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Written Witness Statement by Gulfstream Personnel (March 2012)

(2 pages)

Gulfstream
A GENERAL DYNAMICS COMPANY

MEMORANDUM

Date: March 23, 2012

To: [redacted]

From: [redacted]

Subject: Discussions with Reece Ollenburg on Ground effect and Pitch Angle for Takeoff Rotation

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My name is [redacted]. I am a Technical Specialist III in Department 673 (Flight Dynamics, Flight Sciences). I was involved with wind tunnel testing and CFD prediction during GVI development phase. Since March 2009, I have been on-loan to Department 343 (Flight Test Engineering) to work on the GVI flight test program. My responsibilities at Flight Test include flying qualities, aerodynamics, and flight control system. Between 2009 and March 2011, Reece occasionally requested information to support the field performance testing. This memo documents some of our discussions on the ground effect and the target pitch angle for field performance testing.

Before the first field performance test at Roswell, Reece asked whether there was GVI wind tunnel test data that could be used to estimate the ground effect. The only data with ground effect I was aware of at that time was gathered from a test at the San Diego low speed wind tunnel. I looked up the data and plotted the data for him (Attachment 1). The test was conducted with a subscale model and the scale effect was not corrected in this set of data.

Due to the scale effect (low Reynolds number), the wind tunnel test data could not be used to determine the stall AoA's. Reece was aware of this limitation and he agreed that additional data were required to determine the stall AoA's. The low speed wind tunnel test data was used to estimate the $\Delta\alpha_{ground\_effect}$ at the liftoff C_L between runs in free air and in ground effect. The $\Delta\alpha_{ground\_effect}$ derived from the wind tunnel test data was 2°.

Reece used the plot as a baseline and extended linear portion of the C_L-α curves to higher AoA's to correct for the scale effect. The modified figure was shown in a SRB meeting to explain his build-up approach for the V_{MU} test (Attachment 2). I was not involved with the effort extension of C_L-α curves obtained from the low speed wind tunnel test.

After the first field performance test at Roswell, I was informed during a SRB meeting that the $\Delta\alpha_{ground\_effect}$ was determined to be 1.6° from the V_{MU} test data. I was not involved with the determination of the $\Delta\alpha_{ground\_effect}$ from the flight test data. I do not remember how exactly he described the $\Delta\alpha_{ground\_effect}$. However, I understood it was the amount of alpha change in the free air C_L-α curve to get the same lift experienced in V_{MU} testing. We both understood that the $\Delta\alpha_{ground\_effect}$ was not equivalent to the decrease of stall AoA in ground effect.

Before the second field performance test at Roswell, Reece requested the free air stall AoA's. The stall AoA at low Mach was available from company aerodynamic stall flights.

At approximately the same time when Reece requested the free air stall AoA's, we had a discussion on the target pitch angle during takeoff rotation. We started with estimating the equivalent AoA in ground effect with the following equation:

$$\alpha \approx \theta - \gamma + \Delta\alpha_{ground\_effect}$$

The $\Delta\alpha_{ground\_effect}$ was assumed to be 1.6°, as determined by Reece from previous V_{MU} test. However, we did not know the stall AoA in ground effect; therefore the discussion of safe pitch angle using this approach was inconclusive. Reece stated that previous testing with the pitch angle up to 9° had been successful; therefore he was going to use 9° as the target pitch angle. He mentioned that there were test runs reaching higher pitch angles and the airplane exhibited unsatisfactory handling characteristics. He indicated that he would be conservative with the pitch angle target and he did not plan to increase the target pitch angle beyond 9°.

I concurred with using 9° as the target pitch angle. I also suggested the pitch angle be maintained below 10° in case there was an overshoot during the takeoff rotation to avoid any possibility of stalling the wing.

The target pitch angle discussion was focused on AEO takeoff; we did not discuss the target pitch angle for OEI takeoff.