Submission of The

National Air Traffic Controllers Association

To The

National Transportation Safety Board

Regarding The Accident Involving

Federal Express Corporation (FedEx) Flight 1478

At Tallahassee, Florida

On July 26, 2002

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I. INTRODUCTION

On July 26, 2002, at approximately 0937[1] , a Boeing B-727-232, N497FE, operating as FedEx flight 1478, crashed into trees on short final approach to runway 9 at the Tallahassee Regional Airport (TLH), Tallahassee, Florida. The flight was operating under the provisions of Title 14, Code of Federal Regulations Part 121 as a scheduled cargo flight from Memphis, Tennessee (MEM) to TLH. Night visual meteorological conditions prevailed at the time of the accident. The three flight crewmembers were injured, two seriously, and the aircraft was destroyed by impact and resulting fire.

II. History of Flight

Tallahassee Air Traffic Control Tower (TLH ATCT) and Terminal Radar Approach Control (TLH TRACON) operates part time, and was closed from 0300 to 1000. When TLH ATCT is closed, the airspace normally delegated to TLH TRACON and ATCT reverts to Jacksonville Air Route Traffic Control Center (ZJX). During the approach and landing at TLH, FDX1478 was under control of ZJX, sector R28. The crew of FDX1478 contacted the ZJX R28 controller at 0915:48, stating, "Jacksonville Center, uh good morning Fedex fourteen seventy eight two nine oh discretion to two four oh." The R28 controller responded, "Fedex fourteen seventy eight Jax center roger descend at pilot's discretion maintain niner thousand Tallahassee altimeter three zero one zero." The crew acknowledged. At 0918:30, the crew of FDX1478 transmitted, "Atlanta Fedex uh fourteen seventy eight leaving two nine oh for nine thousand." The R28 controller

[1] All times will be in Coordinated Universal Time UTC.

acknowledged. At 0922:42, the R 28 controller transmitted, "Fedex fourteen seventy eight descend at pilot's discretion maintain three thousand." And the crew responded, "Discretion to three thousand Fedex fourteen seventy eight." At 09:23:29, the R28 controller instructed the crew to change to frequency 135.32, and the crew acknowledged. At 0923:45, the crew of FDX1478 reported on the new frequency. At 0923:49, the R28 controller acknowledged the crew's check-in and asked if the crew had the TLH weather. The crew of FDX1478 responded, "Yes, sir we do Fedex fourteen seventy eight." At 0923:58, the R28 controller told the crew to expect a visual approach and to report the airport in sight. The crew read back the instructions. At 0929:55, the crew of FDX1478 stated, "Jacksonville Fedex uh fourteen seventy eight we have the airport." The R28 controller replied, "Fedex fourteen seventy eight cleared visual approach into Tallahassee. Are you showing the uh NOTAM Tallahassee runway one eight three six is closed?" The crew responded, "Uh no sir but we're going to use runway nine." At 0930:12, the R28 controller transmitted, "All right you're cleared for the visual approach and report your down time this frequency if unable to Gainesville radio change to advisory approved." At 0930:12, the crew of FDX1478 responded, "Fedex fourteen seventy eight good morning." There was no further air traffic control contact with FDX1478. The last recorded return of the aircraft was at 0937:22.97.

III. Weather

The Tallahassee Regional Airport has a NWS (National Weather Service) installed and maintained Automated Surface Observation System (ASOS), which is augmented under a Federal Aviation Administration (FAA) contract by certified NWS observers. The

ASOS equipment is located approximately 1,000 feet from the approach end of runway 09 between taxiways sierra and papa, and directly sough of taxiway Juliet. The weather observer's office is located on the south ramp next to the Airport Rescue Fire Fighting (ARFF) building, which is directly north of the ASOS equipment. The Office has an unobstructed view of the airport from the southeast through the west. The observer must walk to the northern side of the building to view the rest of the area. The ASOS equipment was noted as having no discrepancies.

The observations issued for TLH surrounding the time of the accident are as follows:

> TLH weather at 0853: wind 120 degrees true at 5 knots, visibility 9 statute miles, a few clouds at 100 feet, scattered 18,000 feet, scattered 25,000 feet, temperature and dew point 22 degrees Celsius ©, altimeter 30.10 inches of Mercury (HG). Remarks: automated observation, sea level pressure 1019.2 mb, temperature 22.2 degrees C, dew point 21.7 degrees C, 3-hour pressure tendency decreasing 0.3 mb.
>
> TLH weather at 0953, wind calm, visibility 8 miles, a few clouds at 100 feet, scattered clouds at 15,000 feet, scattered clouds at 25,000, temperature and dew point 22 degrees C, altimeter 30.11 inches Hg. Remarks: automated observation, sea level pressure 1019.2mb, temperature 22.0 C, dew point 21.7 C.
>
> TLH weather at 1053, wind calm, visibility 9 miles, a few clouds at 100 feet scattered clouds at 1,500 feet, scattered clouds at 15,000 feet, scattered clouds at 25,000 feet, temperature and dew point 22 degrees C, altimeter 30.13 inches of Hg. Remarks: automated observation sea level pressure 1020.0 mb, sector

visibility from the southwest through northwest quadrants 1/2/mile with cumulonimbus in the distance toward the southeast and southwest, smoke scattered at 1,500 feet, smoke plume over approach runway 9.

The flight crew obtained the 0853 observation from the Gainesville Flight Service Station (FSS) while enroute. The 0953 observation best reflects the conditions at the approximate time of the accident, and the 1053 observation best reflects the conditions developing after Sunrise. The flight crew received all current meteorological conditions at TLH prior to beginning final approach. Except for the temperature and dew point being the same there were not meteorological conditions that caused or contributed to the accident. The dew point and temperature both at 22 degrees C created the potential for fog or dew. The dew potential may have had an adverse effect on the PAPI light presentation and glide path indication, which I will cover later.

IV. **Airport**

According to Survival Factors Group's factual report, the airfield consists of two precision instrument runways. Runway 9-27 is 8,000 feet long and 150 feet wide. Runway 18-36 is 6,066 feet long and 150 feet wide. Runways 36 and 27 have instrument landing system (ILS) approaches, and runways 9 and 18 have visual approaches. At the time of the accident, runway 18-36 was closed for construction. Notice to Airman (NOTAM) #02-47 was issued July 19, 2002 for the closure. The average gradient for runway 9-27 is –0.2 percent from the runway 9 threshold, and 0.2 percent from the runway 27 threshold. Runway 9-27 has an elevation of 49.0 feet mean sea level (MSL) at

the runway 9 threshold, and 61.2 feet MSL at the runway 27 threshold. The high point for runway 9-27 is 70.5 feet MSL and is located approximately 2,325 feet from the runway 9 threshold. This provided the FedEx crew with an up hill landing gradient.

V. Field Lighting

Runway 9-27 was equipped with HIRLs, with in-pavement centerline lights and touchdown zone lights; Runway 27 had an ILS approach lighting system (ALSF-2) and a PAPI. Runway 9 had runway end identifier lights (REILs) and a PAPI. During hours that the ATCT was closed, all runway, taxiway and approach lighting systems on the airfield were pilot controlled. The runway inspection log indicated that the runway lighting was operational as of July 25, 2002, and the lighting activation log indicated the airfield lighting was on at the time of the accident. The lighting activation log indicated that runway 9 lighting systems had been activated at 08:37:42 and all lights were on at 08:37:47. Examination of the computer that controlled the lighting log indicated that the computer time had not been adjusted for daylight savings time, and also was 3 minutes and 16 seconds ahead of the time displayed on a global positioning system (GPS) receiver, producing a 56 minute, 44 second difference. Applying the difference as a correction factor to the time indicated on the activation log, the approximate time that the airport lights were activated was 09:34:26, and all lights were on at 09:34:31. According to the Air Traffic Control Groups factual report this was approximately 3 minutes prior to the accident. (At the Technical Review the ATC group was instructed to revalidate this time).

VI. PAPI

The PAPI lighting system installed at the approach end of runway 9 was manufactured by ADB, ALNACO, Inc., a subsidiary of Siemens Airfield Solutions. It was a model L-880, style A, consisting of 4 identical light units mounted on the left side of runway 9, along a line perpendicular to the runway centerline, approximately 1000 feet from the runway 9 threshold. The PAPI system had not been certified by the FAA at the time of the accident. According to electrical technicians at TLH, the PAPI lighting system on runway 9 had been checked with the manufacturer-provided sighting tool 5 to 6 times since its installation in 1996, and had not been found to be out of alignment during these inspections. No record or log of inspections of PAPI lighting systems is maintained at TLH. The manufacturer has specific maintenance requirements for the PAPI Lighting System which are found in the ADB instruction manual No. AM.02.512e page 39 (Attachment #1), "Weekly—Using soft cotton cloth moistened with alcohol, to clean outer surface of front protection glass. Monthly—Use soft cotton cloth moistened with alcohol to clean both sides of the protective glass, color filters, lenses and reflectors." According to airports personnel none of this maintenance had ever been performed. All 4 PAPI light boxes displayed a high level of physical particle contamination consistent with not having been cleaned since installation.

The manufacturer has specific operational requirements for their PAPI Light System which are found in the ADB instruction manual No. AM.02.512e page 10 (Attachment

#2), "The PAPI system must operate continuously when the runway is in service." There were no NOTAMs for runway 9 at TLH and the runway was in service. The PAPI lights for runway 9 at TLH are tied into the pilot controlled lighting circuit and had only been activated for a few minutes prior to the accident.

The PAPI Light System for TLH Runway 9 has not been operated or maintained according to the manufacturers instructions.

According to Air Traffic Control Specialist Mike Peymann when he entered the TLH ATCT there was such an unusual accumulation of dew on the tower cab windows that he had to use the tower window wash system before he could see outside.

Testing of the same brand and model of PAPI lights by Transport Canada, as per Aerodrome Safety Circular No. 98-002 (Attachment #3) revealed that:

> -Contaminants such as ice, dew or frost on the PAPI front lens surface does affect the projected signal.
>
> -the testing concluded that false slope indication produced as a result of contamination on the lens is a design problem.

Because of the failure to maintain and operate the PAPI Light system according to the manufacturers requirements contamination of the PAPI Lights occurred. This means that it is possible an incorrect glide path indication was transmitted to the pilots. As interviews with the pilots has revealed the Captain and First Officer saw an on glide path indication while on final. Because there was no DME or other distancing equipment available to the pilots, and no ILS system the PAPI Lights became the primary vertical navigation guidance. In addition, because of the "Black Hole" effect it would be very

difficult to recognize any vertical navigation anomalies to this runway, This is evidenced by the CVR that the First Officer even mentions having to stay a bit higher or they are going to lose the end of the runway.

VII. Controlled Flight Into Terrain (CFIT)

Controlled flight into terrain is defined as any collision with terrain (or water) in which the pilot was in control of the aircraft but was not aware of the airplane's altitude, the terrain elevation, or the airplane's position. CFIT occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the flight crew, according to the Flight Safety Foundation.

According to Human Performance's factual report, FedEx's CRM instructors developed a recurrent training module on "black hole approach" hazards for the 1995-1996 training year. According to Human Performance's factual report Federal Express Lead Instructor Michael D. Taylor said all crew members would have received this through recurrent training. The training explained that visual approaches over water or dark, featureless terrain can be hazardous because of poor and misleading cues for evaluating one's flight path and height above the ground. Without additional glide slope information, these misleading cues were known to result in characteristically low, concave (from above) approaches. Additional risk factors for black hole approach phenomena included aspects of airport location (on the edge of a small city, at a lower elevation than a nearby city, near city lights on a hillside), as well as bright runway lighting. To counter the hazards

of black hole approaches, the black hole approach training encouraged pilots to consider the potential for black hole illusion at specific airports. The training also encouraged pilots to utilize all available glide slope information, perform a thorough approach briefing addressing potential black hole approaches, and ensure adequate cross-check and monitoring. Pilots were also encouraged to monitor glide slope using altitude and distance form the runway during non-precision approaches, and to monitor sink rate using the vertical speed indicator. FedEx CRM instructors developed a training module called "Controlled Flight Into Terrain: A Precision Approach to Awareness" for the 1999-2000 training year. According to Human Performance's factual report Federal Express Lead Instructor Michael D. Taylor said all crewmembers would have received this through recurrent training. The training pointed out that half of all CFIT crashes occurred on the extended runway centerline within one mile of the runway threshold, and that 75 percent of CFIT accidents involved non-precision approaches. The training highlighted the Flight Safety Foundation finding that the CFIT/Approach and Landing accident rate was higher for night flying, and for freight carriers.

VIII. Flight Crew Discussion to Use Runway 9

According to the transcript of the CVR the first officer and the Captain discussed landing runway 9 or 27:

0524:29 Captain -"I don't know, you want to try for nine?

0524:32 First Officer- "we're pointed in the right direction, I don't know, like you said....kind of a long # taxiback,"

0524:37 Captain- "yeah, that'd be all right."

0523:44 First Officer- " I always thought you were supposed to land with the prevailing wind."

0524:49 Captain- "well at five knots it really uh ya know**the only* the only advantage you have landing to the west you have the glides- I mean to the west you have the glideslope..which you don't have to the east."

The decision could have been made to land on runway 27 with the ILS (glide slope) and approach lights which were not available on runway 9. Second Officer David J. Mendez stated in his interview he checked the APLC (laptop computer), and runways 27 and 9 were listed as acceptable for landing. A decision to land on runway 27 with the ILS would have provided glide slope information to the flight crew which should have compensated for any "black hole illusion" and may have prevented a CFIT (Controlled Flight Into Terrain) accident.

IX. Flight Crew's Visibility to Airport

The crew had the runway environment in sight prior to impact and the airport insight prior to turning final, which was approximately 7 miles for the airport according to flight crew interviews and CVR transcript. According to the interview Second Officer Mendez said as they neared runway 9 the runway lights were "plain as day including the PAPI." According to Mendez he and the first officer first saw runway 9 when they were setting up for the left base, at an altitude he estimated as 3,000 feet because they had been cleared down to that altitude. He also said it was a dark hole (approach), but you could see the runway edge lights and the PAPI. According to the interview Captain Walsh said

he saw the PAPI lights when they turned on final and they indicated white and red. . First Officer Frye remembered the PAPI indicated they were on glide path all the way down according to the interview.

X. Conclusion

Contributing Factors:

1. Captain's decision to land on runway nine when he knew it didn't have approach lights or an ILS to back up the visual approach. A decision to land on runway 27 with the ILS would have provided glide slope information to the flight crew which may have compensated for any "black hole illusion" and prevented a CFIT (Controlled Flight Into Terrain) accident.
2. Failure of the TLH Airport to properly maintain the PAPI lights.
3. Failure of the TLH Airport to properly operate the PAPI lights.
4. Absence of an approach lighting system on runway 9.
5. Absence of an ILS on runway 9.

Probable Cause:

Failure of the crew to maintain obstruction clearance from the surface while conducting a visual approach.

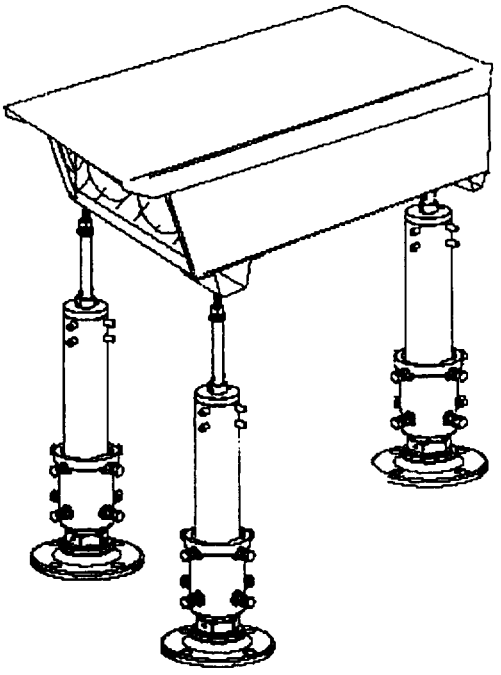
Safety recommendations:

1. Company provide at least yearly refresher training on Control Flight into Terrain for all crew members.
2. All future airport inspections include a special emphasis on airport operators complying with manufacturers recommendations for PAPI Light operation and PAPI Light Maintenance.
3. All PAPI Light systems at the TLH airport be operated and maintained according to Manufacturers instructions.
4. FAA should certify PAPI lighting systems during all Airport Certification for those airports that support part 121 operations.
5. That an ILS be installed on runway 9 at TLH.
6. That an Approach lighting system be installed on runway 9 at TLH.
7. Conduct a study to determine the effect of contamination on PAPI Light systems and if warranted specification L-880 and L-881 be revised.

Patrick L. McCormick
Air Safety Investigator
National Air Traffic Controllers Association
[redacted]

A Siemens Company

Precision Approach Path Indicator (P.A.P.I.)



Type PPL 400/3 PPL 600/3

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Preventive maintenance

Preventive maintenance tasks

In the table below you will find a checklist of preventive maintenance tasks:

Interval	Check	Action
Daily *	Check elevation angle of units (first few weeks).	Reset units if out of alignment (see Checking slope angles of the light beams page 35).
	Check equipment for proper operation.	Repair, adjust or replace.
Weekly **	Using soft cotton cloth moistened with alcohol, clean outer surface of front protection glass.	
Monthly	Inspect housing and closure system, lamps, electrical connections, filters and protective glass for damage, breakage or wrapage.	Repair or replace.
	Clean interior surface of housing; remove any foreign matter. Use soft cotton cloth moistened with alcohol to clean both sides of the protective glass, colour filters, lenses and reflectors.	
	Make sure unit mounting is rigid.	Tighten loosen hardware nuts, screws, etc. Realign unit if hardware has loosened.
	Make sure no vegetation obscures the light beam.	Remove growth in the vicinity of equipment. Use weed killer.
	Make flight check of system if possible.	Observe proper approach angle.

* When the light unit has stabilised, checks may be made weekly.

** More frequently during the rainy season and when there is bare soil in front of the light units

ATTACHMENT #1

ADB
A Siemens Company

Operational conditions for A(PAPI)

Introduction

The operation conditions for the PAPI system are explained below.

Normal operation

The PAPI system must operate continuously when the runway is in service.

When	Intensity setting
During the day:	
• When aircraft are approaching	Use the high intensity setting (100%).
• When no aircraft are approaching	Reduce to the normal standby setting.
At night	The system may operate continuously at 30% brightness or less.

Failure to adopt this practice will result in an increased consumption of lamps.

Regions with heavy snowfall and frost

Units should operate continuously at normal standby brightness, even when the runway is not in use. Any snow will thus melt and drain off.

It is advisable to have separate constant current regulators for each PAPI system (instead of circuit selectors) so that all the systems can be operated simultaneously under snowstorm conditions.

When snowfall is expected to bury the units, the location of the units should be marked with sticks or flags (approx. 2 m high), to prevent damage to the units by snow removal equipment.

As an option, ADB provides PAPI units with a heating system.

ATTACHMENT #2

No. 98-002

1998.07.24

Operation of Precision Approach Path Indicator (PAPI) Units

PURPOSE

This Aerodrome Safety Advisory Circular is to advise aerodrome operators of Transport Canada's investigation of PAPI units producing false signals due to the buildup of frost contamination on the front lens or cover-glass.

BACKGROUND

Concerns that false signals could be produced as a result of frost contaminated PAPI light units were first reported in 1996 by some airport operators in Quebec. In 1997, the regional office of aerodrome safety in Pacific Region was made aware of a similar situation regarding false PAPI signals at Kelowna airport due to frost contamination on the PAPI lens.

When Transport Canada investigated this issue it was believed the problem was limited to units installed at aerodromes in northern Quebec. As a result of its initial investigation, Transport Canada advised the affected aerodrome operators to keep their PAPIs operating continuously during the winter season.

Concerned about the safety hazard that this issue posed for aircraft operations into airports with PAPI units, Transport Canada undertook a study of the problem. In the meantime, airport operators with PAPI systems were informed through an urgent bulletin issued October 30, 1997 that until further notice PAPI light units are to be (1) kept on continuously at the specified current level, for sites having ARCAL control systems, and (2) turned on a half hour before flight arrival at sites having ATS control.

TESTING PROGRAM

The test program used three types of PAPI units that are used at Canadian airports namely; Siemens, Cegelec and Crouse-Hinds. The objectives of the test program were to determine the following:

Does contaminant on the PAPI lens surface affect the quality of the output signal?
What is the time required to remove contaminant from the PAPI lens when frost build up has occurred?
What are the PAPI's abilities to prevent frost accumulation (contamination) during continuous operation at various temperatures?
The results of the testing program indicated that;

ATTACHMENT #3

Contaminants such as ice, dew or frost on the PAPI front lens surface does affect the projected signal.

If contaminents existed on the PAPIs and the units were operated at their maximum current setting of 6.6 amperes, approximately ½ hour was required to remove contaminant at temperatures down to -30 degrees Celsius to the point where a true signal was produced.

Using continuous operation it was found that providing a minimum current of 4.8 amperes to the PAPIs was sufficient to keep the lens/cover-glass free of contaminant which would cause a false signal.

The testing concluded that false slope indication produced as a result of contamination on the lens is a design problem. It is the responsibility of PAPI manufacturers to come up with an satisfactory solution to this problem.

ADVISORY INFORMATION

Based on the test results, Transport Canada requests that aerodrome operators with PAPI units take the following action;

At aerodromes having ARCAL, the PAPI shall be operated continuously at a minimum current level of 4.8 amperes.

At aerodromes having 24 hour ATS service, the PAPI shall be operated at the maximum current level of 6.6 amperes (maximum brightness) for at least a half hour before the arrival of the first morning flight.

At aerodromes having 24 hour ATS service, if there is a long duration of several hours between the day's flights and that expected at night, the PAPI shall again be operated for a minimum of a half hour prior to the arrival of the first flight at the maximum current level of 6.6 amperes.

Where there is more than one PAPI at the aerodrome, these shall be operated simultaneously in accordance with (1), (2) and (3) as above.

Where a PAPI is not producing a proper signal after the warm up period, a NOTAM must be issued that the PAPI is out of service.

If the PAPI has to be used before completion of the warming period, the PAPI shall be visually inspected for the absence of frost.

Should the aerodrome not be able to accomplish any of the above, the PAPI shall be taken out of service.

It is recommended that operators contact the manufacturers to advise them of the critical need to come up with a satisfactory solution. This is especially important since operating the PAPI continuously has a significant cost impact.

Airport operators are cautioned not to relax any of the above requirements until manufacturers produce an acceptable solution.

Harvey Layden