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NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

Rudder Pedal to Rudder Relationship

Boeing Commercial Airplane Group
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April 3, 1995
B-U01B-15215-ASI

BY FACSIMLE: (202) 382-6576

Mr. Thomas Jacky, RE-60
National Transportation Safety Board
490 L'Enfant Plaza SW
Washington DC 20594-2000

BOEING

Subject: USAir 737-300 Accident, N513AU/PP033 Near Pittsburgh, September 8, 1994 - Pedal to Rudder Relationship

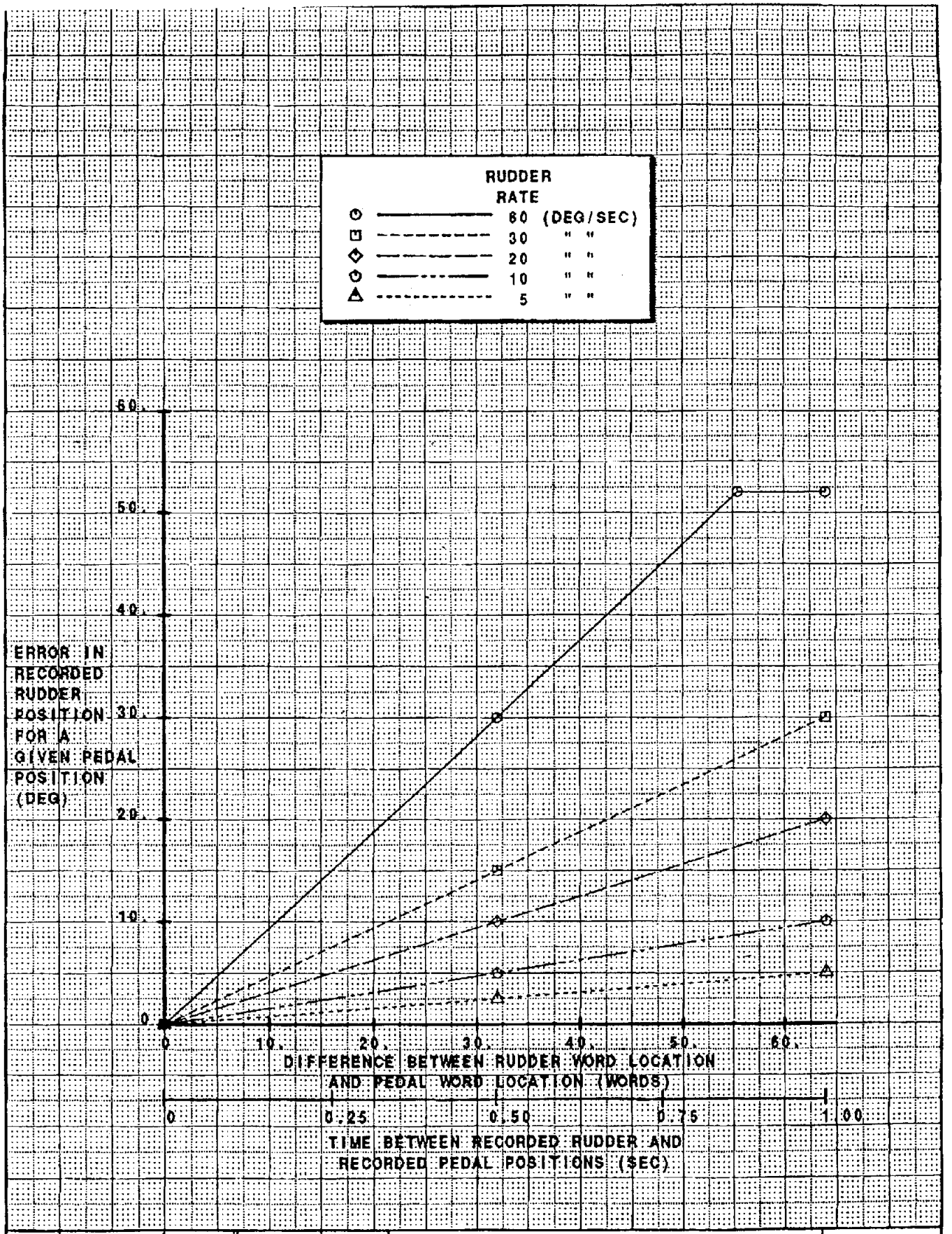
Reference: Your letter to Rick Howes, March 8, 1995

Dear Mr. Jacky:

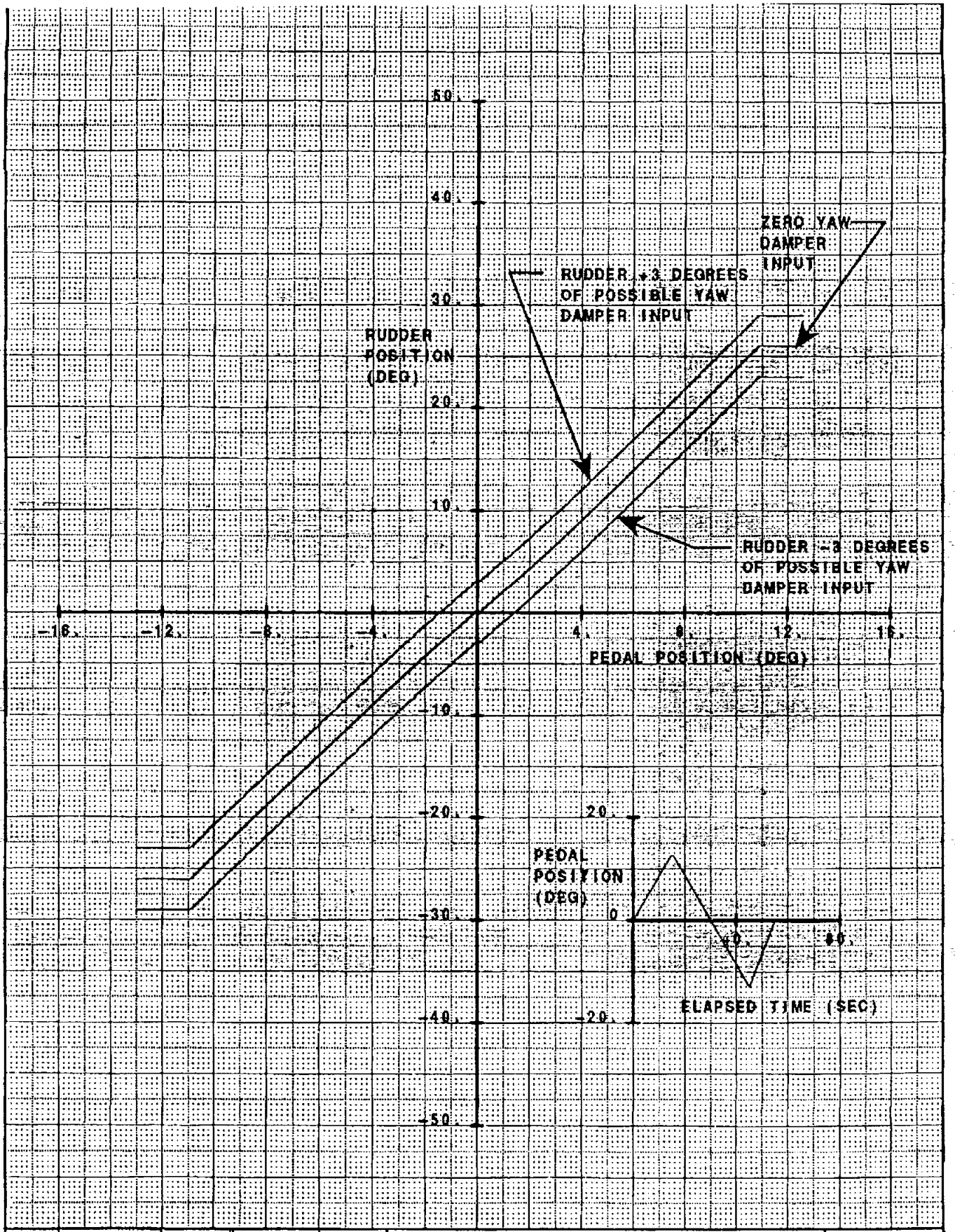
In the reference letter you requested FDR data in ASCII or Excel format and information to support quick access recorder (QAR) data search. The requested FDR data was given to you by Rick Howes on March 15, 1995 in Washington D.C., during the last planning meeting for the subject investigation. The following information provides the 737 pedal to rudder relationship to support the QAR data search.

Figure 1 shows the relationship between the rudder pedal and rudder position for the 737-300 aircraft. Additionally, the yaw damper input which can apply plus/minus 3 degrees of rudder (from the pedal commanded position) has also been included.

However, it should be recognized that attempting to search QAR databases to identify possible rudder system anomalies by comparing the rudder to rudder pedal relationship may encounter significant problems. Because the rudder can travel at a maximum rate of 64.5 degrees per second, a substantial amount of rudder travel can occur between the time the pedal position is recorded and the time the rudder position is recorded. Figure 2 shows the possible error in attempting to match a recorded pedal position with a recorded rudder position for a range of rudder rates. Typically, QAR pedal and rudder positions are measured 32 words apart. This equates to a 1/2 second delay between the time rudder pedal position and rudder position are recorded. In that time, the rudder can travel as much as 32.25 degrees. During takeoff roll and landing, rapid pedal inputs are not unusual as the pilot uses the nose wheel steering and rudder to maintain runway centerline. This, combined with the plus/minus 3 degrees of yaw damper rudder input without



CALC	MD INGHAM	27MAR95	REVISED	DATE	ERROR IN RECORDED RUDDER POSITION FOR A GIVEN PEDAL POSITION BASED ON FDR PARAMETER WORD LOCATIONS	737-300
CHECK						FIGURE 2
APR						
APR					THE BOEING COMPANY	PAGE
PLOT						



CALC	MD INGHAM	27MAR95	REVISED	DATE	RUDDER POSITION VS PEDAL POSITION SLOW PEDAL RATE, STATIC TEST SIMULATOR GENERATED DATA
CHECK					
APR					
APR					
PLOT					THE BOEING COMPANY

737-300

FIGURE 1

PAGE

pedal movement, will make it extremely difficult to identify an event on the basis of the rudder pedal to rudder relationship. Additionally, these figures do not contain the effects of rudder "blowdown" which will also make it difficult to identify any anomalous rudder movements.

If you have questions, please contact Rick Howes, (206) [redacted], or me.

Very truly yours,

BOEING

FLIGHT TEST

[redacted]

FOR

John W. Purvis
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[redacted]

Enclosures: Boeing graph, Rudder Position vs Pedal Position, figure 1
Boeing graph, Error in Recorded Rudder Position data, figure 2

cc: Tom Haueter, NTSB, AS-10