EMPIRE AIRLINES

POST-HEARING SUBMISSION TO THE

NATIONAL TRANSPORTATION SAFETY BOARD

FOR THE

AEROSPATIALE ALENIA ATR42-320 ACCIDENT OF N902FX OPERATED AS EMPIRE 8284

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DRAFT
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Synopsis

On January 27, 2009, at approximately 0437[1], N902FX, an Aerospatiale Alenia ATR42-320, operating as Empire Flight 8284, sustained substantial damage when it collided with terrain short of the runway while executing the Instrument Landing System (ILS) RWY 17R approached at Lubbock Preston Smith International Airport (LBB), Lubbock, Texas. The airplane was registered to Federal Express Corporation, Memphis, Tennessee and operated by Empire Airlines, Hayden, Idaho. The airline transport pilot rated ("ATP") captain and the commercial rated first officer were both injured.

An instrument flight rules flight plan was filed for the flight that departed Fort Worth Alliance Airport (AFW), Fort Worth, Texas, at approximately 0319. Instrument meteorological conditions prevailed for the supplemental cargo flight operated under 14 Code of Federal Regulations (CFR) Part 121.

SECTION 1. FACTUAL INFORMATION

1.1 History of Flight

The flight was originally scheduled to depart from the Midland International Airport (MAF), Midland, Texas, at 1955, on January 26, 2009. See Operations Group Chairman's Factual Report, p. 3. It would have arrived at LBB at 2038 and, after the trans-loading process, it would have continued on to AFW at 2225. Id. After arrival at AFW at 2337, all of the cargo would have been unloaded, and the cargo destined for LBB and MAF would have been placed onboard. Id. The airplane would then have departed for LBB at 0325 on January 27, 2009. Id. It would have arrived at LBB at 0449, completed the trans-load process, and then would have departed for MAF where the cargo would have been off-loaded and the flight would have terminated. Id.

Historically the trip had been operated with a Fokker F27; however, at the time of the accident, the F27 fleet was in the process of being phased out by the operator. Id. Accordingly, since January 5, 2009, the trip sequence was being covered by ATR 42s utilizing flight crews from other crew bases while the F27 flight crews were being trained to operate the ATR. Id.

According to the captain, after checking the weather, the first leg of the trip was changed to El Paso, Texas (ELP) due to freezing drizzle in LBB causing the Caravans to reroute to ELP. See Interview Summaries of Captain Rodney Holberton, p. 4, Exhibit 2-F. The flight departed for ELP at 1945 on January 26, 2009, and arrived at 2113. See Operations Group Chairman's Factual Report, p. 3. After unloading the cargo, the flight then departed empty for AFW at 2230 with 609 pounds of ballast onboard to maintain the center of gravity within the allowable limits. Id. It arrived at AFW at 0018 on January 27, 2009. Id. After the cargo was loaded, the flight departed for LBB at 0313 with the first officer as the flying pilot. Id.

[1] Unless otherwise specified, all times set forth herein are Central Standard Time (CST).

After departure, the flight encountered rime ice which the captain described as being "moderate, bordering on severe" at FL180. Id. He selected Level Three icing protection, which includes engine continuous ignition. Id. The Captain stated that normally they indicate two hundred to two hundred ten knots at cruise, but were only indicating one hundred eighty knots during the encounter. Id. The captain requested descent down to 14,000 feed MSL to clear the ice and indicated that substantial amounts of ice came off the aircraft. Id.

During the descent from 14,000 feet MSL, he received Automated Terminal Information Service (ATIS) Papa for LBB. Id. The ice light on the memo panel began to flash after five minutes and he deselected Level Three ice protection. Id. The ATIS reported rapidly changing weather and advised that the current weather could be obtained from Approach Control. Id.

Fort Worth Air Route Traffic Control Center (ARTCC) handed off the flight to LBB approach control and cleared them to descend to 6,000 feet MSL. Id. LBB approach informed them of "light freezing drizzle" conditions in LBB. Id. The weather was reported to the flight as also having a five hundred foot overcast ceiling with two miles visibility, and a ten-knot tail wind. Id. They were then cleared for the ILS Approach to runway 17R, cleared to descend at 5,000 feet MSL, and were vectored for the approach to runway 17R. Id. The captain stated that approach control had to give additional vectors due to a wind shift during the descent from 6,000 feet to 5,000 feet MSL. Id. The captain briefed the approach, in anticipation of having to fly it, as he had some concerns that the first officer might be "high minimums," but found out shortly thereafter that the visibility would not be a problem and the first officer could fly the approach. Id. at 3-4.

The first officer called for "Flaps fifteen, gear down, and landing check." See Cockpit Voice Recorder Group Chairman Factual Report, p. 12. The captain selected flaps 15 degrees, the crew did the pre-landing checklist and the first officer reduced power on both engines. See Operations Group Chairman's Factual Report, p.4. The captain then realized that there was a problem with the flaps. Id. He said he repositioned the flap handle several times and, in order to diagnose the problem, checked the circuit breakers with a flash light while they were descending on the final approach, but was unable to determine the nature of the problem. Id. He then placed the flap handle in the up or retracted position, as he did not want the flaps to inadvertently travel during the approach. Id.

The captain stated that due to the unknown anomaly, he did not do the reduced flaps landing procedure, did not reset the speeds for a no flap approach, and continued despite the first officer's suggestion to go around. Id. The captain based this decision on the runway conditions, icing conditions, and the flap problem and did not want to execute a missed approach, which would have required him to re-enter icing conditions and apply full power with an unknown flap problem. Id.

According to the captain, they were still carrying ice from their first encounter when they started to descend into LBB. Id. The first officer stated they began to accrete ice once again as they descended through 6,000 feet MSL and received an ice aural warning chime. Id. She stated Level Three ice protection was again activated. Id. She stated the icing light came on and a chime was heard. Id. At that time, she could see icing on the propeller spinner. Id. The stick

shaker then activated at an approximated altitude of 1,000 feet above ground level, and the autopilot disengaged. Id.

The captain in the meantime looked over and noticed that the airplane was drifting off the localizer and saw the first officer flying the approach when the autopilot should have been coupled to the ILS. Id. He was not sure why the autopilot had disconnected, and stated that he had not heard an aural alert. Id. The first officer asked the captain if they should go around. Id. The captain, for the reasons previously discussed, said no and then asked the first officer if she wanted him to take the flight controls. Id. She responded yes and advised that shortly thereafter, the airplane became uncontrollable. Id. The captain stated that the stick shaker then activated, so he added power. Id. Moments later the TAWS (Terrain Avoidance Warning System) issued a "PULL UP" warning and the first officer advised that she had the runway in sight. Id. The stick shaker then activated two more times, and the captain called for maximum RPM. Id. He realized that he had no lateral control, and shortly thereafter the airplane impacted the ground. Id.

1.2 Injuries to Persons

Both the captain and the first officer were injured. See Operations Group Chairman's Factual Report, pg. 5. Both flight crewmembers have fully recovered.

1.3 Damages to Aircraft

The aircraft was totally destroyed by the impact and the resulting fire. See Airworthiness Group Chairman's Factual Report, pp. 16-37.

1.4 Other Damage

The cargo onboard the aircraft was destroyed and/or damaged by fire.

1.5 Personnel Information

Both the captain and the first officer were current and qualified under Empire Airlines and FAA requirements. See Human Performance Specialist's Factual Report, pp. 3, 5. The Captain held an airline transport pilot certificate with ratings for airplane single engine-land and multi-engine land. The first officer held a commercial pilot certificate with ratings for airplane single engine land, multi-engine land, and instrument airplane. See Operations Group Chairman's Factual Report, pp. 5-6. According to FAA and company records, there was no history of previous accidents, incidents, or disciplinary actions involving the captain or first officer. Id. at 5, 7.

1.51 The Captain

Captain Holberton was hired by Empire Airlines on May 9, 1988. See Group Chairman's Factual Report, p. 5. His most recent FAA first-class medical certificate was issued on September 19, 2008. Id. A review of Empire Airlines' Employee Training Events records revealed that the captain had completed a recurrent proficiency check ride and

line check on September 22, 2008. Id. Captain Holberton testified that at the time of the accident he had accrued approximately 13,800 hours total time. See Hearing Transcript, p. 56.[2]

The captain's pertinent training and checks, according to the Operations Group Chairman's Factual Report, were as follows:

Part 121 Training/Checks	**Date**
Upgraded/Transitioned to a 121 Captain position	F27: April 5, 2002 ATR: January 8, 2005
Initial Operating Experience (IOE) for the ATR	January 8, 2005
Type Rating on the ATR	December 30, 2004
Most Recent Recurrent Ground School (ATR Systems)	March 29, 2008
Most Recent Proficiency Check	September 22, 2008
Most Recent PIC Line Check	September 22, 2008

See Operations Group Chairman's Factual Report, pp. 5-6.

1.52 Captains 72 Hour History

Captain Holberton began his trip sequence by deadheading to Midland International Airport (MAF), Midland, Texas on January 24, 2009, and was scheduled to end his 5-day trip on January 30, 2009. See Operations Group Chairman's Factual Report, pp. 5-6.

On January 24, 2009, the captain boarded Southwest flight 2535 and departed for Las Vegas, Nevada at approximately 1015. See Operations Group Chairman's Factual Report, p. 6. He then arrived in Las Vegas, had about a 1-hour layover and departed for MAF at 1325. Id. The flight arrived in MAF at 1535. Id.

On January 26, 2009, the captain met the first officer in the lobby at 1820, drove to the airport and began their flight crew duties at 1845. Id. At 1945, they departed MAF for ELP and arrived at ELP at 2115. Id. Then, at 2230, they departed ELP for AFW. Id.

On January 26, 2009, they arrived at AFW at approximately 0030. Id. After closing out the flight with Empire's dispatch, the captain ate lunch and watched television. Id. At 0230 he arrived back at the airplane and resumed flight crew duties and departed AFW at 0313 for LBB. Id. After arriving at LBB, the accident occurred at 0437. Id.

1.53 The First Officer

[2] The Operations Group Chairman's Factual Report indicates that Captain Holberton had 12,742 total hours as a Pilot In Command (PIC); 2,080 hours total ATR PIC time; 4.7 hours in the last 24 hours; 12.6 hours in the last 30 days; 58.3 hours in the last 90 days; and 362.7 hours in the last 12 months. See Group Operations Chairman's Factual Report, p. 5.

Empire Airlines hired First Officer Cornell on July 25, 2008. See Operations Group Chairman's Factual Report, p. 7. The first officer's most recent FAA first-class medical certificate was issued on December 4, 2008. Id. A review of Empire Airlines' Employee Training Events records revealed that the first officer had completed her initial proficiency check ride on September 10, 2008. Id. She had accrued approximately 2,000 total hours of flight time, of which approximately 130 hours had been in the ATR 42. Id.[3]

The first officer's pertinent training and checks, according to the Operations Group Chairman's Factual Report, were as follows:

Part 121 Training/Checks	**Date**
IOE (For the ATR)	September 26, 2008
Initial Ground School (ATR)	August 29, 2008
Most Recent Proficiency Check	September 10, 2008

See Operations Group Chairman's Factual Report, p. 7.

1.54 First Officer's 72 Hour History

The week before the accident flight, the first officer deadheaded to MAF from Seattle, Washington on January 18, 2009. She then flew the trip sequence with another captain completing the trip pairing on January 23, 2009. See Operations Group Chairman's Factual Report, p. 7. The first officer picked up the captain of the accident flight at the passenger terminal at MAF on January 24, 2009, and commenced the accident flight's trip pairing on January 26, 2009. She was scheduled to end her 5-day trip on January 30, 2009. Id.

On the morning of January 26, 2009 the first officer woke up about 1500 and got ready for her trip and reported for the trip with her captain at approximately 1845. See Operations Group Chairman's Factual Report, pg. 8. At 1945, they departed MAF for ELP and arrived at ELP at 2115. Id. Then, at 2230, they departed ELP for AFW. Id.

On January 27, 2009, they arrived at AFW at approximately 0030. Id. After a break, she arrived back at the airplane at 0220 to resume her flight crew duties and they departed AFW at 0313 for LBB. Id. After arriving at LBB, the accident occurred at 0437. Id.

1.6 Aircraft Information

[3] The Operations Group Chairman's Factual Report indicates that First Officer Cornell had 1,925 total hours as Pilot in Command (PIC); 130 total hours as Second In Command (SIC); 4.7 hours in the last 24 hours; 29.8 hours in the last 30 days; 87.9 hours in the last 90 days; and 130.2 hours in the last 12 months while employed with Empire Airlines. See Group Operations Chairman's Factual Report, p. 7.

The accident airplane was an ATR 42-320, twin-turboprop short haul regional airliner, which was manufactured in France and Italy in 1989 and had conducted its first flight on January 15, 1990. See Operations Group Chairman's Factual Report, p. 8. It had been converted for use in freight operations. Id. It was constructed of both metal and composite materials and was powered by Pratt & Whitney PW-121 powerplants. Id. The airplane was pressurized and its maximum certificated operating altitude was flight level 250. Id. It was registered to FedEx and operated by Empire Airlines. Id. The airplane's most recent inspection was completed on January 9, 2009. Id. At the time of the accident, the airplane had accrued 28,768.0 total hours of operation and 32,379.0 cycles.

1.61 Weight and Balance information

The FedEx Feeder Aircraft Load Control Sheet, and the Empire Airlines ATR 42 LC/SC Cargo Load Manifest, were reviewed. See Operations Group Chairman's Factual Report, p. 8. Weight and Balance information from these documents, was entered into the accident airplane's CG calculator and the weight and balance calculations produced, were verified. Id. No anomalies with the accident airplane's calculated weight and balance were discovered. Id.

1.7 Equipment and Systems

1.71 Ice Detection

An Anti-icing Advisory System (AAS) was installed on the ATR 42. See Operations Group Chairman's Factual Report, p. 10. The AAS included:

- An Ice detector
- ICING (Amber) light
- ICING AOA (green) light
- DE ICING blue light

AAS was designed to remind the flight crew on the need to apply procedures and checklists when flying in icing conditions. Id. The procedures include:

- Increase in the minimum maneuvering speed/operating speeds.
- Selection of anti-icing system when entering icing conditions (selection of horns anti-icing lowers the AOA stall warning threshold and triggers illumination of the ICING AOA light).
- Selection of de-icing system at the first indication of ice accretion.
- When ice does not build up anymore on the airframe ("DE-ICING" flashing), checking if the de-icing system should be switched off.

1.72 Operation of the Ice Protection System

According to the manufacturer, Atmospheric Icing Conditions exist when the outside air temperature (OAT) on the ground and for takeoff is at or below 5 degrees Celsius (C) or

when the total air temperature (TAT) in flight is at or below 7 degrees C and visible moisture in any form is present (such as clouds, fog, with visibility of less than one mile, rain, snow, sleet and ice crystals). See Operations Group Chairman's Factual Report, p. 11.

The leading edges of the wings, horizontal stabilizers, and vertical stabilizer on the ATR 42 were deiced by pneumatic boots (which inflate perpendicular to the airfoil span), and the engine intakes were protected by annular pneumatic boots. Id. The manufacturer advised that with this type of pneumatic boots, that there is no need to wait for ice accretion on the airframe before selecting the system on, and that the system should be selected on as soon, and as long, as ice accretion develops on the airframe. Id. The propeller blades, windshields, probes, and flight control horns were electrically heated. Id.

For operation in atmospheric icing conditions the airplane was to be configured as follows:

- Np [Propeller speed] 86%
- The Horns, propellers, side windows and engine anti-icing must be selected ON.
- The Eng [ine] start rotary selector must be placed to CONT [inuous] RELIGHT.

Id. The AFM outlines the use of the anti-ice/deice systems. Three different levels of equipment have been defined.[4] **Level One** ice protection must be selected for all flight operations. Id. at 12. For all takeoffs and flight operations in atmospheric icing conditions, **Level Two** protection must be selected in addition to **Level One.** Id. Anytime ice is building on the airframe, **Level Three** protection must also be selected. Id. When **Level Three** protection is desired, airframe deicing is selected by pushing the AIRFRAME button. Id. Pockets in the boot system inflate in sequence and deice the leading edges without further flight crew input or attention. Id.

1.73 Flight Controls

The primary flight controls included conventional mechanically operated ailerons, elevators and rudder. See Operations Group Chairman's Factual Report, p. 12.

The trailing-edge flaps and roll spoilers were hydraulically operated. Id. Each of the three axes had electrically controlled trim tabs. Id. The ailerons, elevators, and rudder had "horns" which acted as counterweights and served to balance the flight controls. Id. The horns were anti-iced when level II ice protection was selected. Id.

Vortex generators were installed on the upper surface of the wings, forward of each aileron to ensure aileron response when operating at low airspeeds. Id.

[4] The specifics for each level can be found at Operations Group Chairman's Factual Report, p. 11

The trailing-edge flaps were double-slotted, fowler type, with inboard and outboard panels. Id. They were electrically controlled and hydraulically positioned. Id. The selectable flap positions were: RET [ract] 0 degrees, TO (takeoff)/ APP [roach] 15 degrees, LDG (landing) 30 degrees (which actually corresponded to 27 degrees), and 45 degrees (to be used only in the event of an emergency). Id. The lever and flaps position would automatically control the flap value, which would hydraulically actuate the four flap actuators. Id.

In the event that a possible asymmetry was detected between the right inboard and left inboard flaps, the maximum asymmetry allowed by the system was between 8 and 10 degrees, and then the electrical supply to the flap control system would be isolated, the flaps would stay at their current position, and the flap control lever would have no further effect on the system until a maintenance action was performed. Id.

System indication was also provided in the event of untimely flaps retraction and uncoupled flaps. Id. Indication of flap untimely retraction was made available to the flight crew through illumination of a red FLAP UNLOCK warning light, master warning light, and a continuous chime. Id. The purpose of the unlock warning was to inform the pilot of the untimely flap retraction and induce him to take appropriate action so that rapid development of a stall configuration was avoided. Id. However, the system provided no information to the crew of a flap asymmetry.

1.74 Automatic Flight Control System

The airplane was equipped with an Automatic Flight Control System (AFCS). It provided autopilot (AP), yaw damper (YD), flight director (FD), and altitude alert functions. See Operations Group Chairman's Factual Report, p. 13.

A flight director mode could be selected prior to autopilot engagement. Bank could be selected at High (27 degrees) or Low (15 degrees). Id. The ATR42 AFM indicated that pilots were expected to operate in the LO bank mode for takeoff but could be selected to High after takeoff depending on speed. Id.

Manual disengagement of the autopilot would occur when the quick disconnect button on the wheel is pressed, the normal or standby pitch trim is activated, the AP button on the AFCS panel is pressed, the YD button is pressed, the go around button is pressed on the power levers, or pilot force on the rudder pedals is in excess of 66 pounds. Id.

Automatic disengagement would occur when one of the engagement conditions of the AP or YD was no longer met, stall warning indicator threshold was achieved, there was a disagreement between the two Attitude Heading Reference Systems (AHRS) or between the two Air Data Computers (ADC), or there was a mismatch between the two pitch trims. Id.

Both aural warnings (cavalry charge), and visual indications (AP OFF, AP DISENGAGED) on the Advisory Display Unit (ADU), and an AP MSG on the primary

flight display were generated in the event of manual or automatic disengagement of the autopilot. Id.

If an autotrim failure or mistrim condition occurred, a "PITCH TRIM FAIL" or "PITCH MISTRIM" message would be displayed on the ADU, and an "AP MSG" would be displayed on the primary flight displays. Id. According to the manufacturer, in the event this occurs, "The crew has to disengage the AP and manually fly the airplane." Id.

When deviations in roll occur, the following messages are generated on the ADU: "RETRIM ROLL R (L) WING DN," "AILERON MISTRIM." Id. According to the manufacturer, in the event of "RETRIM ROLL R (L) WING DN," the aileron trim should be operated accordingly. Id. In the event of "AILERON MISTRIM" the control wheels should be held firmly, the AP should be disconnected, and the lateral trims should be adjusted. The autopilot may then be reengaged. Id.

Elevator hinge movement could be affected by external conditions such as takeoff with ice remaining on the tail plane (de/anti-icing hold overtime exceeded) or severe icing. Id. Aileron forces could be affected by external conditions such as prolonged exposure to severe icing or the de/anti-icing hold over time being exceeded. Id.

The AFM also stated that since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when the severe icing exists, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions. Id.

1.75 Low Speed Warning System

The airplane was not equipped with a low speed warning system, nor was one required by regulation. See Group Chairman's Factual Report, p. 14.

1.76 Stall Protection System

To generate a stall alert (cricket and stick shaker), the airplane was fitted with two angle of attack (AOA) probes, one on each side of the forward fuselage. See Group Chairman's Factual Report, p. 14.

1.77 Terrain and Traffic Collision Avoidance System

The airplane was equipped with a T²CAS (Terrain and Traffic Collision Avoidance System). See Operations Group Chairman's Factual Report, p. 14. During the final approach, the system generated a "Pull Up" warning to the flight crew. Id. At the point of the "PULL UP", the aircraft was approximately 1.5 miles from the runway threshold, slightly west of the extended centerline. Id. The date recording indicated that at a radio altitude of 488 ft. and a vertical speed of -2050 ft/min the warning was generated. Id.

According to the TAWS Event Analysis Report, the rapid change in vertical speed combined with the low radio altitude value resulted in an immediate Mode 1 Warning without a preceding Caution. Id. The annunciation to the flight crew at that point consisted of an aural "PULL UP, PULL UP" in conjunction with the illumination of the red TAWS Warning enunciator. Id. at 14-15.

1.8 ATR Flap System

For take-off, approach and landing, lift augmentation is performed by four trailing edge flaps, which rotate on hinges located below the wing. See Airworthiness Group Chairman's Factual Report, p. 38. The flaps can be commanded in four stable positions:

- Position 1: flaps at 0 ° (cruise)
- Position 2: flaps at 15 ° (take off/approach)
- Position 3: flaps at 30 ° (landing)
- Position 4: flaps at 45 ° (emergency): stop tool and sealing wire

Id. The commands are transmitted by electrical signals. Id.; see also Schematic of ATR 42 Flap System, Operations Exhibit 2QQ.

A flap asymmetry detection mechanism and a flap untimely retraction warning system are associated with the control system. Id. The purpose of such a detection system is to interrupt commands when the average asymmetry of the left wing flaps with respect to the right wing flaps is 8 to 10°. Id. at 40. If the flaps are commanded to extend or retract and asymmetry between the left and right flaps exceeds the predetermined value, torsion of the torque detection shaft connecting the two inboard flaps causes microswitch 5CV to close. Id. This microswitch then supplies self latching relay 4CV, cutting off supply to the flap control switch unit. Id. The extension or retraction solenoid valve is no longer energized, and the flaps remain in the position reached before the power supply cut off. Id. Movement of the flap control lever now has no effect on the system and the indicator provides the average position reached by the flaps. Id.

However, notwithstanding the foregoing, there is no indication in the cockpit to warn the crew of a flap asymmetry.

1.9 Meteorological Information

A weather observation taken about 16 minutes after the accident, recorded the wind as 020 degrees at 11 knots, gusting to 18 knots, visibility 2 miles in light freezing drizzle and mist, ceiling overcast at 500 feet, temperature minus 08 degrees Celsius, dew point minus 09 degrees Celsius, and an altimeter setting of 30.13 inches of mercury. See Operations Group Chairman's Factual Report, p. 4.

1.10 Airspeed Bugs

The airspeed indicators in the accident airplane were equipped with movable indices (airspeed bugs), which were mounted on the circular bezels surrounding the periphery of the airspeed indicators. See Operations Group Chairman's Factual Report, p. 25. The three colored bugs (yellow, white, and red) enabled the flightcrew to manually set predetermined speeds for operation of the airplane. Id. For a more detailed discussion of the significance of the airspeed bugs please see section 2.62 below.

1.11 Dispatch Information

Empire operates a centralized communications center at their headquarters in Hayden, Idaho comprised of Dispatch, Maintenance Control, and Crew Scheduling. See Operations Group Chairman's Factual Report, p. 24. Dispatch, had flight following responsibility for Empire's fleet of 48 airplanes. Id.

Empire Airlines was not required as a 14 CFR Part 121 Supplemental carrier to use licensed dispatchers for flight following however; dispatch was staffed with 7 flight followers, all of whom were licensed dispatchers with the exception of one, new hire employee. Id. The flight followers typically worked an 8-hour schedule. Id. To accomplish the required FAA flight following functions, communications with the company's flight crews was done through the use of telephones, fax machines, and Aeronautical Radio, Incorporated's (ARINC) network of air to ground radio stations, and telephone connections. Id.

Maintenance Control was staffed by three maintenance controllers. Id. At the hub stations, the airplanes were maintained by Empire maintenance personnel. Id. At the out stations, airplane maintenance was provided by contract maintenance personnel. Id.

Crew scheduling was responsible for scheduling pilots for ATR Part 121 operations. Id. Individual crew bases were responsible for crew scheduling for the CE208 Part 135 operations. Id. All scheduling was reviewed by headquarters. Id. at 24-25.

1.12 Airport and Approach Information

LBB had three runways, oriented in an 8/26 and 35/17 configuration. See Operations Group Chairman's Factual Report, p. 15. At the time of the accident, the runway complex was covered in ice and runway 8/26 was closed. Id. Runway 17R was concrete, grooved, and in good condition. Id. It was equipped with an Instrument Landing System with Distance Measuring Equipment (ILS/DME), a 1,400 foot long, medium intensity approach lighting system with runway alignment indicator lights, (MALSR) high intensity runway edge lights and precision markings. Id. The total length of the runway was 11,500 feet, and its width was 150 feet. Id.

1.13 Flight Recorders

The Flight Data Recorder indicates, unknown to the flight crew except for an unidentified flap malfunction having occurred, that a flap asymmetry occurred at 04: 34: 26 of the subject flight,

approximately 2 minutes before impact. See Flight Data Recorders Group Chairman's Factual Report, p. 6

1.14 Tests and Research

1.141 Simulator Testing

On March 30, 31, and April 1, 2009, qualitative simulator testing was conducted to assess pilot workload, and to evaluate the airplane/simulator handling qualities with a flap asymmetry and ice accretion. See Operations Group Chairman's Factual Report, p. 31. The simulator as configured could not produce the accident drag levels without introducing unrealistic lift, pitching movement, yawing movement, and rolling moment effects due to ice. Id. As a result, "Normal Icing – Boots On" ice levels were used (as a function of angle-of-attack) with the knowledge that the drag effect was underestimated. Id.

Simulator testing revealed that after autopilot disconnect, the pilot workload that resulted from flight into icing conditions, a 10-knot tailwind, and asymmetric flap deployment was significant. Id. However, even with this pilot workload, a go around (missed approach) could be successfully conducted. Id. Of course, the pilot flying the simulator knew what was going to occur before it occurred.

No dedicated asymmetry indicator was installed. However, when a flap asymmetry caused deviations in roll the generation of an A/P MSG message on the EADI and a "RETRIM LEFT WING DOWN" message on the ADU and a visible displacement of the control wheels to the left would result. Id. This was shortly followed by a flashing "AILERON MISTRIM" message. Id. Re-trimming the airplane, re-engaging the autopilot per the "Aileron Mistrim" checklist in the QRH, and setting power to maintain the minimum safety speed would, however, results in a successful outcome. Id. But when the approach was flown in the Full-Flight Simulators (FFS) without re-trimming the airplane, and at a speed lower than the minimum safety speed, the controllability of the airplane during the approach was often similar to the accident flight. Id.

As noted previously, however, all simulator testing conducted after the accident was by pilots who knew the accident aircraft had experienced a flap asymmetry, something of which the accident flight crew was unaware.

1.15 Company information[5]

Empire Airlines presently holds Air Carrier Certificate number COEA135A for all cargo operations conducted under 14 CFR Parts 135 and 121. Company headquarters are located in Hayden, Idaho. At the time of this accident, Empire was operating 35 CE208s, 10 ATR 42s, and

[5] All information in this section can be found in the Operations Group Chairman's Factual Report, pp. 15-17.

3 ATR 72s, serving 51 destinations on behalf of FedEx. All the airplanes were owned by FedEx and leased to Empire. Empire's flight and maintenance operations were staffed by approximately 250 employees, of which 108 were pilots.

The company was first established as Clearwater Flying Service (CFS) in 1977. The company expanded, and by 1979 had moved its corporate office to Coeur d'Alene, Idaho and was operating fire patrol flights, transporting outfitters into remote areas, operating air ambulance flights, air pollution monitoring flights, charter flights, and providing flight instruction.

In November 1980, the company acquired West Air, Inc. and expanded the business to include aircraft sales and maintenance, at which time they changed their name to Empire Airways. In 1986, Empire began contracting with a Colorado company to run shuttle flights between ski resorts.

In 1987, the company once again expanded and entering into a contract with Hughes Corporation to fly employees between offices in three California locations, and were awarded a contract to operate flights in Alaska on behalf of the Naval Arctic Research Laboratory. Later that same year, they signed a contract with FedEx to fly and maintain Cessna CE208 "Caravans," out of Portland, Oregon, Spokane, Washington, and Seattle, Washington, to numerous locations in the Pacific Northwest.

In 1989, Empire became a 14 CFR Part 121 operator, after the purchase of Pacific Alaska and two Fairchild F27 airplanes. In August of that year, Empire began F27 service on behalf of FedEx and changed their name to Empire Airlines. In 1990, Empire added more cargo routes and performed their first heavy maintenance check on a Fairchild F27. In 1992, Empire assisted Mahalo Airlines startup in Hawaii, and began to operate BAE 146 jets for Silverwing Holidays out of Vancouver, British Columbia.

Starting in 1993, Empire became a sustaining member of CASE (Coordinating Agency for Supplier Evaluation). In 1995, Empire ended passenger service to focus on cargo operations, aircraft maintenance, and airline startups. They also began sending technical representatives to Conair, during their heavy maintenance checks on Fokker 27s.

In 1998, Empire added the Shorts Brothers SD360 to their fleet, which Empire both flew and maintained. That same year Empire entered into a partnership agreement to startup Express Air, to serve FedEx in Europe. In 1999, Empire began to do heavy maintenance checks on the F27. In March of 2000, Empire appointed a new CEO. On December 31, 2000 Express Air began flying independently.

In 2001, Empire received its 14 CFR Part 145 repair station certificate. In 2002, Empire purchased freight forwarder Reliant Logistics, as a wholly owned subsidiary. In 2003, Empire's first ATR 42 arrived in Spokane, Washington, and was converted to a freighter. Empire's BOD also accepted the State of Idaho's proposal for a new hangar and offices at the Coeur d'Alene airport. In 2004, Empire moved into its new hangar and office building. The first ATR was put on Empire's certificate and it made its first revenue flight for FedEx.

In 2005, Empire Airlines performed heavy maintenance on the first ATR 72 imported from Germany by FedEx. In 2006, Empire Aerospace received and signed Operations Specifications to allow the performance of heavy maintenance on ATR 72s and Fokker F27s. Empire aerospace also added deHavilland Dash 8 -100, -200, -300, and Q-400 capabilities to their Operations Specifications. In 2007, Empire Aerospace signed a contract with Horizon Air to support a line of Q-400 airplanes for reliability and performance upgrade modifications.

Since the beginning of its operations, Empire has had only three significant accidents. The first accident occurred in January 1995, when a Cessna 208 Caravan on a 14 CFR Part 135 cargo flight from Flagstaff, Arizona to Phoenix Sky Harbor International Airport crashed about 1.3 miles south-southeast of Flagstaff Pulliam Airport. The second accident was in October 2000, a Cessna 208 Caravan operated by Empire Airlines under 14 CFR Part 135 impacted terrain on Lummi Island, Washington during a VFR cargo flight from Bellingham, Washington to Orcas Island, Washington. The third accident is the one that occurred on January 27, 2009.

1.16 Training

14 CFR Part 121.419 (Pilots and Flight Engineers: Initial, Transition, and Upgrade Ground Training), mandates that pilots and flights engineers receive instruction in initial, transition, and upgrade ground training. See Group Chairman's Factual Report, pp. 27-28.

1.161 Flight Training Manual

The Empire Airlines Flight Training Manual (FTM) provides a standardized course of training for Empire Airlines crewmembers, dispatchers, and flight followers. See Operations Group Chairman's Factual Report, p. 28. The FTM constituted Empire Airlines' FAA approved Flight Training Program. Id. According to the FAA, the FTM met the regulatory requirements of 14 CFR Parts 61, 91, 107, 108, 119, 121, 135 and SFAR 58 and was compliant with the guidance set forth in FAA Order 84000.10, the Air Transportation Operations Inspector's Handbook. Id. The FTM stated Empire's policies and procedures regarding the training of flight operations personnel, as well as information necessary to guide and assist them in their duties. Id.

The ground training curriculum required that instruction be given in abnormal and emergency procedures for flight controls and that instruction be given for adverse weather recognition, avoidance, and escape, including icing. Id. Additionally, a review of the ATR publication, Cold Weather Operations (Be Prepared for Icing), was required along with a review of meteorological conditions likely to cause freezing drizzle, freezing rain or super cooled drizzle droplets (SCDD). Id.

Indication of weather information sources and their use relative to in-flight icing was required, along with discussions of procedures, including Company and Air Traffic Control (ATC) procedures, for pilot weather reports (PIREP) on severe icing to include reporting procedures, content, and use of PIREPS. Id. The FTM also required the discussion of information provided to flight crewmembers, including the identification of

severe icing conditions, freezing rain and freezing drizzle, exit procedures (should severe icing conditions be encountered) and ATC procedures. Id.

1.162 New Hire Training

Under Operations Specification A031, Empire Airlines was authorized to make arrangements with specified training centers in order to conduct instruction and/or evaluations. See Operations Group Chairman's Factual Report, p. 29. New hire pilots were trained in accordance with Empire Airlines FAA approved training program, which consisted of one week of basic indoctrination and company orientation at Empire's headquarters. Id. During basic indoctrination, the pilots would review the ADP, FAA's Handbook of Meteorology, the NASA tailplane icing video, operations in icing for corporate aircraft video, and handouts of flight releases to familiarize the pilots with the format. Id. The new hire pilot would then attend Flight Safety International (FSI) in Houston, Texas, a 14 CFR Part 142 Training Center permitted to conduct initial, transition, and upgrade training on behalf of Empire Airlines for both the ATR 42 and ATR 72. Id.

1.163 Upgrade Training

To upgrade from first officer to captain, a pilot was required to undergo upgrade training, consisting of two days of general operations ground school at Empire's headquarters. See Operations Group Chairman's Factual Report, p. 29. Two and a half days of systems training at FSI, 4 simulator sessions, and a checkride followed. Id. After which the pilot would then receive 2 training sessions in the actual airplane followed by a checkride, followed by 20 hours of IOE with a line check airman before being released to the line. Id.

1.164 Transition Training

To move from one airplane type to another, a pilot had to undergo transition training, consisting of 2 days of general operations differences ground school at Empire's headquarters. See Operations Group Chairman's Factual Report, p. 29. This was followed by 2 weeks of systems training at FSI, 2 weeks of simulator training, and a checkride. Id. The pilot would then receive 2 training sessions in the airplane followed by a checkride, followed by 20 hours of IOE with a line check airman before being released to the line. Id.

1.165 Line Oriented Flight Training

At the time of the accident, Empire Airlines did not conduct Line Oriented Flight Training (LOFT). See Operations Group Chairman's Factual Report, p. 29.

1.166 Flight Crew Winter Operations Training

Prior to the winter flying season, flight crews and dispatchers were required to review Empire's Winter Operations information and take an on-line test. See Operations Group Chairman's Factual Report, p. 30. The Winter Operations On-Line Test subject areas and questions were derived from the airline's ADP and would cover the elements of the ADP. Id. None of the materials however included operations in the inflight icing environment. Id.

1.17 The Presence of Ice

Initial examination of the wreckage by FAA inspectors revealed the presence of ice on the right aileron. See Operations Group Chairman's Factual Report, p. 32. The captain also stated to company personnel that the airplane had been picking up ice on the approach. See Airplane Performance Study, p. 3.

Review of performance data by the Performance Group revealed that while at FL180 at the beginning of the cruise portion of the accident flight, the airplane had a cruise speed that was 10 knots lower than nominal and at the end of the cruise portion of the flight the cruise speed was 20 knots lower than nominal. See Operations Group Chairman's Factual Report, p. 32. This corresponded to a drag increase of 80 counts or approximately 15% of total power. Id.

The accident airplane's performance was once again nominal until descending below 5,000 ft. At this point, the drag began to increase beyond nominal levels again. Id. Airplane performance indicated that an additional 120 counts was present when the flap asymmetry occurred. Id. This was equivalent to approximately 23% of total power. Id.

The Airplane Performance Group concluded that the FDR data does not show behavior consistent with an airplane stall, loss of lateral control, or a sudden change in aileron hinge moment. Id. The stick shaker triggered at the appropriate local angle-of-attack and airspeed on the FDR and, as a result, provided sufficient stall margin. Id. The bank angle followed the commanded wheel and aileron deflections throughout the approach and landing. Id.

The FDR data and ATR simulation analysis of the accident also indicated that, the ice accretion during portions of the flight was significant but that it never exceeded the control authority of the ATR42. Id. However, significant ice accretion will degrade the flying qualities of any airplane design. Id. The full extent of Empire Airlines Flight 8284's degradations due to ice conditions could not be determined. Id.

1.18 Provided Guidance and Icing Information

1.181 Stabilized Approach Criteria

Empire Airlines established procedures for ensuring that each approach was accomplished using standardized procedures. See Operations Group Chairman's Factual Report, p. 17. Empire's General Operations Manual (GOM) established stabilized approach and approach standardization procedures for each type of airplane. Id. Similar information is also discussed in Empire's Flight Training Manual's (FTM) "ATR 42/72

Flight Profiles and Briefings" section and Empire Airlines ATR Pilot Handbook. The ATR Pilot Handbook is issued to the company's pilots. Id.

According to the FTM, approaches should be stabilized by 1000' height above touchdown (HAT) in IMC and by 500' HAT in VMC. Id. The FTM further elaborates on when an approach would be considered stabilized. Id. at 17-18.

1.182 Flight Profiles and Briefings

Empire Airlines' ATR 42 Pilot Handbook (PH) and FTM, notes that during an Instrument Landing System (ILS) approach, the non flying pilot is to provide standard calls and procedures, keep the flying pilot advised of any deviations in altitude, airspeed, or course, and to provide a progressive brief on the approach. See Operations Group Chairman's Factual Report, p. 18.

The Descent and Approach Awareness procedure outlined in the PH and FTM requires that the non flying pilot calls out any deviations from normal altitude, airspeed, or descent rates throughout the approach, touchdown or missed approach, and specifically during the descent and approach, the non flying pilot was required to:

- Call out through FL180, set and crosscheck altimeters.
- Call out through 10,000 feet, landing and ice inspection lights on, approach checks.
- Call out 1000 feet above and below assigned altitudes. Call out star (asterisk) indication for both altitude and navigation acquisitions. ALT*, VOR*, BC*, LOC*, GS*, as appropriate.
- On the approach, check and monitor approach plates for frequencies, airport elevation, MDA or DH, missed approach procedures, descent rates, etc.
- Call "RAD ALT ALIVE" when the radio altimeter began to indicate.
- At the Final fix inbound to cross check the instruments and check the correct altitude at glideslope interception.
- Call out 1,000 feet above minimums. Instruments and altimeters crosschecked. No flags.
- Call out 500 feet above minimums. Instruments and altimeters crosschecked. No flags.
- Call out 200 feet above minimums.
- Call out 100 feet above minimums.
- Call out at minimums.
- Call out lights or runway "In sight" or "No contact."
- Captain calls "missed approach," if necessary.

Id. The Descent and Approach Awareness procedure further required that the proper mode and glideslope during coupled and/or flight director approaches be confirmed, and that the final landing checklist be completed prior to or as soon as practicable after passing the final fix. Id.

1.183 Terrain Avoidance Warning Procedure

Empire Airlines' GOM requires the flight crew to react immediately to a TWAS warning or alert, except in daylight visual meteorological conditions (VMC) when it is possible to immediately and without a doubt confirm that an impact with the ground, water, or an obstacle will take not place. See Operations Group Chairman's Factual Report, p. 18.

Specifically if the crew received a "Pull Up warning," they should:

- Advance to go around power
- Disconnect the autopilot
- Level the wings and simultaneously execute a positive pull up
- Set Flaps to go around position
- Retract the landing gear
- Maintain VmLB (in the ATR) until terrain clearance is assured using all available information

Id.

1.184 Emergency and Abnormal Guidance

In an emergency situation which requires immediate decision and action the Empire Airlines General Operations Manual (GOM) permits the pilot in command to take any action that he or she considered necessary under the circumstances, and to deviate from prescribed operations procedures and methods, weather minimums, FAA regulations, and guidelines to the extent required in the interest of safety. See Operations Group Chairman's Factual Report, p. 19. Id.

The Manufacturer's FAA approved Airplane Flight Manual (AFM) contained specific guidance regarding emergency and abnormal procedures. Id. This information was also contained in the Quick Reference Handbook (QRH), and the Flight Crew Operating Manual (FCOM). Id. Both the AFM and the QRH provide guidance in the event of a wing flaps failure, including procedures for unlocked flaps, jammed flaps, uncoupled flaps, and flap symmetry conditions. Id. Further guidance for a reduced flaps landing was also provided. Id.

1.185 Guidance Regarding Component Failure

The Empire Airlines GOM mandates that when a "failure of any component of the aircraft materially affected the safety of the flight" or if there had been some kind of structural damage (due to a bird strike, etc.), the flight crew is required to assess the damage to the aircraft after the emergency was under initial control. See Operations Group Chairman's Factual Report, p. 19.

The assessment should have included:

(1) Analysis of the affected component(s)

(2) Notification of ATC of the situation

The captain also was required to:

A. Obtain the condition of all intermediate fields in the sector, weather conditions in the vicinity of these fields and airway traffic in the area.
B. Notify Maintenance Control. Arrange for direct radio communications between Maintenance Control and the flight if desired.

1.186FAA Icing Guidance

At the time of the accident, two FAA advisory circulars were available that discussed meteorological and weather information products and services: Aviation Weather AC 00.6A and Aviation Weather Services AC 00.45F Change 1. See Operations Group Chairman's Factual Report, p. 20. These two documents were advisory in nature only and were not required to be provided to flight crews. Id.

1.187 Company Provided Icing Guidance

Empire Airlines had an FAA approved Aircraft Deicing Program (ADP) and provided guidance for on-ground icing conditions to assure that none of their airplanes was released for flight in icing conditions without determining that the airplane had been deiced/anti-iced prior to takeoff. See Operations Group Chairman's Factual Report, p. 21. The program was designed in accordance with 14 CFR 121.69 and conformed to the guidance contained in AC 120-60B. Id. The ADP contained holdover tables as a guideline on the amount of time that deicing/anti-icing fluid would protect the airplane's critical surfaces from frozen contaminants in the specified icing conditions of: active frost, freezing fog, snow, snow grains, freezing drizzle, light freezing rain, and rain on cold soaked wings. Id.

In addition to Empire Airline's FAA approved ADP that was distributed to the flight crews and provided guidance for ground de-icing, the GOM also contained information regarding flight in icing conditions. Id.; see also General Operating Manual, pp. 8-9, Exhibit 2BB. The company also provided their flight crews a two volume Pilot Handbook (PH). A review of the PH revealed that it contained the manufacturer provided icing information. Id.

1.19 Flap Actuators

1.191 Inspection

An examination of the wreckage revealed that both the left actuators were extended. See Airworthiness Group Chairman's Factual Report, p. 42. The left flaps had been exposed to fire, and both actuators were burnt, but remained attached to the wing. Id. at 21. The pistons were covered with soot indicating they extended under gravity (under flap weight) while the aircraft was still on fire. The RH inboard flap actuator was deployed

but no soot was present on the piston. The right outboard actuator of the outboard right flap was found in a fully retracted position. See Airworthiness Group Chairman's Factual Report, pp. 24, 42. It is not known whether the weight of the wing upon impact caused the actuator to become retracted.

Upon review of the actuators, with the exception of the right inboard actuator, all internal components appeared normal. Id. at 42. The left actuators were placed on a test bench and both tension and compression were established. Id. Hydraulic fluid was obtained from both left actuators and was analyzed. Id. The right actuators were bench tested and there was no movement from either piston. Id. at 43. A small fluid sample was taken from the right inboard actuator and retained. Id. Both right actuators were disassembled and greenish and granular deposits were found on the right outboard actuator. See Materials Laboratory Flap Actuators Factual Report.

The aircraft had two previous accidents while owned by Continental and sat idle for some time before FedEx purchased it. See Exhibit 7-A. It is unknown whether or not Continental serviced the actuators and whether they were damaged in the previous accidents. However, the flap actuator manufacturer's records showed that the left inboard and right outboard actuator had been recertified at the manufacturer's facility in October of 2000. See Airworthiness Group Chairman's Factual Report, p. 7.

Report 426426 states no organic pollution was found. Phenol and derivatives were present probably because of the fire.

1.20 Post-Accident Actions

The following corrective actions were taken by the following parties to the investigation.

1.201 Empire Airlines Post-Accident Actions[6]

Empire Airlines has initiated the following changes to its training and procedures.

- Empire increased the amount of time spent in ground training for all categories to include special emphasis on icing training for all ATR pilots and dispatchers.

- Flight Operations Bulletin 09-04 was issued, prohibiting takeoff and landing operations in known or reported FZRA or FZDZ. It also references the procedures to be followed for an in-flight severe icing encounter and expands on the procedure of how to use the severe icing checklist to continue an approach and landing after an inadvertent encounter with freezing drizzle, freezing rain, or severe icing.

[6] All information in this section can be found at Operations Group Chairman's Factual Report pp. 39-40.

- Service Bulletin kits were ordered for the installation of the Icing Evidence Probe (IEP) on the airplanes not so equipped and all have been installed.

- The airline is considering the options of either common charting or the use of Electronic Flight Bags (EFBs) for flight crew use. The airline is currently discussing how to most efficiently implement this policy. Once a policy has been modified, operations specification A006 will be revised to reflect this change.

- The maintenance department implemented a fleet campaign directive to remove the lids from the document cases in order to provide more effective access to the publications therein.

- Flight Information Bulletin 09-01 was sent to all ATR crewmembers explaining the proper determination and setting of airspeed bugs for flight in icing conditions. The airline also added expanded procedures to the ATR Pilot Handbook for flight crews to be aware of errors in setting airspeed bugs, and added a procedure for setting and read back of the bugs during departure and approach briefing.

- The airline devised a method on how to annotate the flight release to show if either crewmember is high minimums.

- The following guidance was sent out to all Empire check airmen and to the Flight Safety International ATR program manager:

  > "In the course of conducting flight training or checking in the ATR (Airplane or Simulator) and specifically while executing flap malfunction and reduced flap landing, do not let the crew think that you want them to continue the approach without taking the time to complete the QRH procedure(s), reset the speed bugs and re-brief the approach, etc."
  >
  > "Depending on where the crew recognizes the flap problem, they should probably ask ATC (instructor/check airman) for a delay vector or hold while they complete the QRH before continuing the approach. The point is we don't want to train or check differently than we want the crew to fly the aircraft. We should expect them to delay the approach until all the QRH procedures and briefs are complete."

- A General Operations Manual (GOM) policy change was implemented to require all ATR flights to be released under Part 121 except for training/checkride or operational check flights. Specific guidance for conducting training/checkride or operational check flights is also contained in the GOM.

- ATR provided Empire with a copy of their Flight Crew Training Manual, which contains task sharing, and priority management guidance. Empire adopted the ATR guidance and published it in their ATR Pilot Handbook.

1.202 Fed Ex Feeder Post-Accident Actions[7]

- In April 2009, FedEx facilitated a safety "summit" with their four in-house operators (Empire, Mountain Air, Morningstar in Canada and Air Contractors Dublin, Ireland) to address many of the findings from the accident and look for improvement and "best practices."

- FedEx also reviewed the training curriculum of its feeder operations.

- Mountain Air Cargo – in conjunction with their POI – performed stick shaker/pusher evaluations of additional ATR icing scenarios in Flight Safety's simulator in Atlanta, Georgia in June 2009. This information will be incorporated into the training curriculum and will consist of both recognition and recovery technique. It will also become part of a "LOFT" module that the operators will be adding.

- ATR training will be enhanced by extending the training by eight hours. Half of this time will be dedicated to systems and half to flight training.

- ATR simulator training will be enhanced by extending the initial simulator training duration by two sessions. Upgrade simulator training will be increased by one session.

- All operators have incorporated a system of ensuring airspeed bugs are properly configured for all phases of flight. With only minor variations, each operator has developed a system in which each crewmember identifies and calls out the appropriate speed settings using the V-Speed cards, sets the bugs, and then cross-checks the settings.

- Ice evidence probes have been ordered and have been installed on all FedEx Feeder ATRs.

SECTION 2. ANALYSIS

2.1 Analysis of Design and Certification

2.11 FAA Acceptance of European Certification

[7] All information in this section can be found at Operations Group Chairman's Factual Report, pp. 40-41.

DGAC France certified the ATR 42-320. See Exhibit 13-F. The original certification basis for the ATR 42-320 was JAR change 8 for paragraph 25.669, which was similar in content to FAR 25.600 amendment level 25-23. See Airworthiness Group Chairman's Factual Report, p. 41. However, at the time the ATR 42 was certified, cockpit indication of a flap asymmetry was not required by the JAR. Id.

As a result of the bilateral agreement between the United States and France, the FAA accepted the original certification basis without insisting upon any additional requirements, and issued a type certificate on August 15, 1998. See Exhibit 13-F; see also Hearing Transcript, pp. 229-30.

It is noteworthy that later models of the ATR aircraft were equipped with cockpit indicators of flap asymmetry. See Airworthiness Group Chairman's Factual Report, p. 41. According to ATR, all ATR 42-200/-300/-320 do not have a flap asymmetry indication in the cockpit, while all ATR 42-400/-500 and ATR 72-101/-102/-201/-202/-211/-212/-212A have a flap asymmetry indication in the cockpit. Id. at n. 17.

It is also noteworthy that the addendum to the Airworthiness Group Chairman's Factual Report contains a list of aircraft certified offering alternatives to equipping the aircraft with a cockpit indication of an asymmetrical flap deployment. Only three aircraft types (including the ATR42-200, 300, and 320 series aircraft) were certificated without it.

2.2 Icing

Icing did not cause the flap asymmetry condition. As noted in Section 1.17 above, the initial examination of the wreckage revealed the presence of ice on the right aileron. See Operations Group Chairman's Factual Report, p. 32. The captain also stated that the airplane had been picking up ice on the approach. See Airplane Performance Study, p. 3. The FDR data and ATR simulation analysis of the accident indicates that the ice accretion during portions of the flight was significant, but that it never exceeded the control authority of the ATR42. See Airplane Performance Study, p. 17.

2.3 Flap Actuators

2.31 Flap Asymmetry

The aircraft performance was analyzed in a study conducted by the NTSB, which determined that there existed a flap asymmetry of between 8°-10° of actual deflection on the left flap and zero on the right flap. See Airplane Performance Study, p. 3.

2.32 Prior fire and Corrosion

The airplane was previously owned by Continental Airlines and is thought to have experienced two accidents and at least one incidence of fire. See Airworthiness Group Chairman's Factual Report, p. 4.

2.33 Testing

Testing of the flap actuators has not established why the actuator jammed and caused the flap asymmetry.

2.4 Lack of Flap Asymmetry Indicator

2.41 Lack of Asymmetry Indicator on ATR42

In a memorandum dated May 15, 2009, an FAA inspector concluded that the cause of the loss of control and resulting crash was the lack of a flap asymmetry indicator in the cockpit. See Federal Aviation Administration Memorandum, Exhibit 13-K. Empire Airlines agrees fully. The memorandum noted that the ATR-72 is equipped with a flight asymmetry warning circuit while the ATR42 is not. Id. at 2. The memorandum further stated French DGAC, who oversaw the manufacture of the ATR42, must have believed the aircraft met the requirements of 14 CFR 25.699 and therefore, did not require that a flap asymmetry circuit be installed. Id. The French DGAC must have assumed an equivalent level of safety by finding this asymmetric scenario controllable by flight crews, but did not take into account this asymmetric flap condition in an icing environment. Id.

The FAA memo further provided that a review of the wiring schematics shows the aircraft is equipped with an asymmetry input to the flight data recorder. Id. This same circuit would require a very minimal change to power a flap asymmetry warning light as well as activate a level 2 centralized crew alerting system that would alert the crew by an additional warning light and single chime. Id.

The memorandum concludes by recommending the installation of a flap symmetry circuit that would alert the crew of the unsafe condition. Id. Had the indicator been installed prior to the incident, the accident would have been prevented. Id.

2.42 Impact on CRM

According to the Empire Airlines General Operations Manual, (GOM), in an emergency situation that requires immediate decision and action, the pilot in command could take any action that he or she considered necessary under the circumstances and could deviate from prescribed operations, procedures and methods, weather minimums, FAA regulations, and guidelines to the extent required in the interest of safety. See General Operations Manual, 11-3, Exhibit 2-JJ.

The manufacturer's FAA approved Airline Flight Manual (AFM), the Quick Reference Handbook (QRH) and the Flight Crew Operating Manual (FCOM) also contains guidance regarding emergency and abnormal procedures. See Quick Reference Handbook, Exhibit 2-Z. Specifically, both the AFM and the QRH provide specific guidance with respect to wing flap failures, unlocked flaps, jammed flaps, uncoupled flaps and flap asymmetry conditions.

However, the lack of a flap asymmetry indicator in the ATR42 resulted in the flight crew having only an indication of a flap anomaly without any indication of the type of anomaly. As a result, the flight crew was required to spend valuable time and resources attempting to determine the unknown flap anomaly which prevented it from being able to utilize the proper guidance for an asymmetrical flap condition.

2.5 Training

2.51 Flap Asymmetry Training

Empire Airlines provides its pilots with all required training for the ATR42. The Empire Airlines training curriculum followed the manufacturer's guidelines. The required training includes flap anomalies, including, no flaps, jammed flaps and uncoupled flaps it does not include training for flap asymmetry.

2.6 Flight Crew

2.61 Flight Crew Followed Proper Procedures Regarding In-flight Flap Anomaly

The Quick Reference Handbook (QRH) stated the procedures for flight crews to follow in the event of a flap anomaly. See Human Performance Specialist's Factual Report, p. 5; see also Quick Reference Handbook, p. 2.21, Exhibit 2-Z. However, before following any procedure outlined in the QRH, the QRH indicates the "crew must assess the situation as a whole, taking into consideration, the failures, when fully identified, and the flight constraints imposed." See Quick Reference Handbook, p. 0.02.

On the day of the accident, the captain selected the flaps 15 degrees, but noticed that the indicator was at zero. See Interview Summaries of Captain Rodney Holberton, p. 5, Exhibit 2-F. The captain, therefore, knew there was a flap anomaly, but there were no indication that the problem was an asymmetric flap. Consistent with the QRH and the training received by both the captain and the first officer, the captain attempted to figure out the nature of the problem before following any additional procedures. See Human Performance Specialist's Factual Report, p. 5; see also Hearing Transcript pp. 34, 65-66. Therefore, the captain repositioned the flap handle several times and checked the circuit breakers with a flash light. See Human Performance Specialist's Factual Report, p. 5.

The first officer testified that the captain checked the circuit breakers "because we are trained to figure out what the problem is by any means necessary." See Hearing Transcript, p. 34. By assessing the situation to determine the nature of the problem, the flight crew followed the in-flight anomaly procedures outlined in the QRH. However, if the ATR 42 aircraft had a cockpit indication of a flap asymmetry, the captain would not have been required to try to diagnose the situation and would have known he had a flap asymmetry.

2.62 Flight Crew Followed Proper Icing Procedures

The first officer, Heather Cornell, stated that the crew departed AFW enroute to LBB and encountered rime ice at Flight Level 180. See Summary of Interview of Heather Nicole Cornell, p. 2, Exhibit 2-G. The crew had lost some airspeed and requested a lower altitude. Id. The ice dissipated at 14,000 feet Mean Sea Level (MSL). Id. The crew members did receive an ice aural warning chime and the level three ice protection was activated. Id. While the captain reported moderate icing to ATC, the first officer noted ice on the wind screens and the spinner of the propeller. Id. When the aircraft was at 18,000 feet MSL, the first officer noticed ice on the window which was shaped like fingers. Id. The propellers were already set to eighty six percent RPM with the ice protection activated. Id.

Captain Holberton stated in his interview that they did pick up ice on the airframe at all altitudes except 14,000 feet MSL. Id. at 6. He said he saw two inches of ice on the windshield wiper probe in the shape of a finger. Id. The captain stated they did receive an ice detect indication and that Empire Airlines had its icing procedures on the control yoke. Id. The captain was aware of the freezing drizzle conditions in LBB and was aware of the freezing drizzle before he selected the flaps to 15 degrees. Id. There were no other aircraft in the area during this time. Id. He was aware there was still ice on the airplane before they reentered icing conditions in LBB. Id.

The captain had extensive experience flying in icing conditions with 13,000 hours in various aircraft including BE-18, Caravans, F-27, and the ATR. The captain had an estimated 1500 hours as pilot in command in the ATR and over 6,000 hours in the Caravan, as well as 600 hours as a first officer in the F-27. See Human Performance Specialist's Factual Report, p. 2; see also Interview Summaries of Captain Rodney Holberton, p. 7, Exhibit 2-F. He stated there was a no freezing drizzle restriction for the Caravan, but for the F-27 and ATR, operations in freezing drizzle was permitted. See Interview Summaries of Captain Rodney Holberton, p. 7.

2.63 Bug Speeds

As they were set, the airspeed bugs should have had no impact on the unstabilized approach or the crash of the airplane. Examination of both Airspeed Indicators revealed that the airspeed bugs were in the following positions:

Captain's Airspeed Indicator:

- Internal Bug: 109 KTS
- Yellow Bug: 110 KTS
- White Bug: 124 KTS
- Red Bug: 145 KTS

First Officer's Airspeed Indicator

- Internal Bug: 106 KTS

- Yellow Bug: 112 KTS
- White Bug: 126 KTS
- Red Bug: 144 KTS

See Operations Group Chairman's Factual Report, p. 26. The Red Bug, which is the minimum airspeed for flap retraction to flaps 0 (takeoff phase), and the minimum airspeed to operate the airplane with flaps 0 (cruise and approach phases) in icing conditions, was the only relevant bug speed at the time of the approach and landing given the icing conditions. The Red Bug should have been set to 143 KTS. Id. As noted above, both members of the flight crew had the red bug set 1 to 2 KTS in excess of the minimum bug speed. The fact that the internal and yellow bugs were set slightly below the indicated minimum speeds had no impact on the landing approach.

2.64 CRM

Captain Holberton stated that the ATIS reported rapidly changing weather and the current weather could be obtained from ATC. See Interview Summaries of Captain Rodney Holberton, p. 5, Exhibit 2-F. ATC handed off the flight to LBB approach control and cleared them to descend to 6,000 MSL. Id. LBB ATC informed them of the freezing drizzle conditions in LBB. Id. The weather had improved to five hundred feet overcast ceiling with two miles visibility, and a ten knot tail wind. Id. They were cleared for the ILS Approach to runway 17R and cleared to descend to 5,000 and were vectored for the approach to runway 17R. Id. The captain stated ATC had to give additional vectors due to a wind shift from 6,000 feet to 5,000 feet MSL. Id.

The captain briefed the approach. Id. He selected flaps 15 degrees and noticed the flaps were indicating zero. Id. He could not state with specificity the time between when he selected 15 degrees of flaps and noticed 0 on the indicator. Id. He then moved flap handle back to 0, and he left it there because he did not want the flaps to inadvertently travel during the approach. He said he looked over and saw the first officer flying the approach when it should have been coupled to the ILS. Id. He was unsure as to why the autopilot had disconnected without his hearing the aural alert. Id. The captain noticed they were slightly right of the localizer course. Id. He then asked the first officer if she wanted him to take the flight controls, to which she replied in the affirmative. Id. After the captain was established on course, he checked the Advisory Display panel for the reason why the autopilot was not displayed. Id.

The captain did not have the opportunity to run the abnormal procedure checklist. Id. at 6. He was actively attempting to determine the cause of the flap malfunction. See Human Performance Specialist's Factual Report, p. 6. Captain Holberton decided not to go around because "things started piling up and it was better to land than to go around." See Interview Summaries of Captain Rodney Holberton, p. 5, Exhibit 2-F.

Once the flap anomaly was discovered, the flight crew had less than two minutes to attempt to determine the exact nature of the anomaly and select the proper course of action in response to the anomaly. Without any viable method to determine that the aircraft had a flap asymmetry, the captain determined that with an unknown flap anomaly

that the best decision was to leave the flaps in the current position and to land the aircraft. His decision took into consideration the icing conditions, the condition of the runway, and the fact that a go-around would require the use of full power into icing conditions with no indication of how the aircraft would react to the application of full power with the unknown flap anomaly.

SECTION 3. FINDINGS

1. The flight crew was properly certified and qualified in accordance with applicable Federal Regulations.

2. Neither the Captain nor the First Officer had a history of previous accidents, incidents, or disciplinary actions.

3. The airplane involved in the accident was a N902FX, Aerospatiale Alenia ATR 42-320.

4. The airplane was properly certified, equipped, and maintained in accordance with applicable Federal Regulations.

5. The ATR 42-320 was originally certified by DGAC France.

6. As a result of the bilateral agreement between the United States and France, the FAA accepted the original certification basis.

7. The flight crew received all required training on the ATR42.

8. Empire Airlines provided the flight crew with all required training on the ATR42.

9. The required training for the ATR42 does not include training for flap asymmetry.

10. During the approach to LBB, the Captain selected flaps to 15 degrees, but noticed that the indicator was at zero, at which time he realized there was a flap anomaly.

11. Despite knowing a flap anomaly existed, the Captain had no indication as to the type of anomaly.

12. The Captain properly followed the procedures as outlined in the Quick Reference Handbook (QRH) and attempted to determine the type of flap anomaly the aircraft was experiencing.

13. In an attempt to ascertain the anomaly, the Captain repositioned the flap handle several times and then checked the circuit breaker with a flash light.

14. The flap handle was then placed in the up or retracted position, as the Captain did not want the flaps to inadvertently travel during the approach.

15. The Captain was never able to determine the type of flap anomaly, and therefore, he was not able to run the abnormal procedure checklist and follow the procedures for an asymmetrical flap condition as outlined in the AFM or QRH.

16. There existed a flap asymmetry of between 8º-10 º of actual deflection on the left flap and zero on the right flap.

17. It has not been established why the flap actuator jammed and caused the flap asymmetry.

18. The ATR42 does not have a cockpit indicator of flap asymmetry.

19. The lack of a cockpit flap asymmetry indicator was a contributing cause in the crash.

20. Had the ATR 42-320 had a cockpit indicator of a flap asymmetry the accident could have been prevented.

21. By first attempting to diagnose the problem by determining the type of flap anomaly, the flight crew followed proper procedures regarding the in-flight anomaly.

22. Based on a review of the circumstances, the Captain determined it was best to land the aircraft, despite the unknown flap anomaly.

23. LBB approach informed the flight crew of "light freezing drizzle" conditions in LBB.

24. Initial examination of the wreckage revealed the presence of ice on the right aileron.

25. Although the icing condition during portions of the flight was significant, it never exceeded the control authority of the ATR42.

26. Icing did not cause the flap asymmetry condition.

27. The flight crew followed the proper icing procedures.

28. The Red Bug, the only relevant bug speed at the time of the approach and landing given the icing conditions, was set 1 to 2 KTS in excess of the minimum bug speed.

29. The settings for the remaining airspeed bugs should have had no impact on the unstabilized approach or the crash of the airplane.

SECTION 4. PROBABLE CAUSE

The probable cause of this accident was a failure, for unknown reasons, of the flap actuator(s) resulting in a flap asymmetry condition that was unknown to the flight crew due to the lack of a

flap asymmetry indicator which prevented the crew from being able to timely initiate the proper procedures.

SECTION 5. CONTRIBUTING CAUSES

5.1 The Lack of Flap Asymmetry Indicator

Shortly after the first officer, the pilot flying, called for a flap and gear extension, the flight crew determined that it had a flap anomaly. The lack of a flap asymmetry indicator in the ATR42 resulted in the flight crew having only an indication of a flap anomaly without any indication of the type of anomaly. As a result, the flight crew was required to spend valuable time and resources attempting to determine the unknown flap anomaly, which prevented it from being able to utilize the appropriate guidance in the QRH and AFM for an asymmetrical flap condition.

5.2 Impact on Stabilized Approach

The FDR recorded a flap asymmetry at 1034:24, shortly after the first officer, the flying pilot, called for a flap and gear extension just outside the LOM. See Airplane Performance Study, p. 3. The FDR data also show that while flying between 160 KIAS and 120 KIAS, approximately 20° of left control wheel was required to counter the flap asymmetry i.e., 8°to 10° of actual deflection on the left flap and zero on the right flap. Id. The ATR42 flap design limits the maximum flap asymmetry to approximately 9°. Id.

The approach flap setting for the ATR42 is 15°. Id. at 4. N902FX had 8° to 10° deflection on the left flap only. Id. As a result, "typical" power settings used during approach would not have applied to the accident approach. Id.

The flap asymmetry coupled with the ice accretion, affected the performance of the aircraft in that the typical power setting used during an approach were inadequate to allow the flight crew to maintain a stabilized approach.

SECTION 6. SAFETY RECOMMENDATIONS

The FAA should issue an Airworthiness Directive requiring all ATR42 aircraft to have instrumentation and/or warnings installed in the cockpit to alert the crew to an asymmetric flap condition.