Factual Report – Attachment 31

MIA B767 Simulator Observation

OPERATIONAL FACTORS

DCA19MA086

Table Of Contents

A. ACCIDENT

    Location: Trinity Bay, Texas
    Date: February 23, 2019
    Operator: Atlas Air Flight #3591 (heavy) (N1217A)
    Time: 1238 Central Standard Time[1]

B. OPERATIONAL FACTORS/HUMAN PERFORMANCE GROUP

David Lawrence - Operational Factors   Bill Bramble – Human Performance
Senior Aviation Investigator   Senior Human Performance Investigator
NTSB   NTSB

Warren Abrams (Ops)[2]   Lawrence Ward[5]
Aviation Investigator   POI, ABX Air (AFC-110)
NTSB   Federal Aviation Administration (FAA)

---

[1] Time based on last radar return (subject to change).
[2] Captain Abrams participated in this portion of the investigation as an NTSB observer.
[5] Larry Ward (FAA) attended day one and two of the interviews in MIA.

Richard E. Lee[3]
Safety Pilot
The Boeing Company

Tyson Howard
Safety Committee, B767 Operations
International Brotherhood of Teamsters 1224

John Blakely[4]
Aircrew Program Designee, B767
Atlas Air

C. SUMMARY

On February 23, 2019, at 1239 central standard time, Atlas Air flight 3591, a Boeing 767-375BCF, N1217A, entered a rapid descent from 6,000 ft and impacted a marshy bay area about 40 miles southeast of George Bush Intercontinental Airport (KIAH), Houston, Texas. The two pilots and one nonrevenue jumpseat pilot were fatally injured. The airplane was destroyed and highly fragmented. The airplane was operated as a Title 14 Code of Federal Regulations Part 121 domestic cargo flight, which originated from Miami International Airport (KMIA), Miami, Florida, and was destined for KIAH.

D. SIMULATOR OBSERVATION PLAN

Location: Boeing Training and Professional Services; Miami, Florida
Date/Time: June 5, 2019
Overall Objectives:

- Document simulator systems and alerts
- Document the EFI switch (normal and alternate modes)
- Document autopilot and autothrottle go-around indications
- Measure pilot's inputs with the speedbrake and proximity to Go-around (GA) switches (normal and in turbulence)
- Document normal Atlas stall recovery techniques for flaps 1, gear up
- Documentation of observations runs were made through notes, photos and/or video (i.e. GoPro camera). All photos and videos to be uploaded into the Accellion secure file separately for this accident.

Aircraft
Participants:

B-767 simulator (Level C)	
Simulator Operator:	Mark Hoover (Atlas)
Captain (Left) Seat:	Tyson Howard (IBT)
FO (Right) Seat:	David Lawrence (NTSB)
Test Conductor:	David Lawrence (NTSB)

---

[3] Bob Aaron (Boeing Ops group member) was unable to attend. Richard Lee (Boeing representative on the CVR group) replaced Bob Aaron for the Miami Ops work for June 3 – 7, 2019.
[4] Andrew Runyon (Atlas Air Ops group member) was unable to attend. John Blakely (Atlas Air B767 Aircrew Program Designee) replaced Andrew Runyon for the Miami Ops work for June 3-7, 2019.

Observers: Bill Bramble (NTSB), Warren Abrams (NTSB), Mark Nikolic (Boeing), Rich Lee (Boeing), John Blakely (Atlas)

Initial Simulator Setup:
- Enroute setup
- Cockpit setup: Normal
- Weather:
  - KIAH 231713Z 32018G24KT 8SM BR SCT016 BKN020 BKN029 19/12 A2991 RMK AO2 PK WND 33029/1701 WSHFT 1653 RAB01E13 VCSH SE-S P0000 T01940122
- First officer (FO) will act as pilot flying (PF), Captain will act as pilot monitoring (PM)
- Simulator motion: off (Runs 1-5)
- Weight and Balance: See Appendix
- Position: LINNK Arrival
  - GILL intersection (N29 40.5/W094 32.8)
  - Altitude: 9,200 feet level (MCP altitude window 3,000 feet)[6]
  - Selected Speed: 239 kts indicated
- Configuration: Flaps one, gear up, autopilot and autothrottle engaged
  - 239 knots selected, on MCP, FMA: FLCH, SPEED, HDG SEL, CMD.

0.0   Run #1: EFI Switch

Objectives:

Document EFI and ADI switch usage to alternate source, including alerts/warnings, timing of displays, etc.

Procedure
1. Took IOS snapshot of position and save
2. Position froze at initial simulator setup position (not full-freeze)
3. Selected EFI switch, deselected EFI switch, then cycled FO's EFI switch (normal to alternate)
   a) Documented display FO's
   b) Timed from when the switch is cycled once to Alt to when displays reappear
   c) Timed from when switch is cycled twice (from normal to Alt to normal again) and when displays reappear within 4 seconds
4. Pressed and cycled FO's Air Data switch (normal to alternate) within 4 seconds
   e) Observed any changes to the airspeed data presentation

---

[6] In order to validate the FO as pilot flying for these simulator observations, an altitude of 9,200 feet will be used as a starting point based on ATC transmissions that occurred at 1837Z indicating the captain (who responded to ATC) was the PM and the FO was the PF after transferring control following the FO's display issues.

5. Documented alerts or warnings associated with EFI/ADI switch cycling

Time	Notes
	Run #1 EFI Switch
	1.1 Run
	Select EFI Switch
	1.2 Run
	Deselect EFI Switch
	1.3 Run
	Cycle EFI Switch
	No master cautions no lights were observed all trials
	1.4 Symbol Generator (SG) Failure - Pushing once
	1.5 SG Failure going back to normal
	1.6 SG Failure – Cycle within 4 seconds – screen remains blank
	1.7 Air Data button press
	1.8 Air Data back out
	1.9 Air data cycle in less than 4 seconds
	1.10 Air data fail (Right airspeed error selected at instructor panel) right side air data button press
	1.11 Air data fail right side air data button back out
	1.12 Air data fail right side cycle in less than four seconds. Still no master cautions or EICAS messages

1.0   Run #2: Go-Around demonstration

Objectives:
Document a go-around on autopilot with mode control panel (MCP) altitude below current altitude

Procedure
1. Position frozen at initial simulator setup position (GILL, 9,200 feet 239 knots, flaps 1)
2. Released position freeze and had FO expedite descent to 3,000 feet (FLCH)
3. Extended speedbrakes
4. At 6,400 feet, pressed GA switch
5. Observed to determine if speedbrakes would auto stow
   a) Observed if speedbrakes auto-restow
   b) Observed pitch change (climb or descent, pitch angles down/up)
   c) Observed EICAS messages
   d) Noted FO's arm position
   e) Noted descent/climb rate
6. Position frozen once climb established

Time	Notes

	2.0 Run #2 Go Around Demo 2.1 6400 feet, hit go around while descending in FLCH, see what airplane does: FMA: GA GA GA CMD; Went to 4000 fpm climb; Speed brakes did not auto-retract; No EICAS messages 2.2 Repeated with wider video shot to capture speedbrakes not autoretracting 2.3 Repeated for video closeup of FO displays

2.0   Run #3: Autopilot override

Objectives:
Observe force needed to override autopilot and stop trim activation during an inadvertent go-around

Procedure
1. John Blakely in the right seat, Tyson Howard in the left seat
2. Position frozen at initial simulator setup position (GILL, 10K 239 knots, flaps 1)
3. Released position freeze and had FO expedite descent to 3,000 feet (FLCH)
4. Extended speedbrakes
5. At 6,400 feet, pressed GA switch
6. Had FO manually retract speedbrakes
7. Had FO push forward on yoke to override autopilot pitch up command. (39 degrees ND)
   a) Observed pitch change (climb or descent, pitch angles down/up)
   b) Observed EICAS messages/EGPWS alerts/FMA mode changes
   c) Noted descent rate
   d) Noted if autopilot remained engaged
8. Position frozen once climb/descent established

Time	Notes
	3.0 AP Override 3.1 GA, manually stowed brakes at 50% thrust, then pitched over to 39 deg ND (JB accidentally stowed brake before hitting GA switch); AP disconnected by itself; JB reported he had to push hard and then during the dive the force required was suddenly greatly reduced 3.2 Same conditions; This time the FO did hit GA first, 4 deg NU pitch initially, then about 2 sec later manual speed brake stow; Required two hands to counteract servos, reduced force required occurred with AP spontaneous disconnect; Forward pressure required on yoke felt constant until the disconnect occurred at which time a noticeable reduction in required force happened

3.0   Run #4: Speedbrake usage

Objectives
Observe speedbrake usage and pitch changes, alerts, warnings, and arm positions related to extended/retracted speedbrakes.

Procedure
1. John Blakely in the right seat, Tyson Howard in the left seat
2. Position frozen at initial simulator setup position (GILL, 9,200 feet 239 knots, flaps 1)
3. Released position freeze and had FO expedite descent to 3,000 feet (FLCH)
4. Extended speedbrakes manually
5. Position frozen at 8,000 feet
      a) Documented FO's arm position to GA switch (holding speedbrake handle)
      b) Observed EICAs messages
      c) Observed pitch angle for descent
6. Released position freeze, and at 6,400 feet, press GA switch
7. Had FO leave speed brakes out
      d) Observed if speedbrakes retract automatically
      e) Observed pitch change (climb or descent, pitch angles down/up)
      f) Observed EICAS messages/EGPWS alerts
      g) Noted FO's arm position
8. Position frozen once climb established

Time	Notes
	4.0 Speedbrake usage
	4.1 Descended from 9200 feet, at 8000 feet then full freeze, Descent rate 2900 fpm noted,
	4.3 Document hand position - Observed EICAS messages – nothing noted on the EICAS, Observed pitch angle - -2 deg

4.0   Run #5: Captain and FO Arm location

Objectives
Observe FO (and Captain) arm positions during PF/PM duties.

Procedure
1. John Blakely and Rich Lee[7] alternated in the right seat, Tyson Howard in the left seat
2. Position frozen at initial simulator setup position (GILL, 10K 239 knots, flaps 1)
3. Released position freeze and had FO expedite descent to 3,000 feet
4. Extended speedbrakes manually
5. At 6,400 feet position frozen

---

[7] Photos of Rich Lee (6 feet 1 inches, 210 pounds, shirt size 35/36) in the right seat (see photos section of these field notes), shown in the pink shirt.

      a) Documented FO's left arm position in proximity of the GA switch (above/behind thrust levers)

      b) Documented Captain's right arm position (with hand on weather radar and FMC) in proximity to GA switches

6. Released position freeze
7. Pressed GA switch
      a) Also observed if GA switch could be activated by FO left hand resting on speedbrake handle.
8. Manually retracted speedbrakes
      a) Documented FO's arm position in proximity of the GA switch
      b) Documented Captain's arm position (with hand on weather radar or FMC) in proximity to GA switches
9. Position frozen once climb established

Time	Notes
	5.0 Captain and FO Arm Location
	5.1 As described with freezes
	5.2 Documented hand position with tape measure and photos
	5.3 Documented bumping GA button with back of hand
	5.4 Repeated
	5.5 Documented with more natural hand position
	5.6 Grabbed under throttle and pushed forward on SB lever – does make them retract but also pushed thrust levers forward asymmetrically

5.0   Run #6: Captain and FO Arm location during turbulence

Objectives
Observe FO and Captain arm positions during PF/PM duties.

Procedure
1. John Blakely in the right seat, David Lawrence in the left seat
2. Turned on simulator motion.
3. Position frozen at initial simulator setup position (GILL, 10K 239 knots, flaps 1)
4. Released position freeze and had FO expedite descent to 3,000 feet
5. Extended speedbrakes manually
6. At 6,500 feet, introduced turbulence (moderate, see notes)
      a) Measured 3-axis accelerations using IOS Accord Acceleration Recorder on iPhone 7 taped to the back of the captain's seat (.CSV data files recorded and uploaded in Accellion file separately)
7. At 6,400 feet, FO pressed GA switch
8. Have speedbrakes auto-retract to allow airplane to pitch up
      a) Document FO's left arm position in proximity of the GA switch during turbulence

b) Document Captain's right arm position (with hand on weather radar or FMC, reaching around to select flaps) in proximity to GA switches
c) Other notes
9. Position freeze once climb established

Time	Notes
	6.0 Arm location during turbulence 6.1 Sample Test severe turb 50 % sample accel 6.2 As described in plan – at 6500 feet introduced turbulence, then at 6400 feet hit GA Documented where hand is when we introduced turbulence

6.0   Run #7: Stall recovery demonstration (right seat)

Objectives
Observation Atlas procedures for departure stall recovery

Procedure
1. John Blakely in the right seat, David Lawrence in the left seat
2. Position frozen at initial simulator setup position (not full-freeze, GILL, 10K 239 knots, flaps 1)
3. Turned motion on
4. Released position freeze
5. Had FO retract speedbrakes and allowed airplane to pitch up on autopilot to shaker and buffet (Used vertical speed mode, 2000 feet per minute - with autothrust off), right turn initiated
6. Demonstrated a stall recovery from a nose-high attitude (per Atlas SOPs) at stall buffet
8. Position frozen once climb established

Time	Notes
	7.0 Stall recovery – Atlas demo started to 9200 feet takeoff departure stall. 7.1 Takeoff departure stall to buffet in flaps 1, Atlas procedures call for the disconnect of autopilot and autothrottle for stall recovery.

E.   GROUP PHOTOS[8]

7.0   Run #3

---

[8] Source: NTSB Operations and Human Performance investigator.
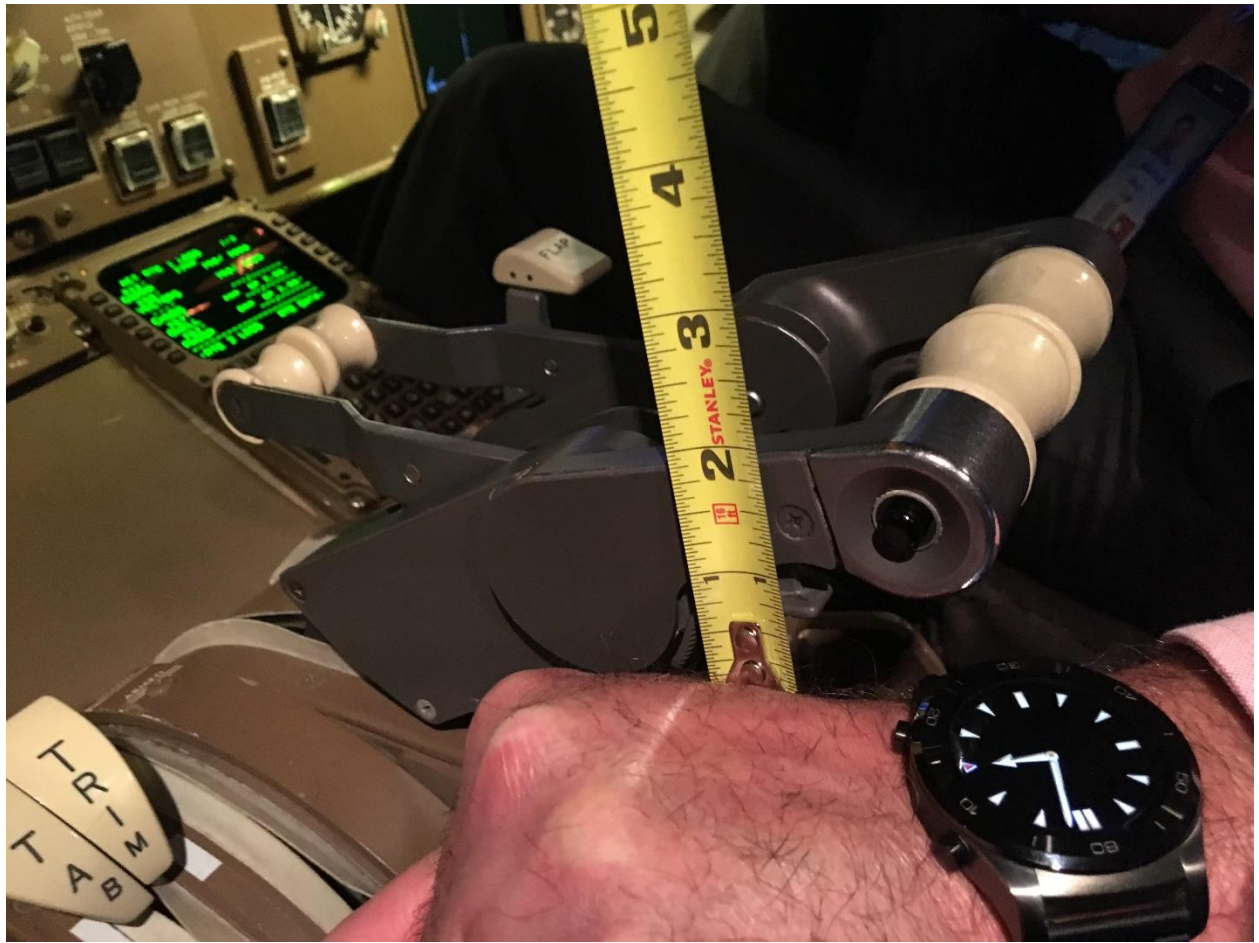
8.0   Run #4

9.0   Run #5

F. APPENDIX

10.0 Photo of accident FO[9]

Photo of accident FO included to illustrate body size and wrist watches worn on the left arm.

---

[9] Source: IBT through the NTSB Systems Group Chairman.

11.0 Weight and Balance

WEIGHT & BALANCE / PERFORMANCE	
Basic Operating Weight	185,646 lbs.
Passenger Weight	240 lbs.
Baggage/Cargo Weight (Shown on Form)	25,933 lbs.
Zero Fuel Weight	21,1819 lbs.
Maximum Zero Fuel Weight*	309,000 lbs.
Fuel Weight	37,700 lbs.
Ramp Weight	250,919 lbs.
Maximum Ramp Weight*	408,483 lbs.
Taxi Fuel Burn	1,400 lbs.
Actual Takeoff Weight	249,519 lbs.
Maximum Takeoff Weight*	408,483 lbs.
Estimated Fuel Burn to Accident Site**	20,000 lbs.
Estimated Landing Weight**	228,861 lbs.
Maximum Landing Weight*	326,000 lbs.
CG	20.7% (TOW MAC)
CG Limits*	35.0%
Takeoff Stab Trim	2.3
Takeoff Flap Setting	5
Takeoff Speeds (V_1 V_R V_2)	124 / 129 / 136
Landing Flaps	25
V_{REF}	126 (From QRH Table)

Submitted by:

David Lawrence and Bill Bramble
NTSB