

**PARTY SUBMISSION OF
THE INTERNATIONAL BROTHERHOOD OF TEAMSTERS LOCAL 2750
TO THE NATIONAL TRANSPORTATION SAFETY BOARD**

ATLAS AIR FLIGHT 3591

Trinity Bay
Anahuac, TX, USA
23 February 2019

NTSB DCA19MA086

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In accordance with Title 49, CFR Section 831.14, the International Brotherhood of Teamsters Local 2750 (“IBT”) a designated party to the National Transportation Safety Board (“NTSB”) investigation of the accident, respectfully submits its proposed findings of fact, proposed probable cause, and proposed safety recommendations designed to prevent future accidents. The IBT’s submission does not attempt to address all of the issues that arose during the course of the investigation. It focuses on what the IBT believes are the significant findings to be drawn from the evidence made available to the IBT.

I. EXECUTIVE SUMMARY

On February 23, 2019, at about 1839 Universal Coordinated Time, Atlas Air (“Atlas”) flight “Giant” 3591, a Boeing 767-375BCF, registration number N1217A (“Accident Aircraft”), entered a rapid descent from 6,000’ MSL and impacted Trinity Bay approximately 34 nautical miles southeast of George Bush Intercontinental Airport (“KIAH”), Houston, Texas. The two pilots and one jumpseat rider were fatally injured. The Accident Aircraft was destroyed and highly fragmented by the impact.

The Accident Aircraft was operated by Atlas under Title 14 C.F.R. Part 121 as a domestic cargo flight in support of Amazon’s Prime Air. At the time of the accident, the aircraft was operating in the vicinity of a line of convective activity. The flight originated from Miami International Airport (“KMIA”), Miami, Florida and was destined for KIAH.

In the assessment of the IBT, the accident chain began during descent. Aircrew workload increased with increased communications, weather avoidance, associated turbulence, and an expedited descent. As noted on the cockpit voice recorder Cockpit Voice Recorder (“CVR”), a problem with the symbol generator occurred on the First Officer’s side, necessitating multiple exchanges of aircraft control between the pilots. All of this occurred in the descent from 12,000’ to 6000’.

Analysis of the wreckage indicated that the aircraft was fully functional during the entire event. No data was captured regarding the apparent symbol generator failure and no avionics survived the impact in a condition that could be examined.¹ The engines operated normally until impact and the aircraft appeared to have been fully intact until impact².

The pilots’ employment backgrounds and training histories were both examined. The Captain’s background contained no inconsistencies and was generally unremarkable. The First Officer’s employment background contained omissions and consistent problems in training. The documentation required by PRIA³ was inadequate to capture these omissions or flag the First Officer’s history of training issues and failed to provide a complete picture of his background for Atlas to evaluate.

As discussed in greater depth in this submission, during the time leading up to this accident, safety concerns regarding Atlas’ operation had been raised by both pilots and Federal Aviation Administration (“FAA”) inspectors, but no additional FAA oversight occurred. Taken as a whole, the FAA’s oversight of Atlas and associated carriers appears to have not met with the level of risk seen in respect to the multiple hazards present in the operation.

¹ NTSB, Tom Jacky, December 16, 2019

² NTSB, Gordon J. Hookey, September 9, 2019

³ PRIA is the Pilot Records Improvement Act

A. Proposed Probable Cause

The IBT submits that the probable cause of the accident was the inadvertent activation of the go around switches while the aircraft was descending in turbulence. The ensuing power increase and pitch up caused spatial disorientation and eventual cognitive lockup, which led the First Officer to believe the aircraft was in a stalled condition and respond with excessive pitch down control input, resulting in flight into terrain.

B. Proposed Contributing Causes

The contributing causes of the accident were:

1. The FAA and Atlas failed to adequately monitor the effectiveness of Atlas' training program and specifically failed to provide sufficient oversight of the progression of pilots with multiple training failures.
2. The FAA failed to mandate, and Atlas failed to ensure effective spatial disorientation training in its training programs.
3. PRIA lacked sufficient safeguards in the event of a candidate's failure to fully disclose prior employers and training history, and the PRIA-required training records and disclosures did not provide sufficient information or history for a prospective employer to fully evaluate a candidate.
4. Boeing failed to design the 767-300 throttle quadrant to protect against inadvertent activation of the go around switches and to design appropriate system logic to prevent go around mode from activating in certain flight regimes.
5. The pilots extended the flaps earlier than called for in Atlas' procedures as set forth in Atlas' Flight Crew Operations Manual and Boeing's Flight Crew Training Manual.
6. The First Officer failed to fully disclose all applicable prior employers and training issues in his application to Atlas, and Atlas was unable to obtain his complete background history in its hiring process.

II. THE IBT’S ROLE IN THE INVESTIGATION

The NTSB led the investigation into Giant 3591 crash into Trinity Bay.

As a party in this investigation, the IBT’s role was to review and analyze the factual evidence provided by the NTSB. All information that came to the attention of the IBT was promptly forwarded to the appropriate NTSB Group Chairman.

The NTSB requested that all parties submit proposed findings drawn from the evidence revealed during the investigation.

The IBT has responded to the NTSB’s request with this document, which:

- identifies proposed findings based on review and analysis of the factual evidence provided and publicly available information relevant to the investigation; and
- offers a proposed probable cause and recommendations based on the IBT’s findings and analyses.

III. FINDINGS

The IBT’s assessment of the evidence is based upon observations of the aircraft, accident site, post-accident examination of aircraft systems and components, the air carrier’s maintenance records, and manuals, Boeing flight operations manuals, Flight Data Recorder (“FDR”) data, the CVR transcript, Operations Group interviews, flight crew records, and publicly available information.

Given the limitations of the data available and the loss of the crew and the jumpseater, certain direct evidence was lacking in the reconstruction of the events leading up to the accident. Below follows a summary of the events leading up to the accident. Where data was unavailable, the IBT notes necessary inferences.

At 11:57:59⁴ Giant 3591 checked into Houston Center. Shortly afterwards they were assigned the arrival into KIAH. The clearance given was GIRLY and the LINNK1 arrival. The crew then began an informal briefing for the assigned arrival and briefed an approach to runway 26R. The brief met all requirements for the planned approach. Discussion occurred related to contingencies, landing performance, and expectations for the approach. At 12:08:04 Houston Center began descending Giant 3591 into the terminal area surrounding KIAH. At 12:08:07 comments were made on the CVR about bleeding, and the IBT inferred that the Captain struck his head while maneuvering around his seat. There were no other indications that this was anything more than a minor injury and it was not considered to be a factor in the event.

At 12:10:50 the crew exchanged aircraft control, leaving the Captain as Pilot Flying and First

⁴ All times are local in this description to match the NTSB’s reports.

Officer as Pilot Monitoring. The First Officer then conducted a formal briefing for the approach and arrival. The formal briefing was for the ILS 26R into KIAH. All briefing items were completed prior to arrival in the terminal area. At 12:30:13 Houston Center handed Giant 3591 over to Houston Approach who assigned a new landing runway, 26L. At this point the aircraft was passing through approximately 18,000' MSL. The crew modified the FMS to program the new routing and runway. Conversation centered around the updates and managing the flight path of the aircraft. There was some discussion regarding problems with the VNAV operation of the aircraft, but the crew did not show concern.

At 12:34:08 Giant 3591 was informed by Houston Approach that there was an area of weather between them and the airport. At 12:35:16 the crew was switched to a different Houston Approach controller. This controller stated at 12:35:49 that the flight would receive radar vectors to runway 26L at KIAH and asked what the crew wanted to do to avoid the weather.

At 12:36:07, the First Officer stated, "Okay – I just had a..." The rest of the transmission was cut off by an exhalation. From the conversation that followed, the IBT deduced that there was a problem with the symbol generator on the First Officer's electronic instruments. Per procedure, the First Officer transferred aircraft control to the Captain and assumed radio communications duties. At 12:36:31 he informed the controller that they would deviate around the weather the west side. There were several exchanges of communications ending at 12:36:51 with the First Officer acknowledging a request to expedite the descent to 3000'.

Conversation then returns to the apparent instrumentation failure from 12:37:07 to 12:37:11. The loss of electronic displays doesn't have a checklist but is covered in training by Atlas Air. The procedure to resolve the issue is to utilize the so called EFI ("EE-FEE") switch to use another symbol generator to drive the screens. The FO uses the EFI switch to restore his screens at the end of this time period. The aircraft is approximately 8000ft msl at this point. They are 43 nautical miles from KIAH and 6.5 nautical miles to the southeast of Anahuac, TX.

At 12:37:16 the APP controller assigns a heading of 270 degrees. The radio call is responded to by the Captain and he follows this response up by transferring the controls after verifying the heading. From 12:37:27 the crew discusses the setup of the approach in the FMS with the radar vectors taking them off the arrival. They agree on a point to select and at 12:38:02 the First Officer calls for the selection of Flaps 1. This decision wasn't understood by IBT 2750 investigators in context of their altitude, speed, and location in relation to the KIAH airport. After the flaps selection the crew completes the verification of the FMS change and executes the change. At 12:38:15 the crew determined that the autopilot is still in LNAV mode not on the assigned heading. This is one minute after the ATC assignment was made and the IBT 2750 investigators made the determination that the crew was experiencing degraded reactions due to the perceived high workload. They correct the situation at 12:38:17 while overhead the town of Anahuac.

At 12:38:31 the sound of a click is heard. The NTSB analyzed this in their Sound Spectrum Study and found it was consistent with the Go Around Switch being activated. As Flaps 1 were already selected, the Go Around system was armed and activated with this button push. This appears to have been inadvertent and the IBT 2750 investigators made the assumption that this was caused by the FO trying to interact with the Spoiler handle or resting his hand on the Spoiler

handle⁵. The Go Around system activation increased the power on the engines up to full 106% power (approximately 120,000 lbs of thrust with an estimated airplane weight of 230,000 lbs) and was apparently not interpreted correctly by the crew as it happened.

At 12:38:43 the First Officer says “Oh”, followed by “whoa” and “(where’s) my speed my speed” in the course of 2 seconds, spoken in an elevated voice. The last radio call made by the Captain is “Okay” at 12:38:47⁶ followed by multiple thumping sounds. These sounds are believed to be items being thrown around the cabin. The IBT 2750 also makes the assumption that the Captain would have also not been looking straight ahead but likely reviewing and setting up changes for the upcoming approach in his EFB (Electronic Flight Bag) or in the FMS. At this point the FDR Data indicates that the first officer has pushed the nose over and the crew is already at less than a 1g environment. The nose continues to the extreme of approximately 49 degrees nose down. The crew experienced a ride that is more similar to a roller coaster ride. The effects of this are discussed in the Somatogravic Illusion section of this report. The longitudinal acceleration coupled with the negative g (vertical) acceleration would have been disorientating. The crew would have been thrown into their seatbelts. Depending on how tight they had their belts it is possible they could strike their heads on the overhead panels of the flightdeck while still in their seats. Negative g’s can be disorientating in themselves and it is further believed this occurred all while in the clouds without visual reference to a horizon.

About 2 seconds after the “where is my speed” comment the First Officer states that, “we’re stalling” at 12:38:48. At 12:38:47⁷ on the FDR timeline we see solid evidence of the Left and Right Elevators splitting their control inputs. The Left (Captain side) is transitions to an upward deflection in comparison to the Right (First Officer side) elevator.⁸ There continues to be comments from the First Officer and a call to the Captain who responds with “what’s goin’ on?” at 12:38:55. The comment’s relation to what is happening could have several possible meanings. The pitch over, statements that they were stalling, lack of response to control inputs that appear to have been made and g forces throwing the Captain around would have made this a difficult environment to process and maintain situational awareness.

We see a prolonged period of less than 1g environment and minimal effective communication between the crew. We attribute this to the disorientation caused by the rapid pitch over, longitudinal acceleration and lack of visual reference to a horizon. Decent rates and rapid acceleration increased noise in the cockpit along with loose items and the crew possibly being dislodged would have caused a chaotic environment. Despite this we do see some actions on the controls. The thrust levers were swiped back quickly to idle but returned to full power just as quickly after about 3 seconds⁹ during the timeframe of the “where is my speed” and “we’re

⁵ Atlas policy is to maintain a hand on the Spoiler handle while it is in use as a memory aid. No audible warning exists for the spoilers being up while the power is at higher power levels than idle.

⁶ There is variability between the timeline of the FDR and CVR information. The FDR indicates the radio call was at 12:38:42 versus 12:38:47 on the CVR.

⁷ Applying an approximate correction to the FDR timeline based on the last radio transmission the timeline for this would be 12:38:52. This adjustment makes more sense in context with the CVR transcript information.

⁸ Only the left control column is monitored in the FDR data.

⁹ There is no information to indicate who actioned the thrust levers.

stalling” comments made by the FO. This action had little effect on airspeed but did have the effect to reduce the longitudinal acceleration. We also see an increasing split in the Left and Right elevators that we assume is the Captain trying to recover the aircraft by pulling back on the controls while the First Officer was still pushing forward on the control column.

The aircraft’s energy state rapidly increased as the plane was accelerated by the engines and gravity. Descent rates increased to 30,720 feet per minute descent as reported by ADS-B out data from the aircraft. This quickly created a high energy state that we believe was unrecoverable shortly after the start of this event. In the end, the IBT 2750 feels that once the crew became oriented with the ground after coming out of the clouds the elevator split evens out and an attempt to recover the aircraft commences. The aircraft transitioned from the oscillating negative G environment to an approximate 4.4g positive loading in 1.5 seconds. Despite this effort, there was not enough altitude remaining to recover from this undesired aircraft state before hitting the terrain.

A. OPERATIONAL FACTORS GROUP

1. Pilot Records Improvement Act

The U.S. airline industry suffered a number of fatal airline crashes between 1987 and 1994 that were, in part, attributed to pilot error. In its investigation of these crashes, the NTSB found that the pilots involved had poor safety and/or performance histories and this information was not available to the hiring carriers. To address this problem, the NTSB recommended in multiple accident reports that the carriers obtain information from the FAA and previous employers. In response, Congress enacted the Pilot Records Improvement Act of 1996 (“PRIA”), which requires airlines to perform background checks and share information on pilots prior to hiring. PRIA requires an air carrier to perform three basic checks on prospective hires: an FAA records check, a National Driver Register (“NDR”) driver’s license check, and a check of the pilot’s former employers.

The FAA records check¹⁰ consists of providing information on the following: current status of Airman Medical Certificate, current Airman Certificates held (including records of FAA checkride failures), and any closed legal enforcement actions against an Airman Certificate (for the previous 5 years, or indefinitely if a certificate was revoked).

The NDR check involves checking a national database for driver’s license records and is primarily used to search for driving while intoxicated offenses.

¹⁰ Federal Aviation Administration (April 21, 2017). Advisory Circular 120-68H, Pilot Records Improvement Act. Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-68H.pdf

The pilot's former employers' records are checked for documentation of Department of Transportation ("DOT") mandatory alcohol/drug testing as well as records pertaining to pilot performance. Pilot performance records are defined in FAA Advisory Circular ("AC") 120-68H as:

4.5.1.2 Records Related to Pilot Performance. These records are not limited solely to events arising out of the pilot's demonstration of proficient flying skills and the demonstration of compliance with FAA regulatory requirements. A pilot's duties and responsibilities to ensure safe aircraft operations also include demonstrating adherence to certain established company procedures during all aspects of an aircraft operation. This includes the procedural requirements for all phases of flight.

The AC does not define which specific records are to be transmitted to the prospective employer. This is reflected in the relative lack of detail provided to Atlas by both Mesa Airlines¹¹ ("Mesa") and Trans States Airlines¹² ("Trans States"), in their responses to the PRIA requests for the First Officer.

The Mesa PRIA response included only a list of training sessions attended by the First Officer, their dates and durations. The records do not indicate whether the training sessions were completed successfully. Even though the First Officer did not complete captain upgrade training due to performance issues (according to NTSB phone conversations with multiple Mesa check airmen)¹³, the only notation in the PRIA response is simply "PER EMAIL RECEIVED ON 09MAY17. HE IS RETURNING TO FO." According to these interviews, not only did he not complete captain upgrade training, he struggled to requalify as a first officer. None of this information was available in the PRIA forms sent to Atlas.

The Trans States PRIA response provides more information with respect to the First Officer's training. It notes 'satisfactory' and 'unsatisfactory', but there is no description to clarify the areas in which the First Officer's performance was unsatisfactory. The record notes that the First Officer had unsatisfactory performance in "PIPCO, PIPC100, and PSLFX". There is presently no standardization of these types of industry training codes. As such, it is difficult or impossible for a hiring carrier to ascertain even the subject matter of the lessons that were unsatisfactory, thereby hampering the prospective employer's ability to gain a complete understanding of the applicant's training history.

Other required documents do not appear to have been transmitted during the PRIA process for the First Officer. AC 120-168H requires all records pertaining to drug/alcohol testing be supplied in response to a PRIA request. Trans States did not include any DOT drug/alcohol test results in its PRIA response even though the First Officer's entire career at Trans States fell within the five-year window of required PRIA recordkeeping.

¹¹ See NTSB Docket Operations Attachment 15 - First Officer PRIA Documentation

¹² See NTSB Docket Operations Attachment 15 - First Officer PRIA Documentation

¹³ See NTSB Docket, Operations Attachment 2 – Records of Conversation

PRIA requires an employer to provide records to a prospective employer for five years preceding the request. Employers are prohibited from providing information prior to the five-year period. AC 120-68H contains the following guidance:

4.5 Specific Records to Be Furnished. Only furnish records from the past 5 years; you must not furnish a record entered more than 5 years before the date of the PRIA records request, unless the information concerns a revocation or suspension of an Airman Certificate or motor vehicle license and the revocation or suspension is in effect on the date of the request. You must respond to the requestor (the hiring employer) within 30 calendar-days of receiving the PRIA records request, and provide the records described below.

If a former employer has gone out of business, the records required for a PRIA check may no longer be available. The Pilot Records Database (discussed below) attempts to fix this particular issue, but participation has not yet become mandatory.

The accuracy of PRIA information is dependent upon full disclosure by the pilot applicant. For example, if a pilot omits a former employer, the hiring carrier will not know about that carrier and therefore will not receive any information pertaining to the pilot's performance there. In this accident, the First Officer failed to disclose at least two former employers, Air Wisconsin Airlines and CommutAir, with his Air Wisconsin employment falling within the five-year reporting period mandated by PRIA. The First Officer had difficulties in training at CommutAir and was released from employment and left Air Wisconsin for personal reasons. The fact that the First Officer worked at these carriers was unknown to Atlas and if known, might have impacted the initial hiring decision or subsequent decisions made during training. AC 120-68H is the main guidance for both employers and pilot applicants and does not make disclosure of failures mandatory. Instead, "[t]he FAA *encourages* a pilot/applicant to disclose all pilot testing failures to any potential aviation employer." (emphasis added.)

Another shortcoming of PRIA occurs when a pilot is allowed to resign instead of being terminated due to training issues. This is a well-known and systemic issue within the industry, perhaps pertaining to concerns about potential litigation or impact on a pilot's career. However, when combined with the lack of comprehensive training records, it creates a situation where a pilot may have had training difficulties at multiple airlines, and even if the prior airlines are disclosed, the hiring airline may not have sufficient information to fully assess the problems in the pilot's training history and/or employment background.

2. Pilot Records Database

After the accident of a Colgan Air Bombardier DHC-8-400¹⁴ near Buffalo, NY in February 2009, the NTSB made several recommendations regarding PRIA and the record keeping requirements for air carriers. These included recommendations A-10-017, 018, 019 and 020. These recommendations spurred the creation of a new program called the Pilot Records Database ("PRD") and were codified into law by the Airline Safety and Federal Aviation Administration

¹⁴ NTSB Accident DCA09MA027

Extension Act of 2010¹⁵ (“the 2010 Act”). Eleven years after the Buffalo accident, the PRD program still has not been fully implemented¹⁶ and remains in the testing phase. Even once PRD is fully implemented, it still will not correct all the flaws of the PRIA system.

The PRD program involves a new system meant to replace PRIA. Instead of a hiring carrier sending PRIA requests to each former employer and the FAA, the PRD will act as a “one-stop-shop.” Upon consent of an applicant, a hiring carrier will have instantaneous access to the applicant’s FAA records. There are some discrepancies between the 2010 Act and AC 120-68H. The 2010 Act states:

Sec. 203. FAA PILOT RECORDS DATABASE

(i)(2) PILOT RECORDS DATABASE – The Administrator shall establish an electronic database (in this subsection referred to as the ‘database’) containing the following records:

(A) FAA RECORDS.—From the Administrator—

...

(B) AIR CARRIER AND OTHER RECORDS. –From any air carrier or other person (...) that has employed an individual as a pilot of a civil or public aircraft, or from the trustee in bankruptcy for the air carrier or person—

(i) records pertaining to the individual that are maintained by the air carrier (other than records relating to flight time, duty time, or rest time) or person, including records under regulations set forth in ...

(ii) other records pertaining to the individual’s performance as a pilot that are maintained by the air carrier or person concerning—

(I). the training, qualifications, proficiency, or professional competence of the individual, including comments and evaluations made by a check airman designated in accordance with ...

(II). any disciplinary action taken with respect to the individual that was not subsequently overturned; and

(III). any release from employment or resignation, termination, or disqualification with respect to employment.

(C) NATIONAL DRIVER REGISTER RECORDS ...

¹⁵ <https://www.congress.gov/111/plaws/publ216/PLAW-111publ216.pdf>

¹⁶ Note: PRD is currently not fully implemented and a Notice of Proposed Rulemaking is expected in the future. Details of PRD are based on currently available information.

On the other hand, AC 120-68H states:

6.7 Review and Evaluation of Records in the PRD. ...

8. The air carrier or operator must contact pilot's current and/or previous employer(s) listed in the PRD report in order to obtain the individual's prior records. The requesting air carrier or operator should provide the PRD pilot consent pages with the employers listed on each page to the current and/or previous employers for response to the records request. These records must be reviewed before entering the pilot into service...

The 2010 Act states that the air carrier records are to be entered into the database maintained by the FAA, but AC 120-68H states that these records are maintained by the employer and sent directly to the hiring employer. This issue of missing records from defunct carriers is not addressed.

PRD also still relies on the pilot applicant to provide a complete and comprehensive work history. Once entered, the applicant cannot restrict the records from specific carriers from being provided; however, there are no checks to ensure that all prior carriers have been entered into the system. The PRD website does display a notice that it is "considered a falsification and subject to enforcement action if current and/or former employers are omitted."

Home | User Guide | Help | Sign Out

Federal Aviation Administration

Pilot Records Database

Pilot Info | Disapprovals | Enforcement | Accidents/Incidents | **Experience** | Driving | Consent | Log | Notifications | Help | User Profile

Employers

First Name: [Redacted] Last Name: [Redacted] Certificate No.: [Redacted] Last Visited On: 1/14/2020

[View/Print PAR](#)

Employer data is used to Generate the Release to Consent authorization to current or former employers.
Enter your current and/or former employers for which you were employed as a pilot within the previous five years, at a minimum. It is considered a falsification and subject to enforcement action if current and/or former employers are omitted.

[Add Employer](#)

* Please select an employer from the Employer list and if not found, click the 'Add New Employer' button to manually enter the employer.

* Employer: [Text Field] [Add Selected](#)

Is Current Employer: ☐

[Add New Employer](#) [Clear](#)

Figure 1 Screen Capture of Pilot Records Database Website¹⁷

¹⁷ Retrieved from <https://prd.faa.gov/PRDEExternal/AirmanInformation/Index/>

PRD also does not address the issue of incomplete or hard-to-read records from previous employers. NTSB safety recommendation A-10-020¹⁸ (from the Buffalo Colgan DHC-400 accident) states “TO THE FEDERAL AVIATION ADMINISTRATION: Develop a process for verifying, validating, auditing, and amending pilot training records of [14 CFR 121,135, and 91k] operators to guarantee the accuracy and completeness of the records.” The ‘safety recommendation history’ of this recommendation is available on the NTSB website and has the most recent comments listed dated February 21, 2014, which states:

On September 28, 2012, we described our concern that the FAA’s planned action might not fully satisfy the intent of the recommendation...We were concerned that your efforts might focus on pilots who dispute records, rather than on this insufficiency of detailed information. This recommendation addresses not only the accuracy of pilot training records but also their completeness, and we cautioned that if your revisions dealt only with accuracy and not also with the minimum level of detail necessary to satisfy the regulations, the revisions would not constitute an acceptable response. Your recent letter states your belief that adherence to the regulations helps operators identify pilots with performance problems, and that once the PRD is available, operators will have more timely access to training records than they do under the existing system. We remain concerned that your planned response may not adequately address the part of this recommendation addressing the completeness of the records that will be placed in the PRD. Without an FAA oversight system to ensure a sufficient level of detail in the information contained in the PRD, training records will not provide the information operators need to make an informed decision. In our investigation of the Colgan Continental Connection flight 3407 accident, **we found that information on pilot training records that complied with the regulations did not provide the needed level of detail.** (emphasis added) {NTSB Safety Recommendation A-10-20}

This comment by the NTSB was made five years prior to the Atlas accident flight and still lacks any response from the FAA, and it does not appear any change has been made to reflect the concerns of the NTSB. Airline record format and the specific data recorded is still left to the discretion of each individual airline. This makes it very difficult for a prospective employer to examine a pilot’s history in detail. Relevant details may be left out, thereby making a comprehensive analysis of a pilot applicant impossible.

As of this writing, PRD still requests that a pilot provide only the previous five-year work history, although air carriers have been requested to begin keeping records permanently. FAA and U.S. government rulemaking applies only to U.S. based carriers, and to date there has been no international standardization of a PRD-type program via ICAO or other agencies.

3. Proficiency Watch Program

After an accident involving an MD-10 in Memphis in 2003 that was partially attributed to the

¹⁸ Retrieved from <https://ntsb.gov/safety/safety-recs/layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-10-020>

lack of oversight in the training of the MD-10 First Officer, the NTSB made a recommendation to “[r]equire all Part 121 air carrier operators to establish programs for flight crewmembers who have demonstrated performance deficiencies or experienced failures in the training environment that would require a review of their whole performance history at the company and administer additional oversight and training to ensure that performance deficiencies are addressed and corrected.”¹⁹ This recommendation was repeated after the Colgan DHC-8-400 crash near Buffalo, NY in 2009. Shortly thereafter, the 2010 Act directed the FAA to establish remedial training and oversight programs.

The requirements for a Proficiency Watch Program (“PWP”) program are specified in 14 C.F.R. §121.415(h) which states: “Each training program must include a process to provide for the regular analysis of individual pilot performance to identify pilots with performance deficiencies during training and checking and multiple failures during checking.” Further guidance as to how these programs are to work is provided in FAA Advisory Circular 121-39.²⁰

The Atlas PWP in effect²¹ at the time of the First Officer’s training was outlined in Bulletin 43 of the Flight Operations Training Manual (“FOTM”)²². The header for this bulletin states: “The Company has established a Proficiency Watch Program (PWP) to comply with the FAA’s requirement to provide a pilot remedial training and tracking program. The requirement states that an air carrier’s training program must include a process for the regular analysis of the performance history of any flight crewmember who has demonstrated performance deficiencies during training and checking or experienced multiple failures during checking, and to provide additional training and oversight to ensure those deficiencies are addressed and corrected.”

As outlined in the bulletin, there are multiple grounds for a pilot to be entered into the PWP. One basis for entry is described as: “a flight crewmember who demonstrates a performance deficiency while in Initial, Upgrade or Requalification training and subsequently receives an unsatisfactory grade on a Type, PC and LC.”

Based on the above-listed criteria, it is unclear to the IBT why the First Officer was not enrolled in the PWP. The First Officer had multiple performance deficiencies during his training, including remedial training sessions, and he subsequently received an unsatisfactory grade on his type rating checkride. The explanation given during the interview with the Atlas Fleet Captain was that the enrollment in PWP also had a component that was subjective in nature and allowed the Fleet Captain leeway in determining who would be enrolled in the PWP.²³ Bulletin 43 does not have any language in it that appears to allow for this leeway.

Notably, when a pilot enters the PWP at Atlas, the pilot remains in it only six months. If the pilot successfully passes a simulator check and two flying line checks (one as Pilot Flying and

¹⁹ Retrieved from

https://www.nts.gov/investigations/AccidentReports/_layouts/nts.recsearch/Recommendation.aspx?Rec=A-05-014

²⁰ FAA, AFS-200, 2014 AC 121-39

²¹ Revision dated April 18, 2016, effective date April 18, 2016.

²² NTSB Ops Group attachment 20 – Atlas PWP Program (FOTM Revision)

²³ NTSB Docket, Operations Attachment 1 – Atlas Air Interview Transcripts. Joseph Diedrich

one as Pilot Monitoring), the pilot is released from the program. In some of Atlas' fleet types, such as the 747, pilots act as Pilot Flying approximately once or twice per month. Therefore, a six-month program may involve a total of only six legs operating as Pilot Flying. There is no regulatory requirement as to the length of the program, but the more legs that are observed, clearly the more effective the analysis of the pilot's progression.

4. Training Documentation Quality and Effectiveness

Training documentation in airlines serves multiple purposes. The documentation for a pilot shows regulatory compliance and assists in administrative record keeping but also serves as a means of communication between instructors. In Atlas' 767 training program, it is common for a student to have multiple instructors throughout a training program. The student training record indicates which events were completed, separated into two parts. The first is a bulk sheet for all the full flight simulator ("FFS"), fixed base simulator ("FBS") or systems integration trainer ("SIT") events where a binary evaluation of complete or incomplete is recorded. This is titled the "767 Grade Sheet" and has versions for the FFS, FBS, and SIT. This sheet is supplemented by a generic block consisting of eight lines of space for an event to be recorded. This form is called "767 Comments/Recommend for RTG/PC". In reviewing these documents, the IBT found that the substance of information contained here is mixed at best. Often it contains no debrief items, but it may contain statements to study or prepare for the next event.

There is no record that contains any information that attempts to quantify the level of mastery of the training event. Sheets for recording information are not event specific. Notes are taken by instructors for debriefing purposes. The instructor transcribes what he or she feels is important into the record for each event. This information is kept in a folder that is shared among instructors.

Throughout both FAR Part 61 and 141 pilot training programs, there is minimal documentation of a pilot's progression. Items are noted in the pilot's logbook to show compliance with training requirements set forth in the regulations. Similarly, there is minimal training documentation done by air carriers; information recorded meets the functional requirements. With the advent of Advanced Qualification Program ("AQP") training, there have been some changes in the industry. AQP's data driven approach to training requires more data.²⁴

Standardization and sharing of training information is essentially nonexistent in the airline industry. Training material is not transferred from one company to the next. In contrast, an aircraft that is transferred is required to come with its maintenance documentation.²⁵ Common frames of reference such as time in service, cycles and total time are universally used in the aircraft maintenance world to describe reliability of aircraft and their components. This common framework allows for comparisons to find meaningful differences in aircraft reliability.

Currently no such requirement exists for pilot training records or flight times. This deficiency was noted by the DOT Office of the Inspector General ("OIG") nearly a decade ago.²⁶ The

²⁴ Please see the section on AQP for more information.

²⁵ See 14 C.F.R. §121.380(a) and §121.380(a)(2).

²⁶ U.S. Department of Transportation Office of Inspector General. (December 20, 2011). *New Approaches Are*

report recommended the development of “a standardized procedure for air carriers to report failures of pilot proficiency checks as well as remedial and recurrent flight training to FAA, and require inspectors to monitor trends and target surveillance to highest risk areas.” No such procedure for obtaining reliable data for comparison exists currently for air carriers.

5. Advanced Qualification Program

The AQP, is a voluntary training program for air carriers authorized by the FAA in 14 C.F.R. Part 121 Appendix Y. Atlas has chosen to not use this program for its training. It remains on the older training program authorized by Part 121, Appendices E and F. Other Part 121 carriers have been moving to AQP programs since the authorization to do so became available.²⁷

AQP program instructions are set forth in AC 120-54A, Change 1. The AC describes AQP as follows:

AQP is a systematic methodology for developing the content of training programs for air carrier crewmembers and dispatchers. It replaces programmed hours with proficiency-based training and evaluation derived from a detailed job task analysis that includes crew resource management (CRM). AQP incorporates data-driven quality control processes for validating and maintaining the effectiveness of curriculum content. AQP provides an alternate method of qualifying and certifying, if required, pilots, flight engineers, flight attendants, aircraft dispatchers, instructors, evaluators, and other operations personnel subject to the training and evaluation requirements of 14 CFR parts 121 and 135. The AQP encourages innovation in the methods and technology that are used during instruction and evaluation, and efficient management of training systems. The goal of AQP is to achieve the highest possible standard of individual and crew performance. A leading objective of AQP is to provide effective training that will enhance professional qualifications to a level above the present standards that are provided in parts 121 and 135.

AQP programs require monitoring and revision on an annual basis. The assessment process uses data monitoring from the training program, safety reporting systems, Flight Operations Quality Assurance programs and other data to ensure required performance standards are being met by the training program. This, for instance, would require an operator to adjust training programs if incoming applicants were showing weak performance in certain areas of knowledge or performance. It also gives the operator flexibility to streamline training if performance is sufficiently high in an area of knowledge or performance. Another benefit of the AQP program according to the AC is improved tracking of performance of training. Many standard programs, such as Atlas’, use a binary “pass/fail” tracking mechanism. The recommended tracking

Needed to Strengthen FAA Oversight of Air Carrier Training Programs and Pilot Performance (Report No. AV-2012-027). Retrieved from <https://www.oig.dot.gov/sites/default/files/Pilot%20Training%20FINAL.pdf>

²⁷ 92% of today’s airline pilots are trained under AQP programs. See: U.S. Department of Transportation Office of Inspector General. (May 31, 2017). *FAA Has Not Ensured All Check Pilots Meet Training and Observation Requirements* (Report No. AV2017050). Retrieved from <https://www.oig.dot.gov/sites/default/files/FAA%20Oversight%20of%20Check%20Pilots%20Final%20Report%5E5-31-17.pdf>

program for AQP has 5 levels of performance.²⁸

GRADE	CRITERIA
1 Unsatisfactory	Major deviations from the prescribed qualification standards occur that are not recognized or corrected. Individual or crew performance could result in hull loss or loss of life. CRM/DRM skills are not effective.
2 Below Standard	Deviations from the prescribed qualification standards occur that are not recognized or corrected. Individual or crew performance is safe but would be unsatisfactory if diminished by any amount. CRM/DRM skills are not completely effective.
3 Standard with Debrief	Deviations occur from the prescribed qualification standards that are recognized and most corrected. Individual or crew performance meets expectations. CRM/DRM skills are effective.
4 Standard	Minor deviations occur from the prescribed qualification standards that are recognized and corrected in a timely manner. Individual or crew performance meets expectations. CRM/DRM skills are clearly effective.
5 Excellent	Performance remains well within the prescribed qualification standards. Individual or crew performance, management and CRM/DRM skills are exemplary.

The benefits of the improved data would extend to the FAA and their ability to track the program and issues in performance. If a standardized program is used, it will further allow the FAA and other air carriers to perform evaluations between air carrier programs. The DOT OIG still has an open finding against the FAA to “[d]evelop a standardized procedure for air carriers to report failures of pilot proficiency checks, as well as remedial and recurrent flight training to FAA, and require inspectors to monitor trends and target surveillance to highest risk areas.”²⁹ Further, a standardized program for data sharing and recording will also support the DOT OIG report finding to “Develop and implement guidance requiring inspectors, or their designees, to verify that check pilots have met training requirements prior to performing recurrent observations.” APQ’s job task assessment creates a means for FAA inspectors to review training records and quickly assess if check pilots have met their requirements.

²⁸ FAA Advisory Circular 120-54A, Section 3, Figure 2-4

²⁹ U.S. Department of Transportation Office of Inspector General. (December 19, 2017). *FAA Oversight Is Not Keeping Pace With the Changes Occurring in the Regional Airline Industry* (Report No. AV2018012). Retrieved from <https://www.oig.dot.gov/sites/default/files/Final%20Report-Regional%20Airlines-AV2018012.pdf>

The IBT maintains that the benefits of AQP are numerous. The focus on competency-based training and testing, good data collection, and operating in a CRM environment are of great benefit. AQP has been widely adopted by Part 121 carriers and is considered a normal method of training in the U.S.

6. Atlas's Corporate Structure and FAA Oversight

Atlas is part of Atlas Air Worldwide Holdings ("AAWW") and operates under one of three air operating certificates held by this holding group. The other certificates are held by Polar Air Cargo ("Polar") and Southern Airways ("Southern"). The management and administrative teams for all three carriers work interchangeably with respect to operational control. Additionally, AAWW operates an aircraft leasing company called Titan Aviation Leasing ("Titan").

AAWW operates Atlas and Polar with a single pilot group and most manuals combined or mirrored to meet the requirements of the FAA. Atlas and Polar maintain three separate Part 119 required positions under AAWW, one set for each certificate. Southern was purchased in the first quarter of 2016 and AAWW has been working to merge Southern and the combined Atlas and Polar pilot group into one. AAWW appears to have completed the work related to unifying the manuals, though various legal hurdles with the pilot groups remain. The pilots of Atlas/Polar were granted their own local, Local 2750, under the International Brotherhood of Teamsters union.

Atlas operates in the Aircraft Crew Maintenance and Insurance ("ACMI") segment of the airline industry. In the ACMI segment, also known as "wet leasing", the lessor provides ACMI in exchange for payment on the number of block hours operated. Amazon.com Inc. contracted with AAWW for CMI and dry leasing of 20 Boeing 767-300 Freighters for its Prime Air operation. Titan provided the airframes for this operation. Each component was of different terms and was not seen as relevant to this submission. Amazon's role in operations generally involved setting city pairs, flight times and general operational procedures that Atlas integrated into its operation of the aircraft.

The FAA certificate management oversight responsibility for Atlas originates from the Dallas Flight Standards District Office ("FSDO"). The certificate was moved from the New York FSDO to the Cincinnati FSDO and now is held in the Dallas FSDO. The IBT has no information available to analyze the reasons for the multiple changes in the past few years; personnel changes associated with the Certificate Management Office have similarly occurred during this time period.

7. Pilot Staffing

Under the AAWW Holding company, Atlas has experienced a great deal of change and growth in recent years. During the past few years, Atlas has gained and lost several contracts, added aircraft, and purchased Southern with the intent of merging. All of this has occurred during a period of protracted pilot contract negotiations and increasing tension between labor and management. Atlas has been involved in multiple lawsuits with its pilots. Studies indicate a

growing pilot shortage³⁰, and Atlas has struggled to fill vacant pilot positions.

The IBT tracks staffing as a normal part of its duties of representation, and staffing levels have been a concern both before and after the accident. Atlas and Polar have had high turnover in recent years. During the years leading up to this accident, the regularly stated goal was to grow the company to 2000 pilots. Staffing levels have never achieved that level.

The figures below show the actual numbers taken from IBT's processing of the regularly issued company pilot seniority list, stated class sizes, and actual results. The charts were developed based on data the IBT obtained from Atlas. The information presented in figures 2, 3, and 4 are a compilation of the seniority lists produced by Atlas on a regularly recurring schedule and the information provided to the IBT on new-hire classes. The figures below indicate that there have been challenges in staffing the airline. Significant losses of pilots occur at an average rate of 16.7 per month. The IBT finds that these numbers echo the challenges that Atlas is facing in recruiting and retaining sufficient numbers of pilots to maintain its operations.

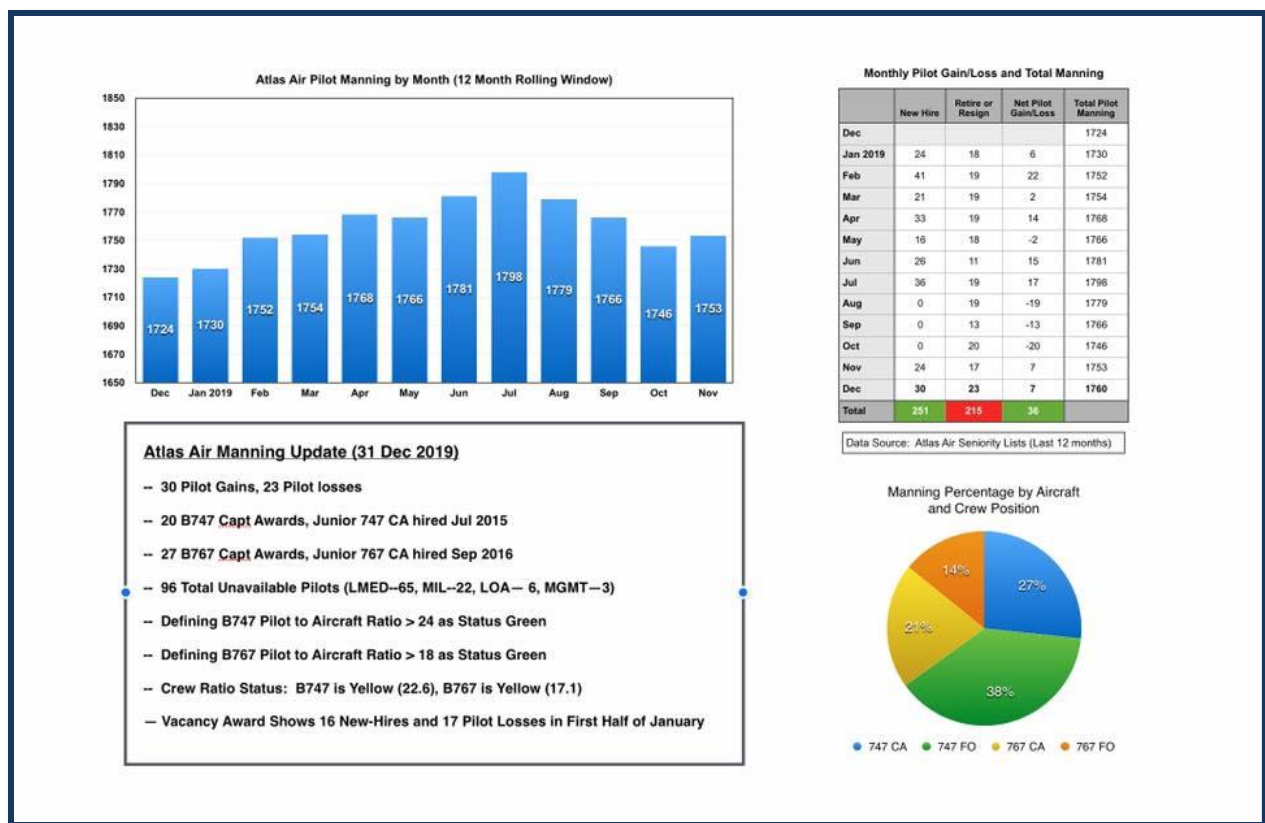


Figure 2

³⁰ Retrieved from <https://www.reuters.com/article/us-airlines-iaa-pilots-analysis/airlines-struggle-with-global-pilot-shortage-idUSKCN1J20XK>

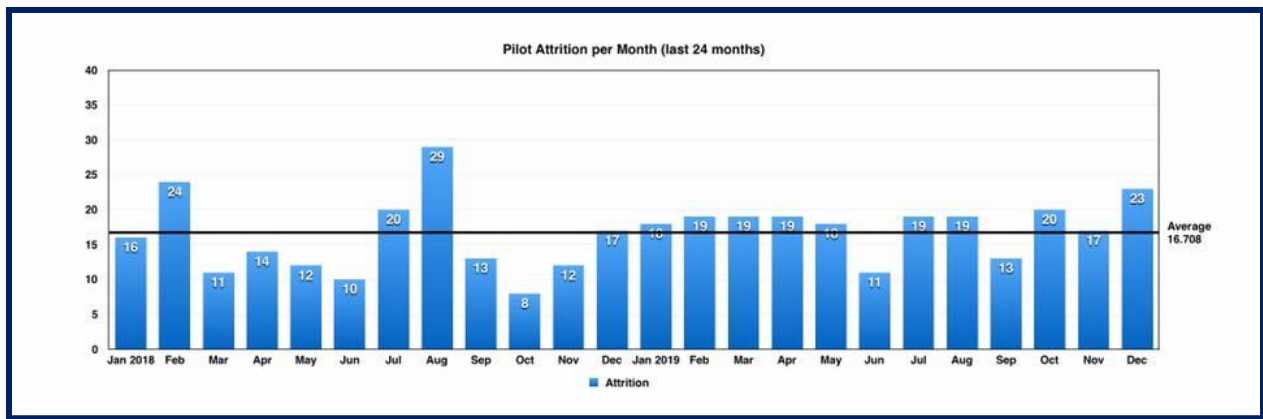


Figure 3

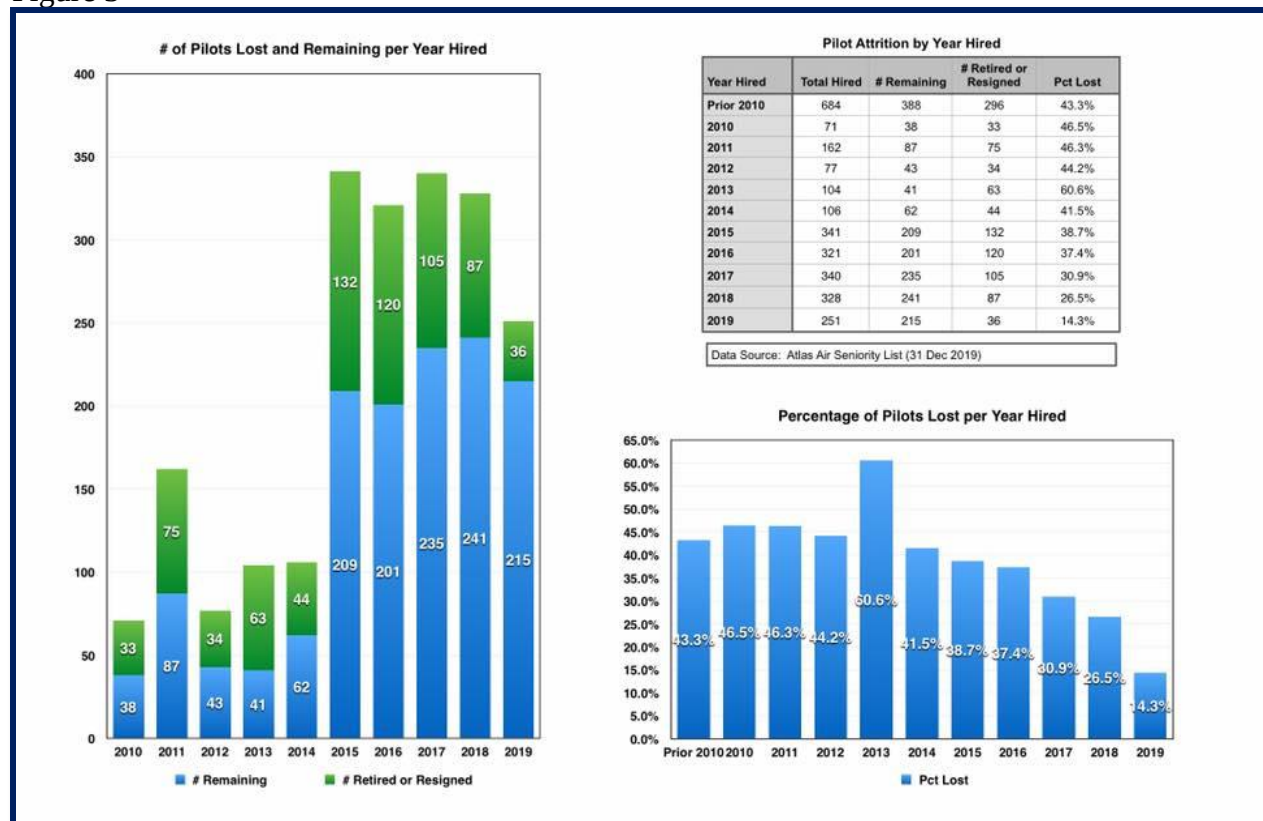


Figure 4

Senior flight management has also expressed concerns about the supply of experienced pilots, as reflected in statements by then Senior Vice President of Flight Operations at Atlas, Jeff Carlson. “At the 2017 meeting, Senior Vice President of Flight Operations Jeff Carlson agreed with the Captain’s assessment. “I worry about quotas on the flight deck,” he said, according to the recording obtained by the Miami Herald. “I’m not oblivious to any of that...We know experience level decreases over time. That’s a challenge for this group...”³¹

In recent years, the company had several serious incidents with its aircraft:

- July 2017, Tokyo: B747-8 nearly overran the runway on takeoff³²
- September 2017, Hong Kong: B747-8 turned wrong direction on takeoff, near collision

³¹ Retrieved from <https://www.miamiherald.com/news/business/tourism-cruises/article230569724.html>

³² This flight was operated as Polar Air Cargo. See: http://www.mlit.go.jp/jtsb-eng-air_report/N852GT.pdf

with terrain³³

- July 2018, Portsmouth, New Hampshire: B767-300 hard landing resulted in significant aircraft damage³⁴
- August 2018, Hong Kong: double engine pod strike on landing³⁵
- October 2018, Cincinnati, Ohio: runway excursion³⁶

During the period these accidents/incidents occurred, a change was made to the training program that reduced the monitoring of pilots with training issues in the PWP³⁷.

This change to the PWP occurred at the same time as now-retired FAA inspector, David Lithgow, former Principal Operations Inspector (“POI”) for Atlas, expressed his concerns to FAA management about strains on the Atlas training department and the need for additional oversight. In an interview with the Miami Herald, Lithgow stated:

“Before I retired from the FAA, I had oversight responsibility for 100-plus flight instructors and check pilots at Atlas Air. While this cohort of training and checking personnel was the best I had worked with during my 50 years in aviation at several US Air Force units and six airlines, I was concerned about their increasing level of stress due to the pace of their activities. I urged my FAA managers to initiate a Risk Management Program in order to provide more resources for surveillance of and support for the Atlas training program but failed to make it happen. I confess that my frustration with lack of FAA support for my program facilitated my decision to retire.”³⁸

The FAA POI overseeing Atlas at the time of the accident also provided information on these issues in response to the NTSB’s request.³⁹ In her response, the POI stated she had received over one hundred (100) notices of unsatisfactory performance for Atlas pilots in her two years as POI⁴⁰. In 2016,⁴¹ as the Assistant POI on the Southern Air Certificate, she was present at a meeting with check airmen for a presentation from AAWW executives. During this meeting they discussed, “the lack of experienced pilots in the near future was discussed as an issue that the company, and the industry, had been experiencing for some time. Since that time, the subject has come up on numerous occasions and in numerous discussions among the management, the training staff, the pilot group, and with the FAA. It was stated that the minimum experience level that they could demand for new hires had dropped considerably, and that pilots that have never flown anything larger than a small, twin-engine turboprop were currently being hired to fly B747s on international routes.” It continues, “It was indicated that due to the lack of experience

³³ Retrieved from <http://avherald.com/h?article=4aede2af>

³⁴ NTSB Accident DCA18CA252

³⁵ Retrieved from <https://www.info.gov.hk/gia/general/201809/28/P2018092800576.htm>

³⁶ Retrieved from <https://aviation-safety.net/wikibase/216510>

³⁷ See the PWP section.

³⁸ Retrieved from <https://www.miamiherald.com/news/business/tourism-cruises/article230569724.html>. The Operations Group requested that Lithgow be interviewed as part of the NTSB investigation, but the request was denied.

³⁹ See Operations Group Attachment 17.

⁴⁰ One of these responses was for the First Officer’s failure on his B767 Type Ride.

⁴¹ The POI states it was three years ago, and at the time of writing it was 2019.

in larger aircraft, the failure rate, as well as the increased need for additional training following unsatisfactory check rides, had increased.”

The POI also described that she was aware of the pilot losses to other carriers, increased times to complete Operational Experience (“OE”), and that new-hire classes were experiencing no-shows of pilots who had been offered employment. She also explained that, “Atlas has experienced staffing issues for existing flights in the past and at times has had difficulty meeting the demands of the continuous worldwide flight schedules.”

The POI concluded, “I have no definitive data that correlates incidents in the aircraft to low experience or a lack of proficiency among the flight group. However, that specific issue has not been directly investigated to try to determine an answer to that specific question. Lack of experience by pilots entering the Air Carriers at this level is an issue that has been recognized and discussed industry-wide and by the FAA in national forums, and is an area of concern to all.”

The statement from the then FAA POI lacks any information or discussion of an increased level of monitoring. The DOT OIG in December 2017 released a report entitled, “FAA Oversight Is Not Keeping Pace With the Changes Occurring in the Regional Airline Industry.”⁴² This report details issues related to FAA oversight. While Atlas is not a regional airline, it does grapple with many of the same challenges, such as multiple contracts with larger airlines, lower experience pilots, and high numbers of contracted vendors handling the operational needs of the airline. The report had a total of ten recommendations for FAA response, but at the time of this writing only one had been closed.

The FAA has a program contained in FAA Manual 8900.1, Volume 6, Chapter 2, Section 18⁴³. In a section called, “Evaluation of Air Carrier’s Management of Significant Changes” it details monitoring programs for FAA inspectors to conduct to detect unsafe situations before they develop. The manual states Flight Standards (FAA) personnel should ensure the certificate holder is able “to ensure that the carrier is appropriately managing these risks consistent with the changing conditions.” The manual describes “Leading Indicators” that should be monitored that include: “Noticeable turnover in personnel, or Changes in experience, training, or proficiency of personnel.” Lagging Indicators can include “Significant shifts in stock prices due to investor concerns.”⁴⁴ The manual goes on to say that the carrier may need to be evaluated due to “General Stressors.” These can include items like; “Labor unrest, difficult contract negotiations, work slowdown, Merger/takeover, change in corporate structure, personnel, or culture, Competition changes in key routes, Changes or reductions in the workforce..., Changes in operational control systems, Changes in program or subsystems that are part of the operational control system...”

In the last several years the structure that maintains operational control has undergone significant

⁴² Retrieved from <https://www.oig.dot.gov/sites/default/files/Final%20Report-Regional%20Airlines-AV2018012.pdf>

⁴³ http://fsims.faa.gov/wdocs/8900.1/v06%20surveillance/chapter%2002/06_002_018_chg_0c.htm

⁴⁴ AAWW Stock price has decreased in 2019 from \$60.31 on 20 Feb 2019 to \$20.96 on 8 Oct 2019. Source, google.com stock price search.

changes. The Systems Operations Control was split between Purchase, New York and Florence, Kentucky near the Cincinnati Airport where Atlas maintains an operation hub and pilot base. The FAA POI described knowledge of shortfalls in staffing, changes in experience levels of incoming pilots, increased failure rates, increased OE completion times, and general concerns over the direction of the company in the view of the check airmen at Atlas. She also noted that they are in fact in a formal merger situation between Atlas and Southern. There are numerous articles in the media that have detailed a long and contentious battle between the pilots' union and the company over the contract negotiations that started in 2016. The IBT has found no evidence of the FAA initiating increased surveillance of the carrier in relation to this part of the FAA's 8900. The DOT IOG's open finding against the FAA in the report on the regional airline industry states that the FAA should, "[u]pdate the scoring system and instructions in the Financial Condition Assessment Decision Aid to reflect that 10 characteristics are being evaluated."

Through its review, the IBT has seen that there are a significant number of signals that there is an organizational risk level at Atlas that should be evaluated and monitored. The FAA's apparent lack of response to this in light of the multiple incidents and accidents, the documented financial stress on the company due to its declining stock price, and the FAA's own knowledge of Atlas' internal issues all call into question whether the appropriate metrics are being reviewed and analyzed for evaluating the safety levels at Atlas.

8. First Officer's Employment History

Figure 5 below depicts the First Officer's employment history based on documents provided to Atlas for his employment application as well as information collected by the NTSB Operations Group. The First Officer reported that he had been a student and/or worked as a freelance real estate agent between June 2010 and January 2013. However, the investigation revealed employment by two otherwise undisclosed airlines,⁴⁵ CommutAir and Air Wisconsin, during this reported gap of employment. Neither airline was listed on his employment application for Atlas nor on his PRIA requests. Another gap in employment was reported from September 2014 until February 2015 with no explanation given.

During his employment at Trans States, he received a notice of disapproval for his EMB145 oral exam on April 22, 2014, and a notice of disapproval for his EMB145 type rating on May 11, 2014. Both exams were subsequently passed on April 26, 2014 and May 12, 2014 respectively. The IBT would like to note that OE was never competed at Trans States. During his employment at Mesa, he failed to complete upgrade training on the EMB 175.⁴⁶

⁴⁵ Gaps still exist in his 10 year background check as found by the investigation's work.

⁴⁶ See NTSB Record of Conversation with Leigh Lawless, Mesa Air Captain; Paul Allred, Mesa Air Captain and Check Airman; Lida Swan, Mesa Air Captain and Former Check Airman.

First Officer Employment History

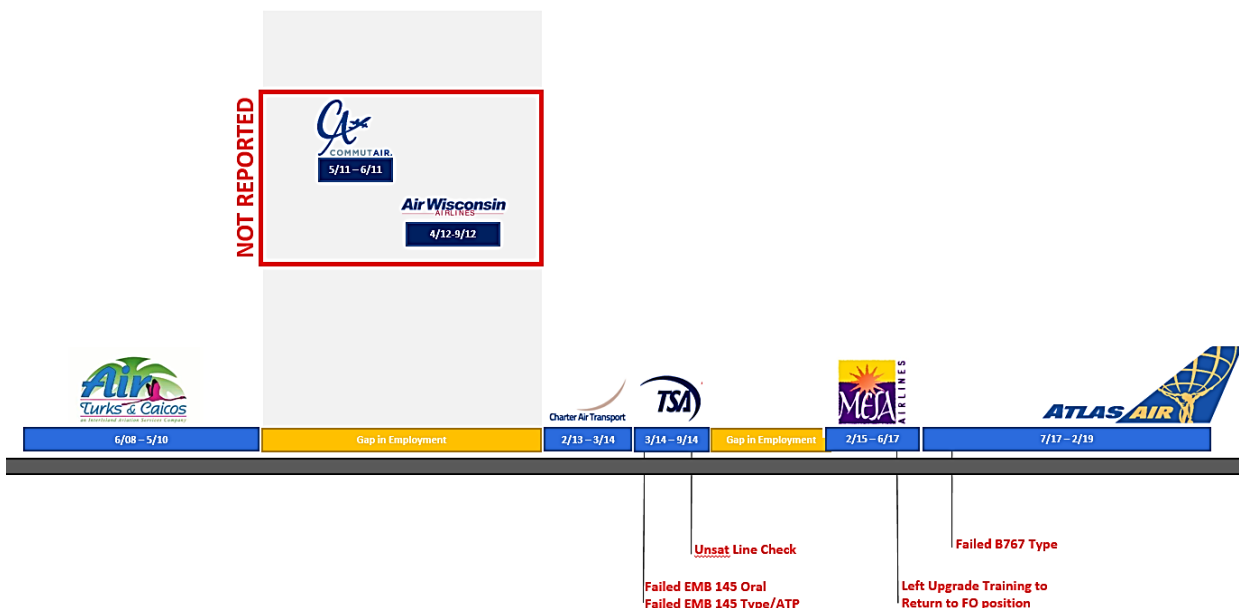


Figure 5 – First Officer Employment History

9. First Officer’s Training History at Atlas

The First Officer was hired by Atlas on July 3, 2017. He successfully completed basic indoctrination training on July 7, 2017 and Boeing 767 ground school training on July 22, 2017. On July 27, 2017, in a training session that acts as a gateway, he was not recommended to take his B767 oral examination. The records⁴⁷ indicate that he needed remedial training in “1) Emphasis on TLR performance⁴⁸ [and] 2) Aircraft Systems Review”. No further details are provided in the records. This four-hour training period was completed on July 28, 2017 and he subsequently passed his oral examination on July 29, 2017.

The First Officer then proceeded to FBS training. During these training sessions, the instructors noted numerous deficiencies in situational awareness and completion of normal procedures. On the fifth FBS session on August 5, 2017, which acts as a gateway, the First Officer was not recommended⁴⁹ to proceed to FFS training. The records indicate he needed remedial training in “Normal procedures from Power-up to Shutdown, Cold Weather, Low Visibility Taxi, FMC Route Modifications, Descent Flow, Multiple Non-Normals to include a Flap, Slat problem”. This remedial training was accomplished on August 8, 2017 and the First Officer proceeded to FFS training.

⁴⁷ See Operations Attachment 12 - Atlas Training Records - First Officer

⁴⁸ TLR Performance is the Takeoff and Landing Report. This document is part of Flight Releases and includes data related to aircraft performance at planned and above planned weights for the runways at the specific airport. It is used to calculate power settings and speeds in the event that ACARS performance information is not available.

⁴⁹ See Operations Attachment 12 - Atlas Training Records - First Officer

Two FFS training sessions were completed.⁵⁰ The instructor notes include “Review normal procedures: callouts, flows, checklists...” as well as “overall aircraft control basics”. In an interview with the Atlas Fleet Captain, the NTSB Operations Group⁵¹ was informed that the First Officer’s simulator partner had complained about being “held back” by the First Officer and requested a different simulator partner. After a delay in finding adequate coverage, Atlas restarted the First Officer’s training in the FFS on August 27, 2017. The instructor notes for these sessions are for the most part unremarkable. There is a two-week gap between FFS-5 and FFS-6 that was attributed to a training center shutdown due to Hurricane Irma.

On September 22, 2017, the First Officer received a notice of disapproval on his B767 type ride. During this check ride, the examiner notes state “Non-precision approach. Incorrect procedures. Unstable approach / Steep turns. Exceeded all PTS limits / CRM/TRM. During emergency, ignored PM [pilot monitoring] attempts to address emergency / Judgment. Situational awareness very low. Oversped flaps on departure. Easily out of sequence procedurally leading to questionable decisions.” During the NTSB Operations Group interview with the examiner, it was noted that this performance was not typical of most B767 first officer candidates.

On September 25, 2017, the First Officer received remedial training in the B767 simulator with no instructor notes other than that everything required for training was completed satisfactorily. On Sep 26, 2017, the First Officer successfully completed his B767 type rating. There were no examiner notes on the examination form. The First Officer was not placed in Atlas’s PWP⁵².

Between October 26, 2017 and November 22, 2017, the First Officer received his initial OE on a series of flights totaling 53:07 hours of flight time. The instructor notes for these flights are unremarkable.

Recurrent simulator training was successfully accomplished on February 17, 2018, July 7, 2018, and January 7, 2019 with no significant instructor notes.

⁵⁰ See Operations Attachment 12 - Atlas Training Records - First Officer

⁵¹ See Operations Attachment 1 - Atlas Air Interview Transcripts interview of Joseph Diedrich

⁵² See section on Proficiency Watch Program

First Officer Atlas Training Record

Initial Training		January 2018 100 hours in aircraft February 2018 RLOFT	July 2018 Recurrent ground school PC Warmup PC	January 2019 RLOFT
July 2017 - Basic Indoc - Ground School - SIT - Oral Rec – Not recommended to proceed - Oral Rec – Remedial - FBS1 August 2017 - FBS 2 - FBS 3 - FBS 4 - FBS 5 – Not recommended to proceed - FBS 5 – Remedial - FFS 0 - FFS 1 - FFS 0 – Restarted sequence - FFS 1 - FFS 2 - FFS 3	September 2017 - FFS 4 - FFS 5 - FFS 6 - FFS 7 - B 767 Type Rating – Fail - FFS 8 - FFS Training – Remedial - B767 Type Rating – Pass - LQT - CAT II/III Training October 2017 - Right Seat Landing Training - OE Started November 2017 - PM Line Check - PF Line Check - OE Completed			

Figure 6 – First Officer Training Record

10. Captain's Training History at Atlas

During his initial training as a first officer at Atlas, the Captain required a total of three extra simulator sessions and some additional flight hours of OE.

During the FFS section of his training, he had to repeat the second and fourth simulator sessions to receive additional training in non-precision approaches and engine failure on takeoff procedures. This training was ultimately completed successfully.

He required additional training before being recommended to take his type rating ride. The instructor notes deficiencies in flows/procedures/profiles on approaches, as well as stalls and MCP/FMA procedures. This additional training was successfully completed the next day and the type rating was subsequently passed.

During his OE flights, the Check Airman requested authorization for additional flight training to prepare him for his line checks. There are no instructor notes that indicate why this was the case. The extra legs were granted and he subsequently passed his line checks. He was entered in the Atlas PWP⁵³ and successfully completed it.

In 2018 the Captain entered upgrade training. From his initial 2015 training until his upgrade 3 years later show normal progression with no remedial training required.

⁵³ See Proficiency Watch Program section

11. Early Flap Extension

On the B767, go around mode is armed when the flaps are out of the up position. In the accident flight, the flaps were set at flaps 1 approximately forty-four nautical miles from the Houston airport, thereby arming go around mode. There is no discussion on the CVR as to why flaps were extended at that point. The Atlas 767 FCOM Volume 1 calls for flaps to be extended twelve to fifteen miles from touchdown.

PF	PM
12-15 miles from touchdown:	
Call "FLAPS 1, SET SPEED" *.	Position flaps as directed. RNP (GPS) approach only - Update the RNP as needed. Check for proper flap indications. *Set speed in the MCP.

The Boeing Flight Crew Training Manual (“FCTM”) and similarly the Atlas FCOM recommends the flaps remain up until approximately the same distance from the airport. The Atlas FCOM states, “Plan the descent to arrive at traffic pattern altitude at flaps up maneuver speed approximately 12 miles from the runway when proceeding straight-in or about 8 miles from the runway when making an abeam approach.”

Giant 3591 encountered light to moderate turbulence while descending into the Houston area. This was due to conditions brought about by convective weather associated with a cold front. (see Meteorology/ATC Group section) This turbulence was indicated by accelerations recorded on the FDR. The crew should have expected this turbulence both from the weather radar presentation in the cockpit and visual cues outside the window of the aircraft. Atlas’ guidance for operations in severe turbulence states: “[d]elay flap extension in an area of known turbulence as long as possible because the airplane can withstand higher gust loads in the clean configuration.”⁵⁴ The flight did not encounter severe turbulence, but an aircraft in a clean configuration has higher wing loading which provides a more stable ride.

It is unknown why the flaps were extended at this stage in the accident flight, but the IBT believes it may have been due to a common misconception that the flaps 1 setting will help increase descent rate. This is in not in accordance with Atlas’ recommended procedures in the FCTM: “The flaps are normally not used for increasing the descent rate. Normal descents are made in the clean configuration to pattern or instrument approach altitude.” The early selection of Flaps 1 was considered to be unusual by the IBT.

⁵⁴ Severe Turbulence Guidance found on page Atlas FCOM SP.16.33 (Atlas, May 22, 2018)

12. Stall Recognition

At the beginning of the accident sequence, the CVR recorded the following exchange:

12:38:44.0	CAM	[Sound similar to a mechanical click]
12:38:45.0	CAM-2	woah. [Spoken in elevated voice]
12:38:45.9	CAM-2	(where's) my speed my speed [Spoken in elevated voice]
...		
12:38:48.0	HOT-2	we're stalling. [Spoken in elevated voice]
12:38:50.5	HOT-2	stall. [Exclaimed.]

At the time of the comment about speed, the aircraft's speed according to FDR data was 265 knots and increasing. At the time of the stalling comment, the FDR recorded a speed of 275 knots and increasing, as well as a pitch angle of 23 degrees nose down. The aircraft was not in a stalled condition. Based on the above comment about stalling, it appears that the First Officer believed the aircraft was stalling, despite the contrary airspeed and pitch indications. Assuming that the displays were indicating correctly⁵⁵, it is unclear why he believed the aircraft was stalling.

During the investigation, the IBT reviewed stall training across the industry and found that while stall recovery is trained extensively, stall recognition is not. Most stall recognition training occurs much earlier in a pilot's career, during private pilot training. The FAA's Aircraft Flying Handbook ("AFH")⁵⁶ is used extensively during private pilot training. Chapter 4 of the AFH discusses stall recognition and states:

Stall Recognition

A pilot must recognize the flight conditions that are conducive to stalls and know how to apply the necessary corrective action. This level of proficiency requires learning to recognize an impending stall by sight, sound, and feel.

Stalls are usually accompanied by a continuous stall warning for airplanes equipped with stall warning devices. These devices may include an aural alert, lights, or a stick shaker all which alert the pilot when approaching the critical AOA.

It continues on to list other sensory cues that a pilot may use to identify a stall: feel, vision, hearing, and kinesthesia. These other cues all have shortcomings, however as discussed below.

⁵⁵ See discussion of display anomalies in EFI Switch section.

⁵⁶ FAA-H-8083-3B. Retrieved from

https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/airplane_handbook/media/06_afh_ch4.pdf

- **Feel** – The AFH states “the pilot will feel control pressures change as speed is reduced”. On a transport category aircraft such as the 767, hydraulics and systems such as rudder ratio compensation and aileron lockout tend to mask such feel in the control column.
- **Vision** – The AFH states “since the airplane can be stalled in any attitude, vision is not a foolproof indicator of an impending stall.” In this accident, the aircraft was most likely not in visual conditions at the beginning of the accident sequence so the only visual cues would be from the instrumentation.
- **Hearing** – The AFH states that “as speed decreases, the pilot should notice a change in sound made by the air flowing along the airplane structure. However, transport category aircraft cockpits are inherently noisy and with the advent of noise-canceling headsets, hearing is not a reliable indicator of speed.
- **Kinesthesia** – The AFH states that “seat of the pants” sensations can warn a pilot of an impending stall. These sensations are notoriously unreliable in instrument conditions, especially when combined with turbulence.

The sensory cues to detect an impending stall as per the AFH were likely insufficient or simply unavailable here. Instead, the principal information available to the pilots to determine if a stall was occurring would have been from the aircraft’s instruments and the aircraft’s stick shaker warning system. As discussed below in the EFI Switch section, the aircraft had previously experienced an instrument malfunction in the form of a symbol generator failure. It is possible that this may have led the pilots to mistrust their instruments. It is the opinion of the IBT that the possible explanation of the First Officer’s statement “we’re stalling” is that a combination of inadequate stall recognition training and somatogravic illusion⁵⁷ created confusion about the aircraft state.

B. SYSTEMS GROUP

1. Autopilot Does Not Disconnect

Discussions with Boeing’s Air Safety Investigation team revealed that the autopilot system is designed such that control column input force that overrides a single channel autopilot servo on the 767-300 will not result in autopilot disconnect, but rather an illumination of the autopilot caution light.⁵⁸ A review of the Boeing 767 manual reveals no notes or cautions to this effect. However, in the simulator training environment the built-in protections of simulator control loading will disconnect the autopilot and release the control columns when excessive force is applied during a maneuver or malfunction of the simulator control loading.

The IBT investigators believe this difference has the potential for a ‘negative learning’ transfer from the simulator training environment to actual line flying. While it did not appear to have a direct impact on the accident, the Boeing 767 manuals should be corrected to highlight this system architecture difference for all operators.

⁵⁷ See Somatogravic Illusion section.

⁵⁸ Emails exchanged between NTSB, Boeing and IBT Systems Group members starting 05 Sept 2019.

2. EFI Switch and Symbol Generator Malfunction

Investigators have been unable to determine the exact failure scenario that required the rapid transfer of controls back and forth between the First Officer and the Captain. Based on a review of the CVR, it appears there may have been a right symbol generator failure of the First Officer's EFIS⁵⁹ screens. Selecting the EFI switch to ALTN⁶⁰ mode would have sourced the center symbol generators. Since this EFI switching event occurred so close to the final upset event, it is possible that the First Officer may have mistrusted his EFIS screen readings and relied instead on sensory input as to aircraft attitude. This EFI/symbol generator event should not have affected the round-dial (analog) airspeed indicators on either pilot's instrument panel or the backup ISFD in the center left panel for airspeed/attitude crosschecking purposes.

3. Go Around Switch Armed with Flaps Out of "Up"

The current Boeing design logic arms the go around mode when the flaps are out of "up". Operators are encouraged by the Boeing FCTM⁶¹ to delay flap extension under normal conditions until pattern altitude or initial instrument approach altitude. The FCTM states that the flaps should not be used to increase descent rate. The Atlas FCOM recommends flap deployment 12-15 miles from touchdown.⁶²

At the beginning of the accident sequence, the flight was approaching an area of turbulence. Air traffic control requested that the crew expedite the descent. The crew selected flaps 1 approximately forty-four miles from the airport, which automatically armed go around mode. It is unclear to the investigators why the crew selected flaps 1 at this time. This configuration would decrease wing loading and increase the turbulence felt by the crew.⁶³ FDR data indicates that the descent rate did not appreciably increase with the selection of flaps 1.

Speedbrakes were extended to expedite the descent. Atlas' manuals recommend that the flying pilot hold the speedbrake handle while speedbrakes are deployed. In this situation, the First Officer's arm could be located behind the throttles. A turbulence encounter could jostle the pilot's arm and cause the go around switches to be inadvertently activated. Boeing switch logic does not provide any other parameters such as a maximum radio altimeter altitude to limit the activation of go around mode. Less than thirty seconds elapsed between the First Officer calling for flaps 1 and the activation of go around mode.

⁵⁹ EFIS is the short term for Electronic Flight Information System that replaces mechanical instruments.

⁶⁰ ALTN is the Boeing label on certain switches or buttons for an Alternate mode.

⁶¹ Boeing FCT 767 (TM) dated June 30, 2019 "Speedbrakes" / "Flaps and Landing Gear" sections page 4.2

⁶² Atlas Air 767 FCOM Vol. 1, SMAC.70.1 Descent Planning and Atlas Air FCOM Vol. 1, NP.50.2 2

⁶³ See section on Turbulence Penetration - Boeing FCTM 1.50 Atlas FCOM SP.16.31-SP.16-32

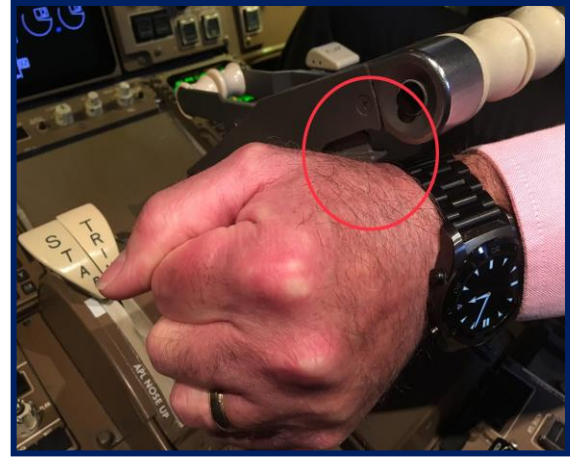


Figure 7 B767-300 Go Around Switches side view.

Source: NTSB

4. Difference of Design of Boeing 767-400 Throttle Quadrant

The 767-400 is a direct outgrowth of the 767-300, with additional capacity via fuselage lengthening, modified and larger wingspan, and an update of the flight deck displays. The most relevant design change for this accident investigation is the changes that occurred to the go around switch placement as depicted in Figures 8 and 9.

The arming of the Go Around switch is the same on both models. Boeing's "AERO" publication⁶⁴, details these, and other changes, between the baseline B767-200/300 and the B767-400ER.

"The flight control column is unchanged from the 767-300, but the control stand hardware more closely resembles the hardware on the 777. The thrust levels are 777 style, but they incorporate a new takeoff/go-around (TO/GA) switch that can be actuated by pressing the switch on the back of the thrust lever (current 767 procedure) or by using TO / GA paddles on the front of the thrust lever (777 procedure) The flaps and speedbrake controls are similar in appearance to the 777 controls and perform the same function as the 767-300 controls."

⁶⁴ Retrieved from: http://www.boeing.com/commercial/aeromagazine/aero_09/flight_story.html



Figure 8- B767-400 Center Console and New TO/GA Switch, image from Boeing “AERO” publication, Issue 9, page 5,6 dated January, 2000

The B767-400ER TO/GA switches are better “masked” than the B767-300 accident aircraft as shown in Figures 8 above and 9 below. The -300 switches actuate in an upward direction whereas the -400 aft switches actuate forward. The switch action on the -400 design would inherently be less prone to inadvertent activation.

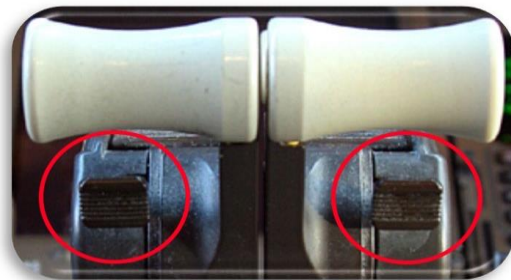
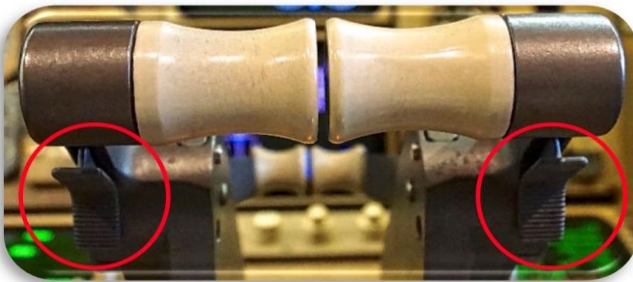


Figure 9 -B767-300 Go Around Switch Left. B767-400 Take Off Go Around Switch Right. (Source Google Images)

5. Limitations of Recorded FDR Data on the Accident Aircraft

The FDR recorded only limited parameters on the Accident Aircraft. Air data computer outputs are recorded, but there is no recording of the data that is sent to the pilots’ EFIS screens or round-dial (analog) instruments. As such, the investigators are unable to confirm what was actually displayed on the pilots’ instruments during the accident sequence.

Based on CVR transcripts, there appears to have been a malfunction in the First Officer’s EFIS screens. However, EFI switching is not monitored by the FDR. Furthermore, the First Officer’s

(right side) control column position was not monitored on the Accident Airplane, and neither side had control column force monitored. The lack of confirmatory data fails to provide a complete picture of information received and control inputs during the accident sequence. While none of these parameters are required to be monitored under current regulations, newer aircraft have more advanced FDRs that serve to provide a broader range of information. There is currently no mandate to retrofit older aircraft with more sophisticated FDRs.

C. HUMAN PERFORMANCE GROUP

1. Excerpt from CVR Transcript

12:38:43.6 **CAM-2** (oh)

12:38:44.0 **CAM** [Sound similar to a mechanical click.]

12:38:45.0 **CAM-2** woah. [Spoken in elevated voice.]

12:38:45.9 **CAM-2** (where's) my speed my speed [Spoken in elevated voice.]

12:38:46.9 **CAM** [Sound similar to louder mechanical click.]

12:38:47.9 **CAM** [Sound similar to multiple random thumping noises.]

12:38:47.3 **RDO-1** okay.

12:38:48.0 **HOT-2** we're stalling. [Spoken in elevated voice.]

12:38:50.5 **HOT-2** stall. [Exclaimed.]

12:38:51.9 **HOT-?** #.

12:38:52.3 **HOT-2** oh Lord have mercy myself. [Spoken in elevated voice.]

12:38:53.3 **CAM** [Sound similar to multiple random thumping noises.]

12:38:53.9 **HOT-2** Lord have mercy. [Exclaimed.]

12:38:55.1 **HOT-2** @Capt. [Spoken in elevated voice.]

12:38:55.7 **HOT-1** what's goin' on?

12:38:56.0 **HOT-2** (Lord)– [Spoken in elevated voice.]

12:38:56.3 **CAM** [Sound of 1000 Hz series of beeps with approximately .25 second spacing begin. Group could not determine if audible sound lasted until end of recording.] ⁴ [see CVR transcript for this footnote]

12:38:56.4 **HOT-2** @Capt. [Spoken in elevated voice.]

12:38:56.6 **CAM-3** what's goin' on? [Spoken in an elevated voice.]

12:38:56.8 **HOT-?** [Sound of rapid breathing.]

12:38:57.4 **HOT-2** @Capt-

12:38:58.1 **CAM** [Sound of quick series of four beeps at 1200 Hz.] ⁵

12:38:58.9 **CAM** [Sound of longer duration pulse tone about 1000 Hz, similar to Siren. Group could not determine if audible sounds lasted until end of recording.] ⁶ [see CVR transcript for this footnote]

12:38:59.4 **CAM-3** * pull up. [Shouted.]

12:39:00.9 **HOT-2** [Unintelligible shout.]

12:39:02.0 **HOT-?** (oh God). [Shouted.] n

12:39:02.0 **HOT-2** Lord * * you have my soul. [Shouted.]

1239:03.9 **END OF TRANSCRIPT END OF RECORDING**

The Captain's actions at the exact moment that go-around thrust was engaged cannot be determined from the data available for analysis. At 12:38:55.7 HOT-1 recorded the Captain asking "what's going on?", which may be indicative of a possible distraction or lack of situational awareness. The crew had recently completed briefing a runway change, and the Captain's attention may have been focused elsewhere while preparing for landing. Task loading for the non-flying pilot during this phase of flight can be high.

Mental workload is defined as "the relation between the function relating the mental resources demanded by a task and those resources supplied by the human operator".⁶⁵ In other words, attention provides the "power" to support information processing, in a way analogous to an engine providing horsepower to move an automobile or to electricity providing the power to a sound amplifier of a home entertainment system. In each case, there are levels of demand that are comfortable, higher levels of demand that are achievable but perhaps can cause strain, and even higher levels of demand that cause breakdown."⁶⁶

The crew had just completed briefing a runway change, and the tasks may have included loading correct approach information into the flight management computer, reviewing taxi diagrams, and analyzing weather. The Captain's distraction may have contributed to partially explain his cognitive delay in assessing the flight path.

It is likely the Captain's attention was not focused on the aircraft flight path when go around thrust was activated. The cognitive delay in processing the changing flight path was potentially due to inattention. This lack of attention when coupled with the physiological response of increased negative G force likely compromised the Captain's ability to accurately diagnose the causal factor resulting from the First Officer's reaction to a "perceived" stall condition.

Regardless of what tasks the Captain may have been completing at the time of the initial upset, it appears that he was not attuned to the aircraft state. The Atlas FCOM cautions against "automatic complacency" and instructs pilot to "[b]e prepared to intervene if the automation is

⁶⁵ See Eduardo Salas & Dan Maurino, *Human Factors in Aviation*, p146-147 (2008)

⁶⁶ See Eduardo Salas & Dan Maurino, *Human Factors in Aviation*, p. 571 (2008)

commanding a maneuver that is not expected.⁶⁷

2. Cognitive Lockup

The IBT's analysis of cognitive lockup in this event is focused on the actions of the First Officer, the pilot flying. It appears the First Officer incorrectly detected an impending stall⁶⁸ due to an increased nose pitch-up moment, an unexpected effect of go around thrust being inadvertently activated. The First Officer's airspeed fixation (cognitive lockup), prevented him from scanning and correctly interpreting other primary instruments, which resulted in an improper response and incorrect flight control inputs. The extreme inputs and subsequent physiological effects limited the First Officer's cognitive process; startle/surprise rapidly transitioned to a flight-or-flight response within seven seconds of the perceived stall.

For pilots, the main effects of the startle reflex are the interruption of the ongoing process and distraction of attention towards the stimulus. These happen almost immediately and can be quickly dealt with if the cause is found to be non-threatening.⁶⁹ The First Officer's response was an immediate application of full forward yoke deflection. A similar response was noted in prior training event at a different carrier.⁷⁰ This is possibly indicative of a rapid cognitive response embedded in his early flight training. The dramatic flight control input, against what would have been significant autopilot pressure, indicates the cognitive path from startle/surprise to a fight-or-flight response was almost instantaneous. The perception of a stall was derived and verbalized within three seconds. Four seconds later the statement: "oh Lord have mercy myself". [Spoken in elevated voice.] would indicate the First Officer had entered a state of fear, therefore triggering a fight-or-flight response.

"A perception of fear can cause a startle reflex to be potentiated (more pronounced) should it occur and attention to become more focused. In a state of fear, very little is required to trigger a full 'fight or flight' response (a startle will probably be sufficient at this point).⁷¹ When we perceive a serious and imminent threat (whether we are already in a high state of fear or not) the hypothalamus initiates a cascade of events (nervous and hormonal) such as increased heart rate and breathing, secretion of adrenaline, and increased sweating. This is called the alarm reaction and is part of 'fight or flight'. These changes immediately prepare the body for action to maximize the chances of survival in the anticipated imminent encounter. No startle is required to activate the fight or flight response, although a startling stimulus may be part of, or coincident with, the same threat.

Reaction to fear, in the opinion of the IBT, played a major role in the responses and subsequent actions of the First Officer. The First Officer's statements and voice as recorded on the CVR

⁶⁷ Atlas-Polar FCOM. Volume 1 Normal Procedure – Introduction NP.10.9

⁶⁸ FDR data indicates almost no airspeed change occurred. However, due to the limitations of the FDR, no information exists as to what the First Officer actually saw on his instruments. In simulator reenactments of this event, an initial slight decrease in airspeed is noted when go around mode is activated.

⁶⁹ See Jarvis, S., Shaw, P., Bagshaw, M., & Cantan, C. (2016). *Flight-crew human factors handbook* [1.2]. Retrieved from <https://publicapp.caa.co.uk/docs/33/CAP%20737%20DEC16.pdf>

⁷⁰ See NTSB Record of Conversation with Christian Hutchcroft, Atlas Captain

⁷¹ Jarvis, p. 64

are indicative of fear. Rapid and abrupt flight control inputs followed, and insufficient time remained for either pilot to analyze the situation and recover.

3. Somatogravic Illusion

Vestibular illusions are covered in the FAA's Pilot's Handbook of Aeronautical Knowledge, which explains somatogravic illusion: "a rapid acceleration, such as experienced during takeoff, stimulates the otolith organs in the same way as tilting the head backwards. This action may create what is known as the "somatogravic illusion" of being in a nose-up attitude, especially in conditions with poor visual references."⁷² "The pilot will then push forward on the control column to control this (imaginary) climb thinking they are lowering the aircraft nose back to level flight, when in actual fact they are lowering the nose into a dive. As the aircraft nose lowers, the aircraft continues to accelerate, generating additional pitch up sensations, causing the pilot to lower the nose even further. Tragically, this illusion normal ends with the pilot commanding the aircraft into a high-speed steep dive and contact with the ground quickly ensues."⁷³

Somatogravic illusion is a hazard that has plagued many parts of aviation. The U.S Navy has grappled with this issue in its carrier operations and all aviators can become susceptible to it, especially in poor visibility. In the case of Giant 3591, the aircraft was flying in the clouds. Data contained in Figure 10 below depicts perceived pitch as generated by the longitudinal acceleration of the aircraft, causing the somatogravic illusion likely experienced by the First Officer. The NTSB specialist used data from the FDR and data transmitted by ADS-B and stored by the FAA. The IBT concurs with the assessments made in the study and wishes to highlight aspects of the report.

The graph in Figure 10 shows actual pitch and perceived pitch in the first block, longitudinal acceleration in "g's" and the status of the go around system in the second block, and pressure altitude and airspeed in the third block. A review of this data in conjunction with Figure 10 in the FDR Specialist Factual Report indicates the dramatic shifts in g-forces experienced by the crew. An initial rapid longitudinal acceleration was followed by a rapid pitch down by the First Officer, which subjected the crew to a less than 1 g flight regime from 12:38:40 almost continuously until 12:38:58. Further, they were in a less than 0 g environment from 12:38:46 continuously until 12:38:52 with about one second of momentary 1 g positive loading before again returning to less than 0 g from 12:38:53 until 12:38:56. At 12:38:58 the crew finally returned to a positive g environment but transitioned straight into a higher g loading than normal flight.

⁷² FAA-H-8083-25B

⁷³ Wilson, T. (1995). *Aircraft Human Performance & Limitations*. Civil Aviation Safety Authority. Retrieved from <http://aviationknowledge.wikidot.com/aviation:somatogravic-illusion>

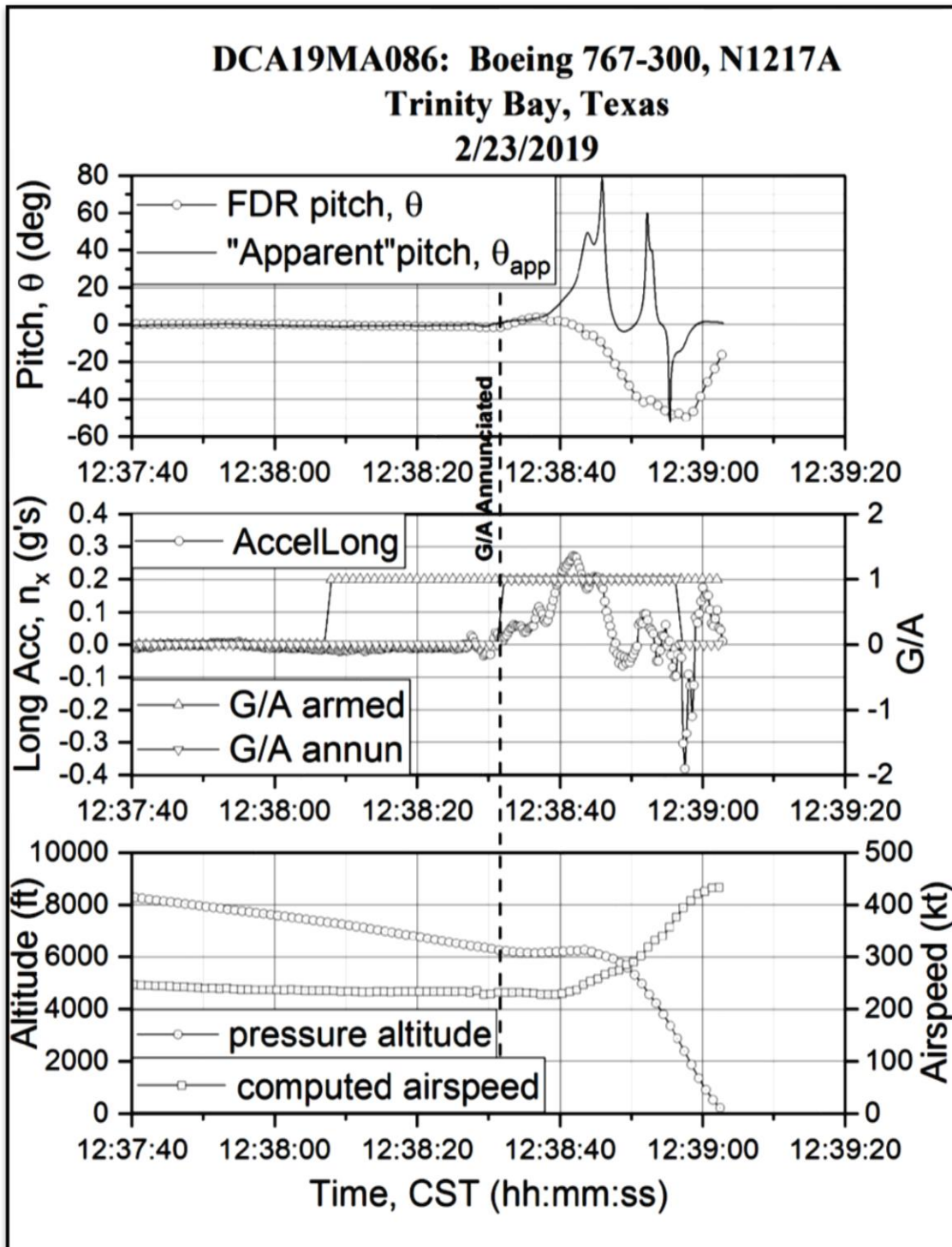


Figure 10

The longitudinal acceleration was caused by the application of full thrust and was calculated to produce up to a perceived +80 degree pitch up. This perceived pitch up caused by the longitudinal acceleration should have been countered by use of the flight instruments. However, as discussed previously, it appears the First Officer may have also been experiencing cognitive lockup and was unable to process the information displayed by the aircraft instruments. A less than 1 g flight regime has been found to be disorienting to pilots, and the issue of negative g disorientation has been cited in cases such as the recent crash of a USAF F15 from Kadena Air Force Base.⁷⁴

As noted in a paper to the Flight Safety Foundation by Captain Simon Ludlow, training and testing for somatogravic illusion is minimal and has been considered ineffective.⁷⁵ NATO countries have a set agreement on spatial disorientation training set forth in “Spatial Disorientation Training – Demonstration and Avoidance”⁷⁶ which includes initial and recurrent training requirements for pilots in NATO. Training programs in other countries such as Singapore have similar initial and recurrent training requirements. Captain Ludlow also noted the limitation of current simulator technology with respect to reproducing the somatogravic illusion in the training environment. Singapore has invested in a high-tech simulator to train pilots to overcome spatial disorientation hazards. This simulator can reproduce a variety of types of spatial disorientation.⁷⁷

The facts suggest that somatogravic illusion played a role in limiting the First Officer’s ability to accurately assess the aircraft’s flightpath. The limited time available to analyze the situation may have ended any meaningful opportunity to recover control of the aircraft by either pilot.

D. METEOROLOGY/AIR TRAFFIC CONTROL GROUP⁷⁸

1. Description of Weather Encountered by Giant 3591

The flight crew encountered turbulence related to a line of convective activity they did not traverse. At the time of the accident, the Houston area was experiencing convective weather driven by a cold front. The convective weather was not appreciably strong, with radar depicted weather tops below FL300. Winds were strong from the southwest ahead of the front.

As Giant 3591 approached the Houston area, the flight crew was advised of the weather conditions in the area by Houston Terminal Radar Approach Control (“I90”). The controller queried the crew about their preferred routing to deviate around the weather and gave them vectors through a gap in the convective activity, as depicted in Figure 11 and Figure 12 below.

⁷⁴ USAF Aircraft Accident Board Report F-15C/TN 84-0008, Kadena AFB, Japan

⁷⁵ Captain Simon Ludlow MRAeS, 2016

⁷⁶ Task Group TG-039

⁷⁷ Mr. Yeo Choon Yong, CSAFE BR, ARMC, 2010

⁷⁸ Meteorology and Air Traffic Control groups were combined, but each group issued a separate report.

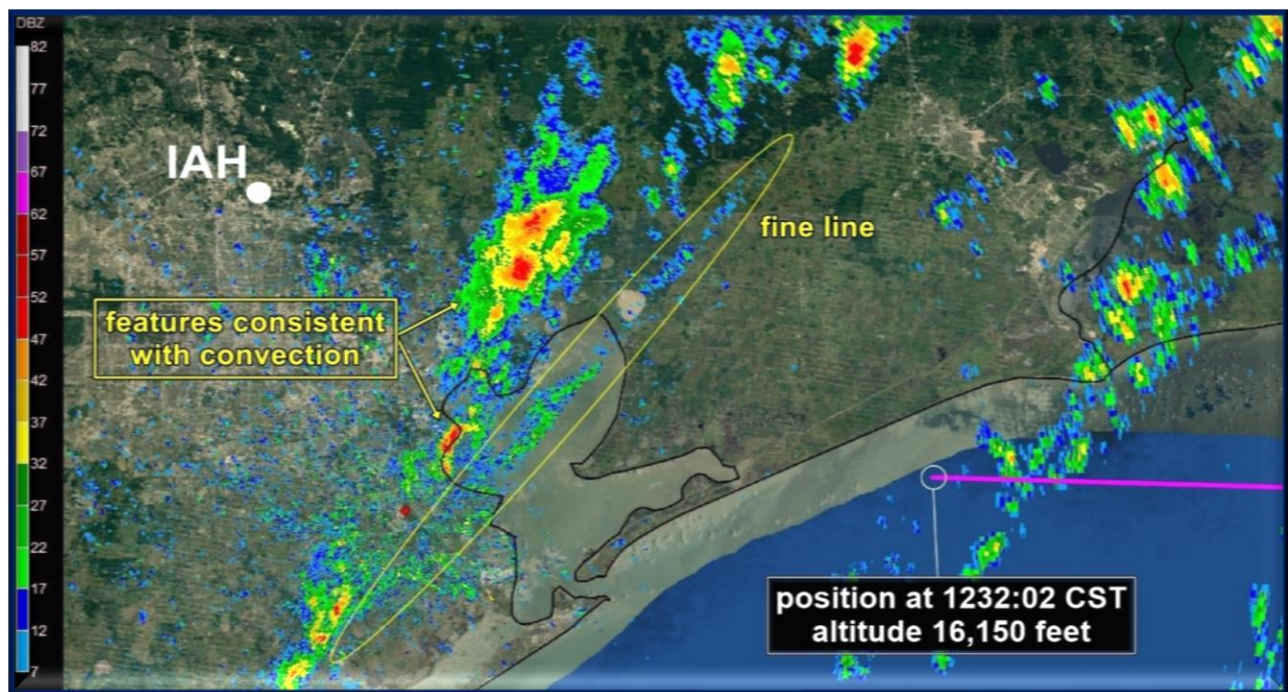


Figure 11 NEXRAD Radar Depiction from NTSB Meteorology Factual Report

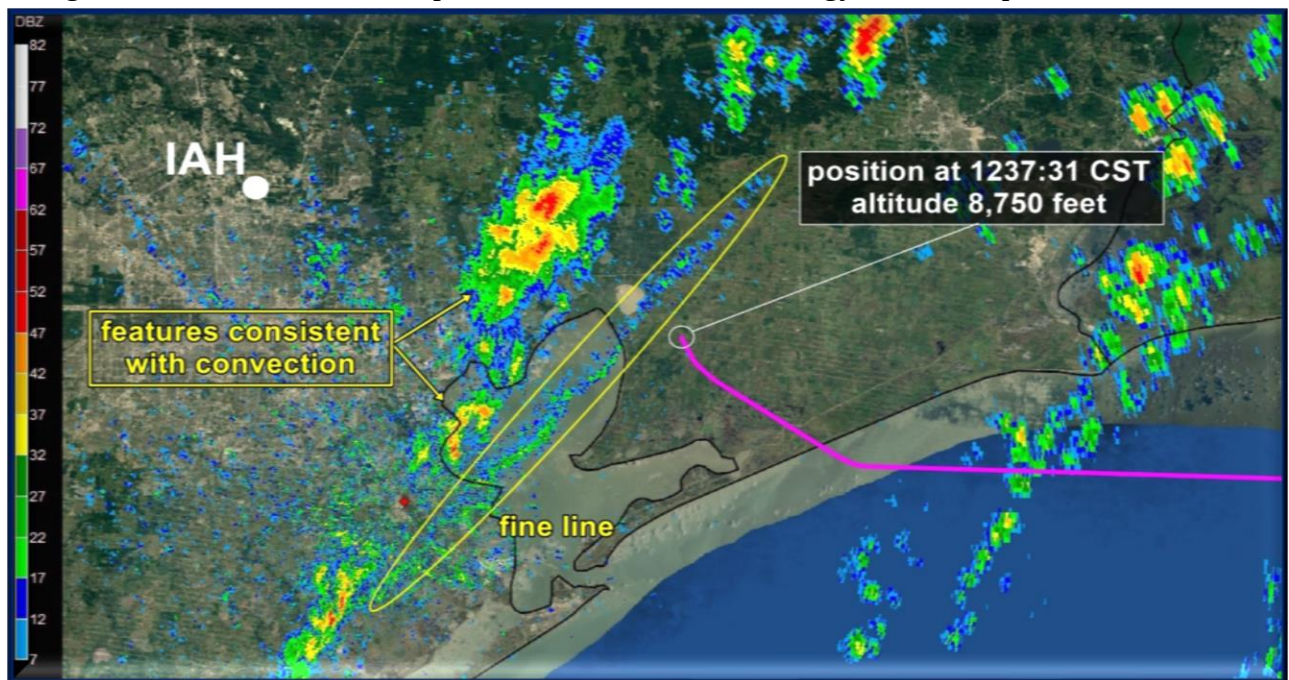


Figure 12 Depiction of NEXRAD with flight track in vicinity of crash site from Meteorology Factual Report.

The image in Figure 11 shows the areas of convection and the initial approach path of the aircraft as it arrived from Miami. The “Fine Line” is in front of the line of convection and indicates an outflow boundary of cold air pushing out in front of the convective weather. The Fine Line is small birds and bugs that are being lifted and pushed out by the gust front that the radar detects

and depicts. The Fine Line depicted is in the vicinity of the crash site as depicted in Figure 12 on the next page.

Witness video in the area depicts conditions on the ground with a shelf cloud and associated windy conditions on the surface. Other videos taken from security cameras and another witness all depict similar conditions with increasing wind and low clouds sweeping across the area. The NTSB Factual Group Report also contains images produced to indicate what the cloud formations would have looked like to match the videos.

All of this weather was relatively localized and only in the lower portions of the atmosphere. Limited turbulence in the area can be anticipated under these conditions. The FDR data indicated the aircraft was experiencing light to moderate turbulence. There are no FDR indications of any turbulence in excess of any aircraft limitation.

Houston Approach vectored the aircraft on a 270 degree heading to fly between the two areas of weather depicted in Figure 12. The gap appears to be large enough to allow the aircraft to pass through, and other traffic departing KIAH eastbound flew through this same gap. Statements and FDR data collected from other aircraft do not indicate that weather hazards would have been a significant factor for Giant 3591.



Figure 13 – A cropped screenshot of the local video." from NTSB Meteorology Factual Report

2. Air Traffic Control Group

The IBT found that the actions of the Houston area air traffic controllers and all controllers associated with this flight met all requirements of their duties. We further commend their rapid actions to begin to alert authorities to the loss of the aircraft in such an expeditious manner and believe they should be recognized for these actions.

The IBT was not a part of the Meteorology Group but concurs fully with the material contained in the NTSB Meteorology Factual Report.

E. STRUCTURES GROUP

1. Status of Aircraft Structure and Wreckage

The IBT worked with the Structures Group assisting primarily in sorting materials recovered from the crash site. The IBT concurs fully with the material contained in the NTSB Structures Group Factual Report.

2. Cargo Handling System

The IBT wishes to highlight one issue found with the main deck locks. While we feel it had no direct impact on the accident flight, a large number of the cargo locks were found in the down position. This is in violation of Atlas' policy, which requires all locks to be placed in the up position if any cargo is in the cargo hold. The Accident Aircraft had a light load with pallets in the rear of the main deck. This would have left many locks uncovered that should have been locked in the up position. Had there been a cargo load shift, locks in the up position would have prevented the load from shifting further. During our work with the Structures Group we sampled numerous locks that were undamaged. We found all the locks we sampled to be functional. We feel this is indicative of the locks not being locked in the up position by the ground crew that loaded the aircraft. The practice of placing the locks in the up position is an additional layer of safety in unexpected situations.

- Main deck center guides with 2 guide arms - 40 recovered, 3 with an intact housing and both arms fractured, 1 with an intact housing and 1 arm fractured, and the remaining with the housing and both arms intact
- Main deck side guides in 2 guide housing with red vertical restraint tab - 14 recovered with 28 guides, 7 guides were locked down
- Main deck side guides, single, with red vertical restraint tab - 48 recovered, 5 guides were locked down
- Main deck side guides with single guide - 85 recovered, 24 locked down
- Main deck door guides with yellow vertical restraint tab - 13 recovered, 3 locked down, 1 attached to structure with a lock
- Main deck cargo stops - 6 recovered
- Main deck locks, single - 140 recovered, 72 locked down
- Main deck locks, double - 23 recovered with 46 locks, 23 locked down
- Main deck locks, triple - 9 recovered with 27 locks, 18 locked down

F. POWERPLANTS GROUP

The IBT was not a part of the NTSB Powerplants Group. During the course of our work, members of the IBT investigative team received briefings from the Powerplants Group. The IBT finds the report of the Powerplants Chairman to be fully accurate.

G. MAINTENANCE GROUP

The IBT was not selected to participate in the work of the Maintenance Group. During the course of our work with the NTSB Systems Group, we discovered that Atlas' conformity checks did not capture all the differences of the Accident Aircraft from the rest of the fleet. We discovered that the Accident Aircraft had been modified to include an Integrated Standby Display, which was not in the records maintained by the Atlas Maintenance Department.

IV. RECOMMENDATIONS OF THE IBT

1. Comprehensive overhaul is needed of the PRIA/PRD law enacted by Congress. The FAA should require air carriers to maintain training records indefinitely. Air carriers' PRIA/PRD and training data should be mirrored in a centralized data warehouse held by a non-federal entity such as MITRE⁷⁹.
2. The FAA should mandate the standardization of airline training records for exchange of data with PRIA/PRD requests, similar to the ATA Code system used in aircraft maintenance.
3. PRD should provide a centralized and standardized data base, similar to the WBAT for ASAP program to allow small operators to comply cost effectively.
4. The FAA should mandate that air carriers be required to characterize the status of the pilot's training or performance at time of departure and reasons for resignation or termination.
5. The FAA should convene an industry forum to develop an industry standard for Proficiency Watch/Monitoring Programs with a focus on standards for entry, exit, duration, and monitoring of pilots in the program. Atlas should update and standardize their PWP program similar to industry peers and provide a non-subjective program standard.
6. The FAA should require more detailed observations from instructors and examiners on pilot performance during training and checking events. This information should be maintained in the pilot's record.
7. The FAA should require Boeing to mandate the installation of the improved B767-400 throttle quadrant design in the B767-300 and other models with similar design to protect against the possibility of inadvertent go around switch activation.
8. The FAA should require Boeing to change the parameters of system logic in the arming of go

⁷⁹ MITRE Corporation ("MITRE") is a Federally Funded Research Center (FFRDC) already entrusted with ASIAs data. MITRE is entrusted by the FAA and industry to hold the ASIAs database which is the Aviation Safety Information Analysis and Sharing program used to share safety reports throughout the airline industry and beyond.

around mode and emphasize potential hazards associated with early flap extension to operators.

9. The FAA should improve PRIA/PRD and Atlas should improve their background check process to include multiple points of verification and eliminate the current loopholes in the system that allow for omissions.
10. The FAA and Atlas should phase out Part 121 Appendix E & F training/checking and transition to AQP as the standard for the industry.
11. The FAA should require that Part 25 aircraft be equipped with FDRs with enhanced fidelity, and older aircraft should be retrofitted with these improved FDRs if an aircraft goes through a passenger to freight conversion or heavy maintenance event.
12. Simulator fidelity should be enhanced to allow for more effective training in spatial disorientation, including demonstrations of somatogravic illusion.
13. The FAA should direct air carriers to and Atlas should highlight systems and performance differences between the simulator and the aircraft, such as the difference in autopilot disconnect parameters as discussed in this investigation.
14. Atlas should improve training for ground operations personnel on the correct use of main deck locks and improve procedures for verification of compliance.

V. IBT ACTIONS

The IBT 2750 stands ready, willing and able to assist Atlas, the FAA, Boeing, and the NTSB with respect to incorporating any safety enhancements or recommendations that will prevent future accidents and incidents. The IBT will also conduct internal communication programs to highlight issues of relevance from this accident in its safety communications program.

VI. CONCLUSION

The IBT 2750 has stated findings and recommendations that we believe address those areas found to be causal or contributing factors to this accident. We remain confident that the NTSB will determine the probable cause consistent with our findings and put forth the appropriate conclusion and recommendations.

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