NATIONAL TRANSPORTATION SAFETY BOARD
Public Meeting of September 9, 2014
(Information subject to editing)

Crash During a Nighttime Nonprecision Instrument Approach to Landing United Parcel Service (UPS) flight 1354, Airbus A300-600, N155UP Birmingham, Alabama August 14, 2013

This is a synopsis from the NTSB's report and does not include the Board's rationale for the conclusions, probable cause, and safety recommendations. NTSB staff is currently making final revisions to the report from which the attached conclusions and safety recommendations have been extracted. The final report and pertinent safety recommendation letters will be distributed to recommendation recipients as soon as possible. The attached information is subject to further review and editing.

EXECUTIVE SUMMARY

On August 14, 2013, about 0447 central daylight time (CDT), United Parcel Service (UPS) flight 1354, an Airbus A300-600, N155UP, crashed short of runway 18 during a localizer nonprecision approach to runway 18 at Birmingham-Shuttlesworth International Airport (BHM), Birmingham, Alabama. The captain and first officer were fatally injured, and the airplane was destroyed by impact forces and postcrash fire. The scheduled cargo flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 on an instrument flight rules flight plan, and dark night visual flight rules conditions prevailed at the airport; variable instrument meteorological conditions (IMC) with a variable ceiling were present north of the airport on the approach course at the time of the accident. The flight originated from Louisville International Airport-Standiford Field, Louisville, Kentucky, about 0503 eastern daylight time.

A notice to airmen in effect at the time of the accident indicated that runway 06/24, the longest runway available at the airport and the one with a precision approach, would be closed from 0400 to 0500 CDT. Because the flight's scheduled arrival time was 0451, only the shorter runway 18 with a nonprecision approach was available to the crew. Forecasted weather at BHM indicated that the low ceilings upon arrival required an alternate airport, but the dispatcher did not discuss the low ceilings, the single-approach option to the airport, or the reopening of runway 06/24 about 0500 with the flight crew. Further, during the flight, information about variable ceilings at the airport was not provided to the flight crew.

The captain was the pilot flying, and the first officer was the pilot monitoring. Before descent, while on the direct-to-KBHM leg of the flight, the captain briefed the localizer runway 18 nonprecision profile approach, and the first officer entered the approach into the airplane's flight management computer (FMC). The intended method of descent (a "profile approach") used a glidepath generated by the FMC to provide vertical path guidance to the crew

during the descent from the final approach fix (FAF) to the decision altitude, as opposed to the step-down method ("dive and drive") that did not provide vertical guidance and required the crew to refer to the altimeter to ensure that the airplane remained above the minimum crossing altitude at each of the approach fixes. When flown as a profile approach, the localizer approach to runway 18 had a decision altitude of 1,200 ft mean sea level (msl), which required the pilots to decide at that point to continue descending to the runway if the runway was in sight or execute a missed approach.

As the airplane neared the FAF, the air traffic controller cleared the flight for the localizer 18 approach. However, although the flight plan for the approach had already been entered in the FMC, the captain did not request and the first officer did not verify that the flight plan reflected only the approach fixes; therefore, the direct-to-KBHM[1] leg that had been set up during the flight from Louisville remained in the FMC. This caused a flight plan discontinuity message to remain in the FMC, which rendered the glideslope generated for the profile approach meaningless.[2] The controller then cleared the pilots to land on runway 18, and the first officer performed the Before Landing checklist. The airplane approached the FAF at an altitude of 2,500 ft msl, which was 200 ft higher than the published minimum crossing altitude of 2,300 ft.

Had the FMC been properly sequenced and the profile approach selected, the autopilot would have engaged the profile approach and the airplane would have begun a descent on the glidepath to the runway. However, this did not occur. Neither pilot recognized the flight plan was not verified. Further, because of the meaningless FMC glidepath, the vertical deviation indicator (VDI), which is the primary source of vertical path correction information, would have been pegged at the top of its scale (a full-scale deflection), indicating the airplane was more than 200 ft below the (meaningless) glidepath. However, neither pilot recognized the meaningless information even though they knew they were above, not below, the glideslope at the FAF. When the autopilot did not engage in profile mode, the captain changed the autopilot mode to the vertical speed mode, yet he did not brief the first officer of the autopilot mode change. Further, by selecting the vertical speed mode, the approach essentially became a "dive and drive" approach. In a profile approach, a go-around is required upon arrival at the decision altitude (1,200 ft) if the runway is not in sight; in a "dive-and-drive" approach, the pilot descends the airplane to the minimum descent altitude (also 1,200 ft in the case of the localizer approach to runway 18 at BHM) and levels off. Descent below the minimum descent altitude is not permitted until the runway is in sight and the aircraft can make a normal descent to the runway. A go-around is not required for a "dive and drive" approach until the airplane reaches the missed approach point at the minimum descent altitude and the runway is not in sight. Because the airplane was descending in vertical speed mode without valid vertical path guidance from the VDI, it became even more critical for the flight crew to monitor their altitude and level off at the minimum descent altitude.

About 7 seconds after the first officer completed the Before Landing checklist, the first officer noted that the captain had switched the autopilot to vertical speed mode; shortly thereafter, the captain increased the vertical descent rate to 1,500 feet per minute (fpm). The first

[1] In this report, BHM refers to the airport and KBHM refers to the waypoint.

[2] Although the display was correct based on the information the flight crew input to the system, the information output was meaningless for the approach.

officer made the required 1,000-ft above-airport-elevation callout, and the captain noted that the decision altitude was 1,200 ft msl but maintained the 1,500 fpm descent rate. Once the airplane descended below 1,000 ft at a descent rate greater than 1,000 fpm, the approach would have violated the stabilized approach criteria defined in the UPS flight operations manual and would have required a go-around. As the airplane descended to the minimum descent altitude, the first officer did not make the required callouts regarding approaching and reaching the minimum descent altitude, and the captain did not arrest the descent at the minimum descent altitude.

The airplane continued to descend, and at 1,000 ft msl (about 250 ft above ground level), an enhanced ground proximity warning system (EGPWS)[3] "sink rate" caution alert was triggered. The captain began to adjust the vertical speed in accordance with UPS's trained procedure, and he reported the runway in sight about 3.5 seconds after the "sink rate" caution alert. The airplane continued to descend at a rate of about 1,000 fpm. The first officer then confirmed that she also had the runway in sight. About 2 seconds after reporting the runway in sight, the captain further reduced the commanded vertical speed, but the airplane was still descending rapidly on a trajectory that was about 1 nautical mile short of the runway. Neither pilot appeared to be aware of the airplane's altitude after the first officer's 1,000-ft callout. The cockpit voice recorder then recorded the sound of the airplane contacting trees followed by an EGPWS "too low terrain" caution alert.

The safety issues discussed in this report relate to the need for the following:

- **Clear communications**. This investigation identified several areas in which communication was lacking both before and during the flight, which played a role in the development of the accident scenario.

    - **Dispatcher and flight crew.** Before departure, the dispatcher and the flight crew did not verbally communicate with each other even though dispatchers and pilots share equal responsibility for the safety of the flight. In this case, the dispatcher was aware of a runway closure, approach limitations, and weather that warranted discussion between the dispatcher and the pilots. However, neither the dispatcher nor the flight crew contacted each other to discuss these issues.

    - **Between flight crewmembers.** During the flight, the captain did not rebrief the approach after he switched the autopilot from the profile to the vertical speed mode. Therefore, the first officer was initially unaware of the change and had to seek out information on the type of approach being flown. The purpose of briefing any change in the approach is to ensure that crewmembers have a shared understanding of the approach to be flown. Because the captain did not communicate his intentions, it was not possible for the first officer to have a shared understanding of the approach, and her situational awareness was degraded.

    - **Weather.** Lastly, the relevant weather was not provided to the crew: the meteorological aerodrome reports (METARs) provided to the crew did not contain

[3] The airplane was equipped with a Honeywell enhanced ground proximity warning system, which is a type of terrain awareness and warning system.

information about variable ceilings at BHM because the weather dissemination system used by UPS automatically removed the "remarks" section of METAR reports, where this information was contained. Further, the air traffic controllers did not include the "remarks" information in the automatic terminal information service broadcast. The lack of communication about the variable ceilings may have played a role in the flight crewmembers' expectation that they would see the airport immediately after passing 1,000 ft above the ground, when in fact they only saw the runway about 5 seconds before impacting the trees. If they would have had access to the METAR remarks, the flight crew may have been more aware of the possibility of lower ceilings upon arrival at BHM.

- **Off-duty time management, fatigue awareness, and counseling.** Review of the first officer's use of her off-duty time indicated that she was likely experiencing fatigue, primarily due to improper off-duty time management. Even though the first officer was aware that she was very tired, she did not call in and report that she was fatigued, contrary to the UPS fatigue policy. Further, fatigue and fitness for duty are not required preflight briefing items; if they were, the first officer would have had the opportunity to identify the risks associated with fatigue and mitigate those risks before the airplane departed. Further, fatigue counseling for pilots would help to increase awareness and understanding about fatigue and the circumstances surrounding fatigue calls and better equip operators to provide guidance for managing fatigue while fostering an environment wherein all pilots call in fatigued when necessary.

- **Use of continuous descent final approach technique.** Nonprecision approaches do not provide any ground-based vertical flightpath guidance to flight crews and therefore can be more challenging to fly than precision approaches. These factors may contribute to the higher occurrence of unstabilized nonprecision approaches compared to precision approaches. Federal Aviation Administration (FAA) Advisory Circular 120-108, "Continuous Descent Final Approach [CDFA]," outlines a nonprecision approach technique that uses a stable, continuous path to the runway. Flight crews should be able to easily set up a CDFA approach using available airplane technology that generates vertical flightpath guidance internally when ground-based vertical navigation equipment is not available. The use of CDFA techniques while flying nonprecision approaches can provide an additional means of standardization for flight crews when they are conducting nonprecision approaches and reduce the risk of an unstabilized approach.

- **Standardized guidance.** UPS flight crews received guidance from several UPS publications, including the aircraft operating manual, the flight operations manual, and the pilot training guide (PTG). However, the PTG is not a required manual and is only an internal UPS reference manual. The National Transportation Safety Board (NTSB) found a lack of standardization among the documents, and some critical procedures contained within the PTG were not found in the other manuals, such as EGPWS alert responses; planned approach procedures, such as the CDFA technique; and procedures critical to approach setup and sequencing. It is critical that such procedures be contained in an FAA-accepted or -approved document that is onboard the airplane so that they will be subject to FAA review and so that pilots can be both trained and tested on the procedures.

- **Altitude alerts.** The airplane was equipped with an EGPWS that could, if activated, provide a 500-ft alert, as required by terrain awareness and warning system Technical Standard Order C151A. Airbus operators typically use the flight warning computer 400-ft alert in lieu of the EGPWS 500-ft alert, but UPS had not activated either alert on its A300 fleet. Additionally, the flight warning computer was equipped with an automated aural "minimums" alert, but UPS had not activated this alert either. Although it cannot be known how the accident crew would have responded to these alerts had they been activated, in general the alerts can provide a beneficial reminder to pilots about the airplane's altitude above terrain.

FINDINGS

1. The pilots were properly certificated, qualified, and trained for the 14 *Code of Federal Regulations* Part 121 flight in accordance with Federal Aviation Administration regulations. No evidence was found indicating that the flight crew's performance was affected by any behavioral or medical condition or by alcohol or drugs.

2. The accident airplane was loaded within weight and center of gravity limits and was equipped, certificated, and maintained in accordance with Federal Aviation Administration regulations and the manufacturer's recommended maintenance program. Postaccident examination found no evidence of any preimpact structural, engine, or system failure or anomaly.

3. Although the activation of the crash phone was delayed, the aircraft rescue and firefighting (ARFF) response proceeded rapidly, and ARFF operations began in a timely manner.

4. The dispatcher of United Parcel Service flight 1354 should have alerted the flight crew to the limited options for arrival at Birmingham-Shuttlesworth International Airport (BHM), especially that runway 18 was the only available runway, because doing so would have further helped the pilots prepare for the approach to BHM and evaluate all available options.

5. The captain, as pilot flying, should have called for the first officer's verification of the flight plan in the flight management computer (FMC) and the first officer, as pilot monitoring, should have verified the flight plan in the FMC; their conversation regarding nonpertinent operational issues distracted them from recognizing that the FMC was not resequenced even though several salient cues were available.

6. The captain's change to a vertical speed approach after failing to capture the profile path was not in accordance with United Parcel Service procedures and guidance and decreased the time available for the first officer to perform her duties.

7. The flight crew did not monitor the descent rate and continued to fly the airplane with a vertical descent rate of 1,500 ft per minute below 1,000 ft above ground level, which was contrary to standard operating procedures, resulting in an unstabilized approach that should have necessitated a go-around.

8. The flight crew did not sufficiently monitor the airplane's altitude during the approach and subsequently allowed the airplane to descend below the minimum altitude without having the runway environment in sight.

9. The first officer's failure to make the "approaching minimums" and "minimums" altitude callouts during the approach likely resulted from the time compression resulting from the excessive descent rate, her momentary distraction from her pilot monitoring duties by looking out the window when her primary responsibility was to monitor the instruments, and her fatigue.

10. Although it was the first officer's responsibility to announce the callouts as the airplane descended, the captain was also responsible for managing the approach in its final stages using a divided visual scan that would not leave him solely dependent on the first officer's callouts to stop the descent at the minimum descent altitude.

11. The captain's belief that they were high on the approach, his distraction from his pilot flying duties by looking out the window, likely contributed to his failure to adequately monitor the approach.

12. For the captain, fatigue due to circadian factors may have been present at the time of the accident.

13. The captain's poor performance during the accident flight was consistent with past performance deficiencies in flying nonprecision approaches noted during training; the errors that the captain made were likely the result of confusion over why the profile did not engage, his belief that the airplane was too high, and his lack of compliance with standard operating procedures.

14. The first officer poorly managed her off-duty time by not acquiring sufficient sleep, and she did not call in fatigued; she was fatigued due to acute sleep loss and circadian factors, which, when combined with the time compression and the change in approach modes, likely resulted in the multiple errors she made during the flight.

15. Given the increased likelihood of fatigue during overnight operations, briefing the threat of fatigue before every flight would give pilots the opportunity to identify the risks associated with fatigue and mitigate those risks before taking off and throughout the flight.

16. The schedule the flight crew was flying would have been in compliance with 14 *Code of Federal Regulations* Part 117 requirements, had those requirements been in effect and applied to all-cargo operators.

17. The first officer did not adhere to the United Parcel Service fatigue policy; she could have called in fatigued for the accident flight if she were not fit for duty and been immediately removed from duty until she felt fit to fly again.

18. By providing fatigue counseling to its members, the United Parcel Service and the Independent Pilots Association would help to increase pilot awareness and understanding about fatigue and may provide a valuable resource to the United Parcel Service in its understanding of fatigue calls.

19. A joint dispatcher/pilot training module, specific to crew resource management and dispatcher resource management principles, would facilitate improved communication between pilots and dispatchers and enhance their understanding of the challenges and capabilities of the pilot/dispatcher roles in the safe operation of the flight.

20. By not rebriefing or abandoning the approach when the airplane did not descend via the profile vertical path after passing the final approach fix, the flight crewmembers placed themselves in an unsafe situation because they had different expectations of the approach being flown.

21. The captain's moderate response to the enhanced ground proximity warning system "sink rate" caution alert (adjusting the flight's vertical speed) was consistent with aircraft operating manual guidance and training; however, the response was not sufficient to prevent striking the trees on the approach and was not consistent with the more conservative guidance in the pilot training guide.

22. The continuous descent final approach technique provides a safer alternative to "dive and drive" during nonprecision approaches.

23. If operators identified and implemented ways for pilots to receive more opportunities to maintain proficiency in nonprecision approaches, pilots could conduct such approaches more safely.

24. Due to the importance of pertinent remarks, such as variable cloud ceilings, to the flight crew's understanding of weather conditions, it is critical that flight dispatch papers, the aircraft communication addressing and reporting system, and automatic terminal information service contain pertinent remarks for weather observations because such remarks provide flight crews a means to understand changing weather conditions. Had the flight crew been provided with the pertinent remarks in this accident, they may have been aware of the possibility of changing visibility and ceilings upon their arrival at Birmingham-Shuttlesworth International Airport**.**

25. The newer enhanced ground proximity warning system software, part number 965-0976-003-218-218 or later, will provide an advanced alert and significantly improve safety margins, although its effect on the outcome of this accident is unknown because it cannot be determined how aggressively the pilots would have responded to an earlier "too low terrain" alert.

26. An escalating series of terrain awareness warning system (TAWS) alerts before impact with terrain or obstacles is not always guaranteed due to technological limitations, which reduces the safety effectiveness of the TAWS during the approach to landing.

27. In the absence of the automated “minimums” alert, either the enhanced ground proximity warning system 500-ft callout or the Airbus 400-ft callout could have made the flight crewmembers aware of their proximity to the ground, and they could have taken action to arrest the descent.

28. An automated “minimums” and/or altitude above terrain alert would have potentially provided the flight crewmembers with additional situational awareness upon their arrival at the minimum descent altitude and made them aware that their continued descent would take them below the minimum descent altitude. Additionally, in the absence of the automated “minimums” alert, either the enhanced ground proximity warning system 500-ft callout or the Airbus 400-ft callout could have made the flight crewmembers aware of their proximity to the ground, and they could have taken action to arrest the descent.

29. Consistent training in and Federal Aviation Administration oversight and evaluation of fundamental procedures necessary to conduct an approach, such as sequencing the flight management computer, are critical to flight safety.

30. A vertical deviation indicator constructed from information known to be anomalous (for example, containing a flightpath discontinuity) could be confusing to flight crews.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flight crew’s continuation of an unstabilized approach and their failure to monitor the aircraft’s altitude during the approach, which led to an inadvertent descent below the minimum approach altitude and subsequently into terrain. Contributing to the accident were (1) the flight crew’s failure to properly configure and verify the flight management computer for the profile approach; (2) the captain’s failure to communicate his intentions to the first officer once it became apparent the vertical profile was not captured; (3) the flight crew’s expectation that they would break out of the clouds at 1,000 feet above ground level due to incomplete weather information; (4) the first officer’s failure to make the required minimums callouts; (5) the captain’s performance deficiencies likely due to factors including, but not limited to, fatigue, distraction, or confusion, consistent with performance deficiencies exhibited during training; and (6) the first officer’s fatigue due to acute sleep loss resulting from her ineffective off-duty time management and circadian factors.

Recommendations

New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations:

To the Federal Aviation Administration:

1. Require principal operations inspectors to ensure that operators with flight crews performing 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K overnight operations brief the threat of fatigue before each departure, particularly those occurring during the window of circadian low.

2. Require operators to develop an annual recurrent dispatcher resource management module for dispatchers that includes participation of pilots to reinforce the need for open communication.

3. Require principal operations inspectors to work with operators to ensure that their operating procedures explicitly state that any changes to an approach after the completion of the approach briefing should be rebriefed by the flight crewmembers so that they have a common expectation of the approach to be conducted.

4. Require principal operations inspectors to ensure consistency among their operators' training documents, their operators' Federal Aviation Administration-approved and -accepted documents such as the aircraft operating manual, and manufacturers' guidance related to terrain awareness and warning system caution and warning alert responses, and ensure that responses are used during night and/or instrument meteorological conditions that maximize safety.

5. Require principal operations inspectors of 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K operators to ensure that Federal Aviation Administration-approved nonprecision instrument approach landing procedures prohibit "dive and drive" as defined in Advisory Circular (AC) 120-108. (Supersedes Safety Recommendation A-06-8)

6. Require that the remarks section of meteorological aerodrome reports be provided to all dispatchers and pilots in flight dispatcher papers and through the aircraft communication addressing and reporting system.

7. Expand the current guidance available in Federal Aviation Administration Order 7110.65, "Air Traffic Control," to further define meteorological aerodrome report pertinent remarks.

8. Issue a safety advisory bulletin to air traffic controllers providing examples of the types of meteorological aerodrome report remarks information considered pertinent and reminding them of the requirement to add such pertinent remarks to automatic terminal information service broadcasts.

9. Issue a special airworthiness information bulletin to notify operators about the circumstances of this accident and the potential safety improvements related to the Honeywell enhanced ground proximity warning system part number 965-0976-003-218-218 or later software update.

10. Advise operators of aircraft equipped with terrain awareness and warning systems (TAWS) of the circumstances of this accident including that, in certain situations, an escalating series of TAWS warnings may not occur before impact with terrain or obstacles. Encourage operators to review their procedures for responding to alerts on final approach to ensure that these procedures are sufficient to enable pilots to avoid impact with terrain or obstacles in such situations.

11. Revise the minimum operational performance standards to improve the effectiveness of terrain awareness and warning systems when an airplane is configured for landing and near the airport, including when the airplane is descending at a high rate and there is rising terrain near the airport.

12. Require all operators of airplanes equipped with the automated "minimums" alert to activate it.

13. Require all operators of airplanes equipped with terrain awareness and warning systems (TAWS) to activate the TAWS 500-ft voice callout or similar alert.

14. Require principal operations inspectors of 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K operators to verify that procedures critical to approach setup, like configuring an approach in the flight management computer for those approaches dependent on that step, are included in Federal Aviation Administration-approved or -accepted manuals.

15. Work with industry, for all applicable aircraft, to develop and implement means of providing pilots with a direct and conspicuous cue when they program the flight management computer flight plan incorrectly such that it contains such elements as improper waypoints or discontinuities that would allow the vertical deviation indicator to present misleading information for an approach.

To the United Parcel Service:

16. Work with the Independent Pilots Association to counsel pilots who call in fatigued and whose sick bank is debited to understand why the fatigue call was made and how to prevent it from recurring.

17. Work with the Independent Pilots Association to conduct an independent review of the fatigue event reporting system to determine the program's effectiveness as a nonpunitive mechanism to identify and effectively address the reported fatigue issues. Based on the findings, implement changes to enhance the safety effectiveness of the program.

To the Independent Pilots Association:

18. Work with the United Parcel Service to counsel pilots who call in fatigued and whose sick bank is debited to understand why the fatigue call was made and how to prevent it from recurring. Based on the findings, implement changes to enhance the safety effectiveness of the program.

19. Work with the United Parcel Service to conduct an independent review of the fatigue event reporting system to determine the program's effectiveness as a nonpunitive mechanism to identify and effectively address the reported fatigue issues. Based on the findings, implement changes to enhance the safety effectiveness of the program.

To Airbus:

20. Develop and implement, for applicable Airbus models, means of providing pilots with a direct and conspicuous cue when they program the flight management computer flight plan incorrectly such that it contains such elements as improper waypoints or discontinuities that would allow the vertical deviation indicator to present misleading information for an approach.

Previously Issued Safety Recommendations Reclassified in This Report

As a result of its investigation, the National Transportation Safety Board reclassifies Safety Recommendation A-06-8. This recommendation, previously classified "Open--Acceptable Alternate Response," is reclassified "Closed—Unacceptable Action/Superseded."

> Require all 14 CFR Part 121 and 135 operators to incorporate the constant-angle-of-descent technique into nonprecision approach procedures and to emphasize the preference for that technique where practicable. (A-06-8)