NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 4, 2014

Group Chairman's Factual Report

OPERATIONAL FACTORS

DCA13FA094

A. ACCIDENT

Location:	Newark International Airport, New Jersey (EWR)
Date:	May 18, 2013
Time:	0104 EDT
Airplane:	DHC8-102, N934HA

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C. SUMMARY

On May 18, 2013, about 0104 eastern daylight time[1], a Piedmont Airlines (PDT) Bombardier DHC8-102, N934HA, operating as US Airways Express flight 4560, intentionally landed with all gear retracted on runway 4L at Newark Liberty International Airport (KEWR), Newark, New Jersey. During the original approach, the left main landing gear failed to lower and lock prior to landing. The flight crew performed the applicable emergency procedures to lower left main landing gear but all attempts were unsuccessful. The airplane sustained substantial damage but there were no injuries to the three crewmembers or 31 passengers onboard. The flight was operating under the provisions of 14 CFR Part 121 and originated from Philadelphia International Airport (KPHL), Philadelphia, Pennsylvania.

D. DETAILS OF THE INVESTIGATION

The Operations Group conducted telephone interviews with the two incident pilots on May 24, 2013. Requests were made to Piedmont Airlines and Bombardier for flight documents, crew

[1] All times in this report are eastern daylight time (EDT)

information and manuals and to FAA for crew background documents. Additional information was obtained from Piedmont officials in June, 2013.

E. FACTUAL INFORMATION

1.0 History of the Flight

According to information provided by Piedmont Airlines, the flight departed PHL at 10:52 PM on May 17, 2013 with a crew of two pilots and one flight attendant and 31 passengers on board. The accident flight was the crew's sixth flight on the third day of a planned four day trip. The first officer (FO) was the pilot flying (PF). At about 11:25 PM the airplane was cleared for an ILS approach to runway 4R at EWR. The weather conditions as recorded on the automatic terminal information service (ATIS) were winds 080 degrees at 3 kt., visibility 10 statute miles, few clouds at 20,000 ft. AGL[2], temperature 19 degrees Celsius and dew point 5 degrees Celsius. When the landing gear was lowered on the approach to runway 4R at EWR, the left main landing gear (MLG) showed a red unsafe indication. The captain received approval from the EWR tower to perform a fly-by[3] and the tower confirmed the left MLG appeared to be partially extended.

The FO performed a missed approach and the flight was provided Air Traffic Control (ATC) vectors and clearance to maintain 3,000 ft. MSL[4]. The captain initiated the alternate landing gear extension checklist, but decided to take over PF duties and allow the FO to run the checklist.[5] The FO read and the captain confirmed the steps in the checklist as the FO performed them. The FO stated when he pulled the main gear release handle the gear did not extend. When asked by the captain if the checklist was complete, the FO said it was. He had not read the notes at the bottom of the checklist which discussed the use of a hydraulic pump handle and the high force that might be needed on the alternate gear extension handle. The FO stated he had performed an alternate gear extension twice before and was familiar with the force required on the handle.

After again giving PF duties to the FO, the captain called company operations and spoke with a maintenance control supervisor, who advised they should use the hand pump to extend the MLG. With the captain then acting as the PF, the FO got out of his seat to get better leverage on the pump handle and made repeated attempts to pump the gear down without success. With the FO flying, the captain got out of his seat and attempted to operate the pump, also without success. The captain stated he left the cockpit to inspect the MLG from the cabin and observed the gear doors were open but the left MLG was not extended.

Following a second tower fly-by the tower re-confirmed the left MLG was not down. At the suggestion of the maintenance control supervisor who was on the radio, the crew reconfigured the alternate gear system to normal, raised all the landing gear, and then re-extended them using the normal system. The left MLG again showed a red unsafe indication. The crew then retracted

[2] Above ground level
[3] A low altitude flight past the tower
[4] Mean sea level
[5] The PDT Pilot Operating Handbook (POH) stated the captain should be the PF and the FO should be the PM due to the proximity of the alternate extension checklist items.

the landing gear using the normal system. The captain requested the maintenance supervisor to contact the flight duty officer and he was told a company management conference call was in progress and they were discussing the best landing configuration. According to recorded information, the captain briefed the flight attendant and told her to prepare for an emergency landing.

At the suggestion of the company maintenance control supervisor, the crew attempted once again to lower the gear while applying a positive G force to the airplane. This maneuver was not successful. The captain again asked the supervisor if the company had any advice as to the best emergency landing configuration. The crew made one more attempt to extend the gear normally without success, then retracted the gear and left it retracted for the reminder of the flight.

With fuel remaining at 900 lbs., the captain decided to make an emergency landing with all landing gear retracted and the company agreed. The captain made a passenger address (PA) announcement, briefed the FO on the planned landing, and called for the emergency landing checklist. In accordance with the checklist he pulled the B3 GPWS[6] circuit breaker (CB)[7]. The captain flew the ILS approach to runway 4L. The FO stated that during the approach the landing gear warning horn, which he described as "dominating," sounded when they slowed below 130 kts. and the captain maintained a speed above 130 kts. to prevent the horn from sounding until "he was close to the runway." After the captain called for the flaps to be selected to 35, the landing gear warning horn continued to sound until after landing. According to Piedmont personnel, the airplane landed about 3,000 ft. down the runway and slid approximately 2,000 ft., stopping on the runway centerline in a wings level attitude.

The captain stated that after landing he observed smoke on the right side of the airplane which he attributed to aluminum oxide particles. He notified the tower they were evacuating and gave a verbal command to the FO and flight attendant to evacuate using the left main cabin door. The passengers and crew assembled in a grassy area and no one reported any injuries.

2.0 Flight Crew Information

2.1 The Captain

The captain of the flight was 60 years of age. The captain stated he had been a captain on the DHC-8 since the company had acquired the airplanes around 1992. He stated he had about 22,000 hours of flight time on the DHC-8. He had been continuously employed by Piedmont or its predecessor, Allegheny Airlines, since June 8, 1988.

According to company records, the captain began a four day trip on May 15, 2013. The incident took place on the sixth and final leg of the third duty day. On the day of the incident he began duty at 1255. The captain stated he had received good rest and was not affected by fatigue or other personal issues.

[6] Ground proximity warning system
[7] The checklist also called for the B9 CB to be pulled, but the captain was recorded as saying that CB did not exist.

Regarding company training for a partial gear up landing, the captain stated he thought the subject had been discussed at some point in the past. He stated the case with the nose wheel retracted was fairly controllable, but the worst case was one MLG up and one down due to possible loss of control. He did not recall any formal training on the subject. He stated it was his thinking that with the nose and right MLG extended they would have no nosewheel steering and would rely on rudder, and as soon as the wing dropped the fuselage and wingtip would touch. He would need to use full right brake and reverse on one prop and he was not sure if he could control it. A ground loop was highly probable. With all the gear retracted he expected all the people would be able to walk away.

2.1.1 The Captain's Pilot Certification Record

Records from the FAA showed the captain's progressive record of certification and original issue dates as follows:

Private Pilot – Airplane Single Engine Land – February 9, 1981
Commercial Pilot – Rotorcraft - Helicopter – March 23, 1983
Instrument Helicopter
Commercial Pilot – Airplane Multiengine Land – September 29, 1986
Instrument Airplane
Airline Transport Pilot – Airplane Multiengine Land – March 31, 1990
BE1900/BE300 Type rating
SIC required
Airline Transport Pilot – Airplane Multiengine Land – July 24, 1990
BE1900/BE300 Type rating (SIC removed)
Airline Transport Pilot – Airplane Single Engine Land – May 5, 1992
SD3 type rating added
Airline Transport Pilot – Airplane Multiengine Land – October 7, 1993
DHC-8 type rating added

2.1.2 The Captain's Pilot Certificates and Ratings Held at Time of the Accident

The captain's FAA Airman Certificate showed the following:

Airline Transport Pilot: Airplane Multiengine Land
Type Ratings: BE-1900, BE-300, SD-3, DHC-8
Commercial Privileges: Rotorcraft-helicopter, Instrument-Helicopter
Private Privileges: Airplane Single Engine Land

Records from the FAA showed the PIC's most recent medical certificate to be:

First Class
Date: December 28, 2012
Limitations: must have available glasses for near vision

The captain was wearing his glasses during the event. The captain had no prior accidents, incidents or enforcements according to a review of FAA records.

2.1.3 The Captain's Training and Proficiency Checks Completed

The captain's training record showed the following events and dates:

Special Training – May, 2013
CQLOE Continuing Qualification Line Operational Evaluation – April, 2013
Continuing Qualification Systems Validation – April, 2013
Continuing Qualification Ground Training - April, 2013
Wind Shear Training - April, 2013
Continuing Qualification Maneuver Validation SAT 04/13
HAZMAT Training SAT 04/13
Recurrent Emergency Door Operations - April, 2013
Aircraft Operator Security - April, 2013
Continuing Qualification Systems Written - April, 2013
Winter Operations Written – November, 2012
Continuing Qualification Online Evaluation – August, 2012
Continuing Qualification Online Evaluation – April 2012

A review of the captain's training records from 2005 to the present showed no unsatisfactory events.

2.1.4 The Captain's Flight Times

The captain's flight times, based on pilot statements and Piedmont Airlines records:

Total pilot flying time	28,000 hrs.
Total Pilot-In-Command (PIC) time	25,000 hrs.
Total DHC8 flying time	22,700 hrs.
Total flying time last 24 hours	4.6 hrs.
Total flying time last 7 days	11.1 hrs.
Total flying time last 30 days	39 hrs.
Total flying time last 90 days	158 hrs.

2.2 The First Officer

The first officer was 25 years of age. He stated he had been in his current position as a DHC-8 FO since he was hired by Piedmont on April 4, 2011. He stated he had logged 1,700 hours in the DHC-8. On the day of the accident he started his duty day at 1255 at Binghamton (BGM) airport. He had been on duty about 12 hours at the time of the accident. He felt rested when he reported

for duty and did not feel that fatigue or other personal issues affected him during the accident flight.

The FO had performed two previous alternate gear extension procedures, and in both cases the landing gear had extended without the need for use of the hand pump. He stated during the accident flight he "really pulled" the alternate gear handle all the way multiple times.

Regarding the decision to land with all gear retracted, the FO stated he felt it was the best choice. He stated landing with the nose gear and the right main extended created a balance issue and made it difficult to keep the prop on the gear retracted side from hitting the ground. The airplane could spin and the prop could shatter, puncturing the cabin or a fuel cell. This was a larger risk than landing gear up, which allowed them to keep the wings level. He had not practiced a partial gear extension in the simulator, but he had been trained to understand how the props can shatter and he had seen a video where a Q400 had this happen. He did not recall seeing a PowerPoint presentation on alternate gear extension and landing with partial gear extended.

2.2.1 The F/O's Pilot Certification Record

Records from the FAA showed the FO's progressive record of certification and original issue dates as follows:

Private Pilot – Airplane Single Engine Land – September 24, 2005
Private Pilot – Airplane Single Engine Land – Instrument Airplane – November 28, 2007
Commercial Pilot – Airplane Single Engine Land – January 31, 2008
Instrument Airplane
Commercial Pilot – Airplane Single and Multiengine Land – May 3, 2008
Instrument Airplane
Commercial Pilot – Airplane Single Engine Sea – January 24, 2010
Commercial Pilot – Airplane Single Engine Land and Sea – December 9, 1989
Airplane Multiengine land
Instrument Airplane
DHC-8 type rating SIC privileges only

The FO was not approved for his private pilot instrument rating on a practical test November 27, 2007. Reexamination items were preflight preparation and procedures, ATC clearances, flight by reference to instruments, navigation systems, instrument approach procedures, emergency procedures, and post flight procedures. He successfully completed the rating on November 28, 2007. According to the FAA form 8710, he had 220 total hours flight experience at that time.

2.2.2 The F/O's Pilot Certificates and Ratings Held at Time of the Accident

The FO's FAA Airman Certificate showed the following:

Commercial Pilot Privileges: Airplane Single Engine Land and Sea
Airplane Multiengine land
Instrument Airplane

DHC-8 type rating SIC privileges only

Records from the FAA showed the FO's most recent medical certificate to be:

First Class
Date: February 18, 2013
Limitations: must wear corrective lenses

The FO was wearing his glasses during the event. He had no prior accidents, incidents or enforcements according to a review of FAA records.

2.2.3 The F/O's Training and Proficiency Checks Completed

The FO's training record showed the following events and dates:

CQLOE Continuing Qualification Line Operational Evaluation – April, 2013
Continuing Qualification Systems Validation – April, 2013
Continuing Qualification Ground Training - April, 2013
Wind Shear Training - April, 2013
Continuing Qualification Maneuver Validation – April, 2013
HAZMAT Training - April, 2013
Recurrent Emergency Door Operations - April, 2013
Aircraft Operator Security - April, 2013
Continuing Qualification Systems Written - April, 2013
Winter Operations Written – November, 2012
Weight and Balance Training – November, 2012
Continuing Qualification Online Evaluation – August, 2012

A review of the FO's training records from 2005 to the present showed no unsatisfactory events or retraining required.

2.2.4 The F/O's Flight Times

The accident F/O's flight times, based on pilot statements and Piedmont Airlines records:

Total pilot flying time	2,000 hrs.
Total PIC time	240 hrs.
Total DHC-8 flying time	1,684 hrs.
Total flying time last 24 hours	4.6 hrs.
Total flying time last 7 days	11.1 hrs.
Total flying time last 30 days	73 hrs.
Total flying time last 90 days	203 hrs.

3.0 The Airplane

The accident airplane was a Bombardier DHC8-102, registration N934HA, a twin engine turboprop aircraft. It was commonly referred to as the "Dash 8." The DHC8-100 series was the first version of the design produced. Later models were the DHC8-200, -300 and -400. The DHC8 was originally produced by de Havilland of Canada beginning in 1984. The DHC8-400 model is now produced by Bombardier. According to Bombardier data, as of December 31, 2013 a total of 1,125 Dash 8's had been built, of which 299 were the DHC8-100 version.

3.1 Airplane Performance

3.1.1 Weight and Balance

The following weight and balance information was taken from the load manifest for the flight. Limitations were obtained from the Piedmont Airlines Dash 8 Pilot Operating Handbook (POH).

Basic Operating Weight	23,913 lbs.
Passenger Weight (31 adult passengers x 184 lbs.)	5,704 lbs.
Baggage Weight	650 lbs.
Zero Fuel Weight	30,267 lbs.
Maximum Zero Fuel Weight	31,400 lbs.
Fuel	3,200 lbs.
Ramp Weight	33,467 lbs.
Maximum Ramp Weight	34,700 lbs.
Taxi Fuel	200 lbs.
Takeoff Weight	33,267 lbs.
Maximum Allowable Takeoff Weight	34,500 lbs.
Actual Landing Weight	31,067 lbs.[8]
Maximum Landing Weight	33,900 lbs.
Takeoff Center of Gravity	27 % MAC[9]

3.1.2 Approach Speed

According to the Piedmont Airlines POH, the Vref speed for a flaps 35° landing at a landing weight of 31,000 lbs. was 88 kts.[10] The Piedmont POH page 9-79, Approach Procedures, stated the approach speed for a standard approach, which was to be flown during a non-normal or emergency situation, was Vref + 20 kts. at 1000 ft. above the touchdown zone for a visual approach, Vref + 10 at 500 ft. above the touchdown zone, and Vref crossing the threshold.

In an interview the FO stated the captain maintained an approach speed of just above 130 kts. until approaching the runway to avoid having the landing gear warning horn sound.

[8] Based on reported landing fuel on board of 800 lbs.
[9] Derived from 7.1 loaded CG index
[10] See attachment 3

3.1.3 Flap and Alternate Gear Speed Limitations

According to the Piedmont POH Limitations Section, paragraph 7.4.1, the maximum flap extended speed (VFE) for the DHC8-102 model was:

Flaps 5°	148 kt.
Flaps 15°	148 kt.
Flaps 35°	130 kt.

According to the Piedmont POH Limitations Section, paragraph 7.4.1, the maximum alternate gear extension speed was 140 kt. A note stated "under this mode of extension, speed is limited because all wheel well doors remain open after gear is fully down."

3.2 Airplane Systems

The following information was taken from the Piedmont Airlines DHC8 Systems Manual and training materials.

3.2.2 Landing Gear

The DHC8-100 has a tricycle landing gear normally operated by the #2 hydraulic system. The two main landing gear (MLG) retract rearward into the respective engine nacelles and the nose landing gear (NLG) retracts forward into a NLG well. The NLG has two landing gear doors and each MLG has three landing gear doors (forward, center and rear) which are automatically sequenced during extension and retraction of the gear. Proximity sensors and a proximity switch electronics unit (PSEU) control the sequencing of the gear and gear doors during extension and retraction and provide signals to the gear and gear door advisory lights.

3.2.3 Landing Gear Indication

A landing gear actuation and indication panel is located on the forward engine indication panel[11]. In addition to the landing gear selector lever, the panel has nine landing gear advisory lights, three for each gear. The top three lights are door open advisory lights and illuminate amber when the respective gear door remains open after extension or retraction. The center three lights illuminate green when the respective gear is down and locked. The bottom three lights are gear unsafe advisory lights and illuminate red when the respective gear is not locked up or down. An amber light in the landing gear selector lever illuminates concurrent with red unsafe lights to indicate gear in transit.

A landing gear inoperative warning light illuminates amber on the caution light panel when there is a gear door sequence failure after gear retraction.

[11] See attachment 4

3.2.4 Landing Gear Warning Horn

When the airplane is in flight a landing gear warning horn sounds and cannot be silenced when airspeed is less than 130 kts., power levers are near flight idle, and the gear is not down and locked. The horn can be silenced by a mute button on the gear actuation panel if only one power lever is near flight idle.

3.2.5 Alternate Gear Extension System

An alternate gear extension system provides for mechanical extension of the landing gear. The system relies on gravity to extend the gear; a hydraulic hand pump is provided to assist the MLG to fully extend if necessary. The alternate gear extension controls consist of an alternate release door and MLG extension T-handle in the cockpit ceiling above the FO, a landing gear down select inhibit switch also located in the cockpit ceiling above the FO, an alternate extension panel in the cockpit floor behind and to the left of the FO, and a NLG extension T-handle, a MLG extension hand pump and three alternate gear position indicators located in the floor panel.

Opening the ceiling alternate release door activates a bypass valve which returns hydraulic fluid in the landing gear system to the reservoir. Moving the inhibit switch in the cockpit ceiling to "inhibit" disables normal hydraulic extension of the landing gear. Pulling the MLG extension T-handle releases the MLG door uplocks and the MLG uplocks, allowing the MLG to free fall. Opening the alternate extension panel door in the cockpit floor activates a valve which permits the MLG hand pump to function. Pulling the NLG extension T-handle releases the NLG door uplocks and the NLG uplocks, allowing the NLG to free fall. Moving the pump handle up and down provides hydraulic pressure to assist the MLG in becoming fully extended. The alternate gear position indicators provide a positive indication that each of the three landing gear are fully extended when the downlock verification switch within the floor panel is selected on.

3.3 Airplane Abnormal Procedures

3.3.1 Piedmont Procedures

The Piedmont Pilot Operating Handbook (POH), section 9.18.26, "Landing Gear Malfunctions," stated that in the event of an alternate gear extension the captain will become the PF and the FO the PM due to the proximity of the extension controls.[12]

According to the accident FO, the crew ran three abnormal procedures from the Piedmont Airlines Dash 8 Model 102 Non-Normal and Emergency Checklist[13]. They were:

- Illumination of red landing gear unsafe light
- Alternate landing gear extension
- Emergency landing procedure

[12] See attachment 5
[13] See attachment 6

The Piedmont emergency landing procedure did not distinguish between landing with landing gear extended or retracted. Procedural steps were:

• Instruct flight attendant to brief and prepare passengers as appropriate to the emergency.
• If possible, ensure that no passengers are seated in the rotational plane of the propellers.
• Secure all loose items in the flight compartment and cabin.
• Complete all necessary radio communications concerning the intended landing with ground support personnel.
• Review the procedures to be followed, covering all aspects of crew actions and coordination.
• Consider the suitability of a practice approach.
• Ensure that both pilots' shoulder harnesses are secure and locked.
• Deactivate the GPWS by pulling GPWS circuit breakers **B3** and **B9** on the avionics circuit breaker panel.
• Cabin altitude Auto/Man/Dump switch ..... Dump
• Emergency light switch ..... On
• Battery Master switch ..... Off
• Emergency Landing Procedures checklist ..... Complete

3.3.2 Bombardier (deHavilland) Procedures

The Bombardier (deHavilland) DHC8-102 Quick Reference Handbook (QRH) emergency landing procedure was revised in 2009.[14] It provided procedures for landing with the landing gear extended and for landing with the landing gear retracted. The procedure for landing gear retracted called for the landing gear warning horn circuit breaker to be pulled prior to landing.

The Bombardier (deHavilland) DHC8-102 Operating Data Manual (ODM) Safety of Flight Supplement No. 9[15], dated January 10, 1997, addressed alternate landing gear extension and emphasized the importance of applying sufficient force on the gear release handle. The supplement suggested that proper procedures should be taught in flight or simulator training.

The Bombardier (deHavilland) DHC8-102 ODM Safety of Flight Supplement No. 14[16], dated July 24, 2009, addressed landing considerations with landing gear failure. It discussed landing with the nose gear retracted or unsafe, landing with one MLG retracted or unsafe, and landing with all landing gear retracted. Points of emphasis were:

- Reduce landing weight through fuel burn
- Passengers must be moved from the seats in the plane of the propellers and re---seated elsewhere in the cabin
- Select a runway with minimal crosswind
- Land with flap 35º

[14] See attachment 7
[15] See attachment 7
[16] See attachment 7

- Fly the appropriate VREF for the landing weight
- Touchdown offset from the runway centerline if the runway is equipped with a centerline lighting system
- Maintain a nose---up pitch attitude not exceeding 5º prior to runway contact
- On touchdown, maintain wings level using lateral control and directional control with rudder
- Feather and secure engines

4.0 Company Overview

Piedmont Airlines, Inc. was a wholly owned subsidiary of US Airways and operated as a US Airways Express carrier. The company's origin was as Henson Flying Service in 1931. According to company sources, Piedmont operated 440 departures per day from 55 cities in the eastern United States and Canada. The company operated a fleet of DeHavilland DHC-8 (Dash 8) aircraft, of which 11 were DHC8-300 models and 32 were DHC8-100 models.

4.1 Company Procedures

Piedmont provided its crews with general guidance in its Flight Operations Manual (FOM) and more specific guidance about Dash 8 operation in its Pilot Operating Handbook (POH). Excerpts from these manuals relevant to the investigation are presented here.

4.1.1 Stabilized Approach

The FOM, section 6.11.10, Stabilized Approach," stated:

> ***"Policy.*** *Pilots will fly all approaches in accordance with the following rate of descent and flight parameters unless non-normal conditions require deviation and are briefed (e.g. DCA River Visual, flap non-normal, etc.). The PM makes the appropriate callouts for the type of approach being executed."*
>
> ***"Rate of Descent.*** *By 1,000 ft. AFE[17]the descent rate is transitioning to no greater than 1,000 fpm."*
>
> ***"Flight Parameters.*** *Below 1,000 ft. AFE the aircraft is*
>
> - *On a proper flightpath (visual or electronic) with only small changes in pitch and heading required to maintain that path.*
> - *At a speed no less than Vref and not greater than Vref + 20 allowing for transitory conditions.*
> - *In an approved landing configuration.*

[17] Above field elevation

4.1.2 Emergency Authority

The FOM, section 8.1.2, Pilot in Command (PIC), stated, in part:

> *"— In an emergency situation requiring immediate action, the PIC may take any necessary action(s). Deviation from prescribed policies and procedures and FARs in the interest of safety is authorized.*
>
> *— Under emergency conditions, it is imperative the PIC and controlling dispatcher exercise teamwork, initiative, and good judgment. However, ultimate responsibility for the flight's safety remains with the PIC."*

4.1.3 Passenger Evacuation

The FOM, section 8.21.2, "Evacuation Required," stated:

> *"Communication and coordination between the PIC/SIC and flight attendants are paramount for safe and effective aircraft evacuation. Using effective and timely communications, the PIC/SIC will keep the flight attendant informed and updated.*
>
> *The decision to evacuate must be based on an objective evaluation of a real threat, as opposed to a subjective evaluation of a perceived threat to the safety of the passengers and crew.*
>
> ***Captain Initiated Evacuation.***
>
> *— Once the decision is made, make the evacuation announcement:*
>
> > *"THIS IS THE CAPTAIN/FIRST OFFICER (state which). EVACUATE! EVACUATE!"*
>
> *— Remove all passengers to a point well clear of the aircraft, out of range of possible fire or explosion.*
>
> *— Do not allow passengers to return to the aircraft until danger no longer exists."*

4.1.4 Communications

The FOM, section 8.5, "Communications" addressed crew communication with Air Traffic Control (ATC), the PDT Operations Control Center (OCC), and flight attendants during emergencies.

Section 8.5.1, "General," stated in part:

> *"— During an emergency or irregularity, communications between the flight crew and ATC, controlling dispatcher, flight attendants, and passengers provides a common sense*

of direction and allows the crew to utilize all available resources. If communications are not established or are misleading and ineffective, individuals are left to draw their own conclusions. Once the situation in the flightdeck is under control, communicate. This communication may be handled by the PIC or a crewmember designated by the PIC. Once on the ground, immediately contact the controlling dispatcher."

Section 8.5.5, "Flight Attendant Notification, Emergency with Possible Evacuation" stated:

"— Use the EMER CALL button to notify the flight attendants when an emergency could require an evacuation (e.g. smoke, fire, landing gear malfunction, ditching, etc.). The signal implies conditions of an urgent nature and cabin must be prepared for planned evacuation. Cabin response must be prompt.

— The PIC should brief the flight attendant by use of the interphone on at least the following items:

***T** = how much **Time** is available*

E** = what type of **Emergency

S** = what is the brace **Signal

*T = **Take** special instructions*

— The flight attendant will advise the PIC when the cabin is ready for landing."

Section 8.5.6, "Passengers," stated:

"An announcement should be made over the public address system to assure passengers someone is in command. The crew must provide direction with calm, clear, concise instructions and information. If possible, inform the flight attendants of an emergency or irregularity before making a passenger announcement."

4.2 Company Training

4.2.1 Emergency Landing

A review of company training materials pertaining to emergency landing found several slides which addressed landing with all gear up or one MLG unsafe. The guidance on the slides recapitulated the guidance provided in the Bombardier (deHavilland) DHC8-102 AFM Safety of Flight Supplement No. 14, which addressed landing considerations with landing gear failure.[18]

[18] See attachments 8

5.0 The Airport

Newark Liberty International Airport, Newark, New Jersey, is a major air carrier airport. According to information provided by the airport, it averages over 1,100 operations per day, 66% of which are commercial flights. The airport has three runways: runway 4L/22R, 11,000 ft. long and 150 ft. wide; runway 4R/22L, 10,000 ft. long and 150 ft. wide; and runway 11/29, 6,726 ft. long and 150 ft. wide.

Runway 4L has high intensity runway edge lights, precision runway markings, a 4-light PAPI (precision approach path indicator) on the left (3.00 degrees glide path), medium intensity approach lights (MALSR) with runway alignment indicator lights, centerline lights and an ILS/DME instrument approach. The runway landing threshold is displaced 2,540 ft., and 8460 ft. are available for landing.

F. LIST OF ATTACHMENTS

Attachment 1: Interview Summaries
Attachment 2: Crew Statements
Attachment 3: Landing Data Card for 31,000 lbs.
Attachment 4: Landing Gear Actuation and Indication
Attachment 5: Piedmont POH Landing Gear Malfunctions
Attachment 6: Piedmont Abnormal Checklists for Gear Unsafe, Alternate Extension, and Emergency Landing
Attachment 7: Bombardier (deHavilland) DHC8-102 Airplane Flight Manual (AFM) Revisions and Supplements
Attachment 8: Piedmont Training Slides on Gear Up Landings
Attachment 9: Piedmont FOM Warnings Cautions and Notes