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February 4, 1997
B-B600-15955-ASI

Mr. Dennis Crider
National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594-2000

BOEING

Subject: Additional Wake Encounter Scenario - USAir 737-300
Accident N513AU, near Pittsburgh, Pennsylvania,
September 8, 1994

Dear Mr. Crider,

During your visit last December, you requested an additional wake encounter scenario for further consideration in your validation of the kinematic process used to derive the lateral and directional control positions for the subject accident. The enclosure contains the information requested.

If you have any questions, please contact me.

Very truly yours,

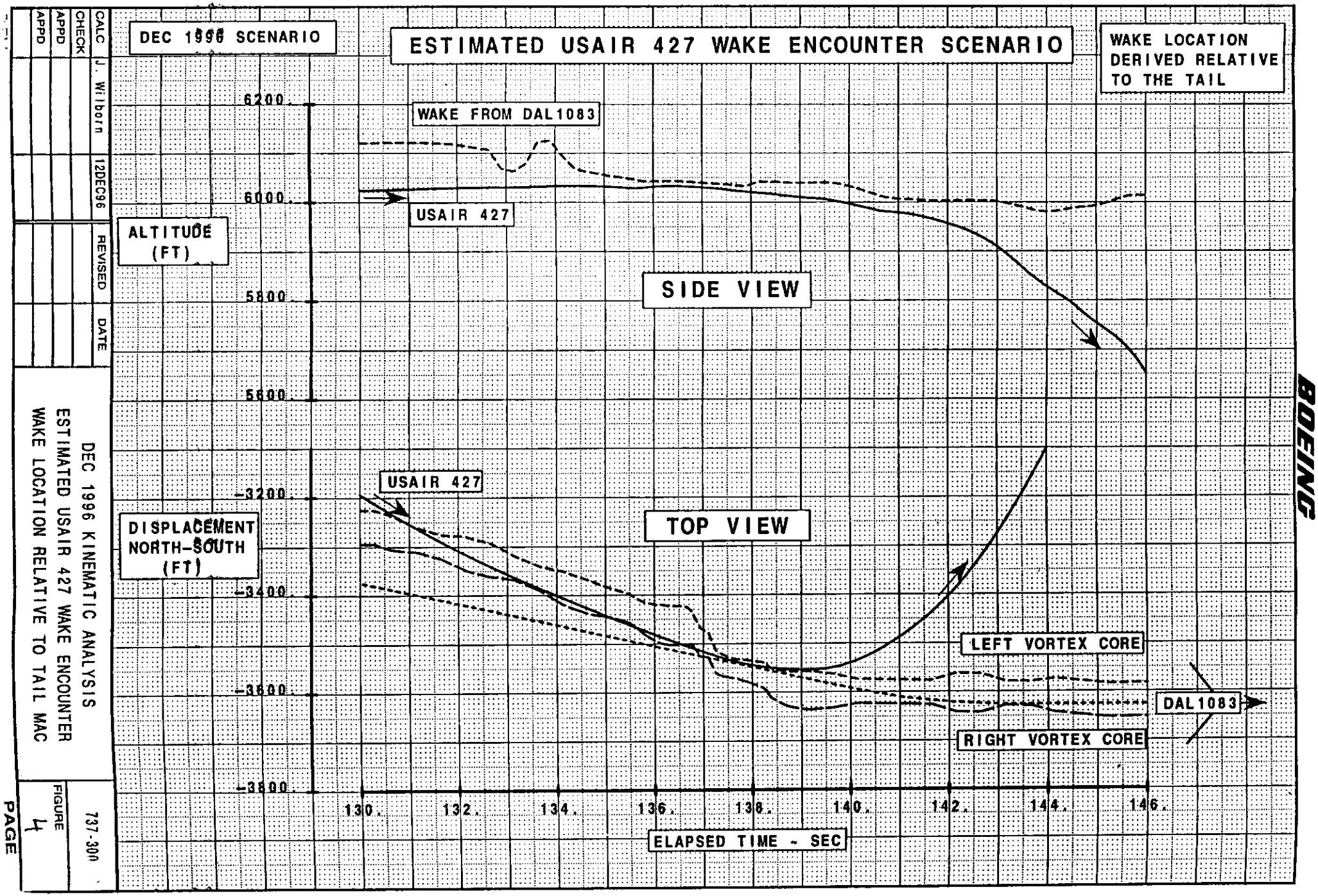
[redacted]

for John W. Purvis
Director, Air Safety Investigation
Org. B-B600, M/S 67-PR
Telex 32-9430, STA DIR PURVIS
[redacted]

Enclosure: Boeing Discussion with Figures 1 through 4

cc: Tom Haueter, NTSB, AS-10
Tom Jacky, NTSB, RE-60

Enclosure to B-B600-15955-ASI



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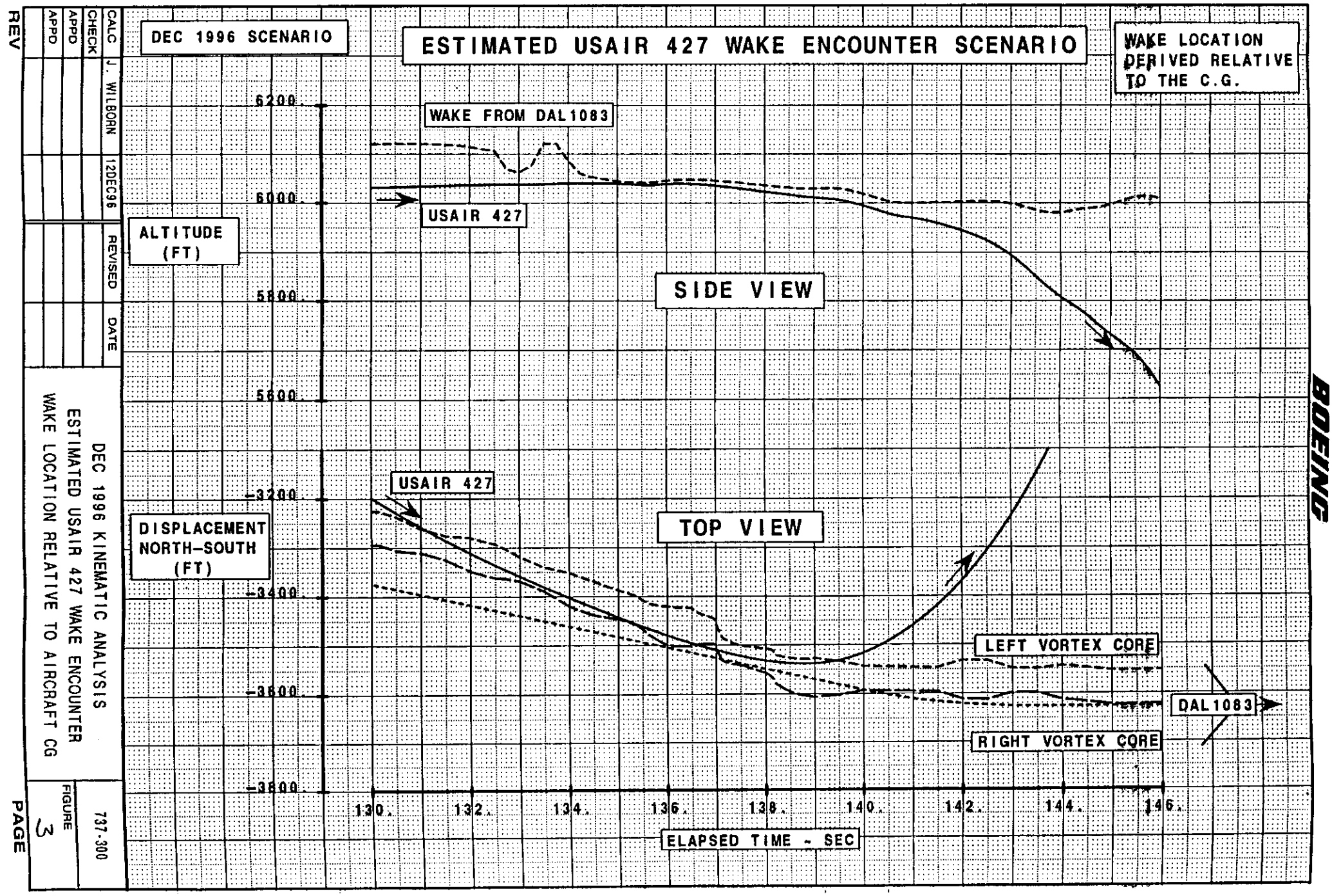

During the month of December 1996, the National Transportation Safety Board (NTSB) sent a representative, Mr. Dennis Crider, to work on-site at Boeing in Seattle to validate the processes used to derive the lateral and directional control positions for the USAir accident. During Mr. Crider's visit, he requested that an effort be made to use the methods described in the reference to determine the parameters of a wake encounter scenario for the USAir 427 accident which, when combined with the kinematic and coefficient extraction processing used to derive control surface positions, would result in the derivation of a roughly constant rate rudder input between FDR times 136-140. The lift and pitching moment for the derived encounter were then compared to those derived from the accident aircraft's FDR. In addition, an analysis of the wake path required to produce the the desired rudder derivation and an analysis of the derived wheel were also undertaken to determine the plausibility of the encounter.

Figure 1 shows the results of the most successful attempt to derive a constant rate rudder. It contains the derived rolling and yawing moments and the resulting wheel and rudder required to match the FDR data. The clear implication is that the wake encounter which results in the derivation of a constant rate rudder also results in the derivation of a strong left wheel input at a time when the aircraft is already rolling to the left (time 138).

Figure 2 shows the corresponding matches of lift and pitching moment for this derived encounter with those derived from the FDR. Both lift and pitching moment diverge from the FDR traces from time 136.5 to 138, which indicates that the wake scenario is not properly modeled during this time segment.

Figures 3 and 4 present the wake position at the C.G. and the tail required to produce the derivation of rudder shown in Figure 1. The essential change that was made was a sharp shift in the wake position to the right at time 137 in order to make the airplane trajectory pass through the left wake core. This resulted in the yawing moment needed to produce the desired rudder derivation, but was also responsible for inducing a right rolling moment, which resulted in the derivation of the left wheel. Furthermore, the path of the airplane between the wake cores causes the lift and pitching moment peaks to occur at the wrong times when compared to the FDR traces, resulting in a poor match of lift and pitching moment from time 136.5 to 138.

This derivation was produced using the same simulation model used to derive the wheel and rudder traces in the reference. The work was performed by the Boeing Aerodynamics Stability & Control - Fleet Support group, in conjunction with Mr. Crider.

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