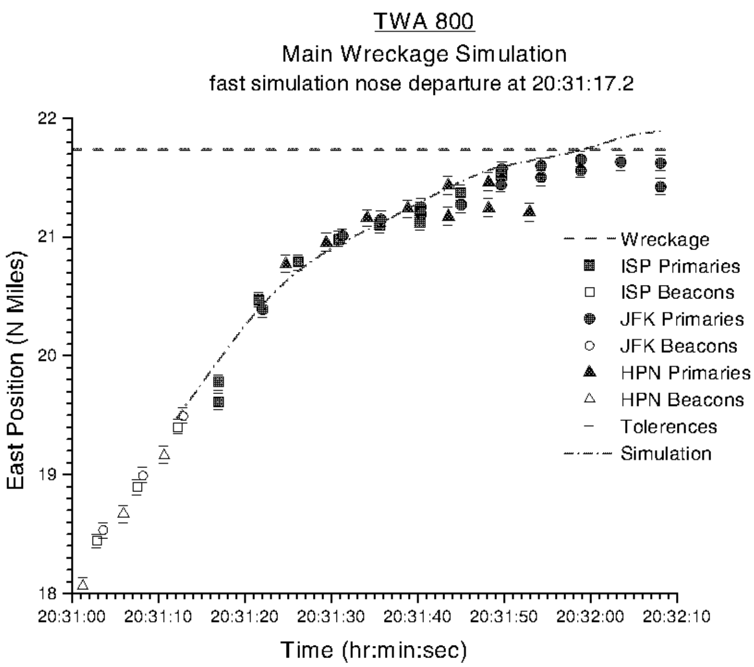

Figure 7; East position for nose off at 20:31:17.2

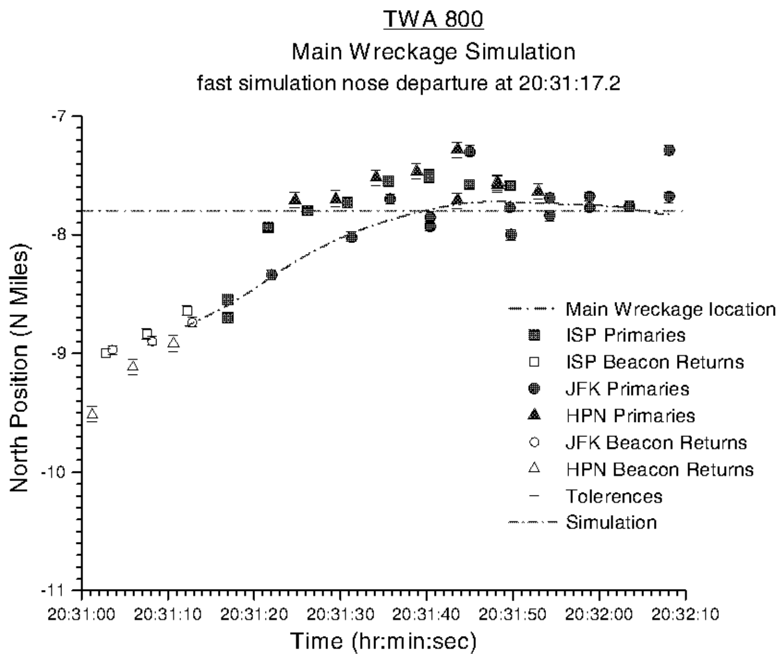

Figure 8; North position for nose off at 20:31:17.2

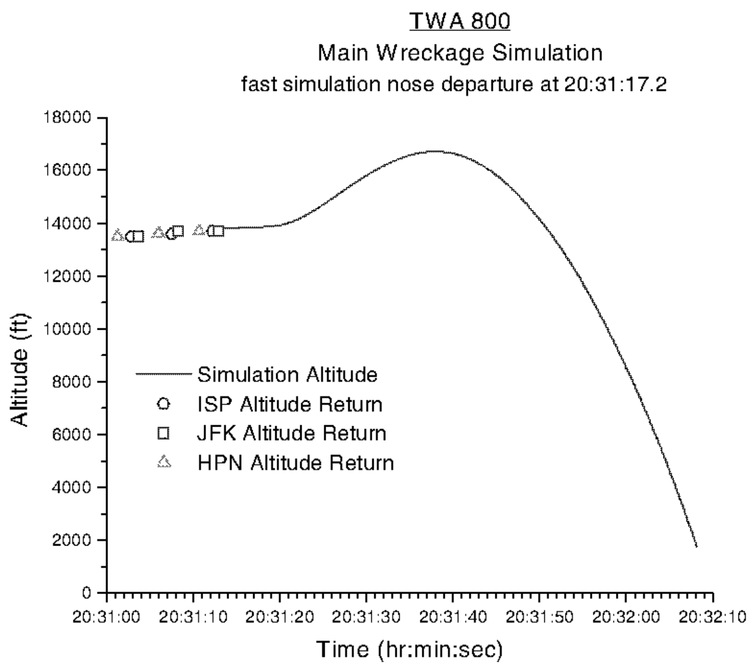

Figure 9; Altitude for nose off at 20:31:17.2

SUMMARY

Simulations matches have been found using later wing failure timing for the best match cases from Addendum I to this report. Radar limitations during an in-flight breakup create uncertainties in the altitude gain. This addendum has identified maximum altitudes from 15537 ft to 16678 ft.

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