# Impact with Power Lines
# Heart of Texas Hot Air Balloon Rides
# Balóny Kubíček BB85Z, N2469L
# Lockhart, Texas
# July 30, 2016


**Accident Report**

NTSB/AAR-17/03
PB2018-100161

**National Transportation Safety Board**

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# Aircraft Accident Report

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Lockhart, Texas
July 30, 2016

National Transportation Safety Board

490 L'Enfant Plaza, S.W.
Washington, DC 20594

**National Transportation Safety Board. 2017.** ***Impact with Power Lines, Heart of Texas Hot Air Balloon Rides, Balóny Kubíček BB85Z, N2469L, Lockhart, Texas, July 30, 2016*****. NTSB/AAR-17/03. Washington, DC: NTSB.**

**Abstract:** This report discusses the July 30, 2016, accident involving a Balóny Kubíček BB85Z hot air balloon, N2469L, operated by Heart of Texas Hot Air Balloon Rides, which struck power lines and crashed in a field near Lockhart, Texas. The pilot and 15 passengers died, and the balloon was destroyed by impact forces and postcrash fire. Safety issues identified in this report include the lack of medical oversight for commercial balloon pilots and the lack of targeted Federal Aviation Administration (FAA) oversight of potentially risky commercial balloon operations. As a result of this investigation, the National Transportation Safety Board makes two safety recommendations to the FAA.

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# Abbreviations

| | |
|---|---|
| **AAII** | Air Accidents Investigation Institute |
| **ADHD** | attention deficit hyperactivity disorder |
| **AFS** | flight standards service |
| **agl** | above ground level |
| **AME** | aviation medical examiner |
| **AUS** | Austin-Bergstrom International Airport |
| **AWOS** | automated weather observing system |
| **CDT** | central daylight time |
| ***CFR*** | *Code of Federal Regulations* |
| **CNS** | central nervous system |
| **DWI** | driving while intoxicated |
| **FAA** | Federal Aviation Administration |
| **FSS** | flight service station |
| **HYI** | San Marcos Regional Airport |
| **LOA** | letter of authorization |
| **mg** | milligram |
| **msl** | mean sea level |
| **NAS** | National Airspace System |
| **NDR** | National Driver Register |
| **NHTSA** | National Highway Traffic Safety Administration |
| **NTSB** | National Transportation Safety Board |
| **PED** | portable electronic device |
| **PTRS** | program tracking and reporting subsystem |
| **SMS** | safety management system |
| **TAF** | terminal aerodrome forecast |
| **VFR** | visual flight rules |

# Executive Summary

On July 30, 2016, about 0742 central daylight time, a Balóny Kubíček BB85Z hot air balloon, N2469L, operated by Heart of Texas Hot Air Balloon Rides, struck power lines and crashed in a field near Lockhart, Texas. The pilot and 15 passengers died, and the balloon was destroyed by impact forces and postcrash fire. The balloon was owned and operated by the pilot, and the flight was conducted under the provisions of 14 *Code of Federal Regulations* Part 91 as a sightseeing passenger flight. The flight originated about 0658, just after sunrise, from Fentress Airpark, Fentress, Texas.

About 1 hour 50 minutes before launch, weather observations and forecasts that the pilot accessed indicated visual flight rules weather for airports near the planned route of flight but included observations of clouds as low as 1,100 ft above ground level and a temperature/dew point spread of 1°C (which indicated the possibility of fog formation although fog was not forecast). The pilot did not check weather again before launch; updated observations and forecasts available at that time indicated deteriorating conditions. A ground crewmember stated that fog was seen near the launch site.

The balloon launched about 0658, and the ground crew stated that they watched the balloon fly in and out of the clouds as they followed it until losing sight of it for the last time as it went above the clouds. A passenger photograph taken about 4 minutes before the accident showed the balloon flying above a dense cloud layer that appeared to extend to the horizon. The balloon impacted power lines while descending, about 44 minutes after launch.

To be able to see and avoid obstacles during landing, balloon pilots must ensure weather conditions are compatible with the limitations of balloon maneuverability. The accident pilot had the opportunity to make decisions regarding the flight based on the weather conditions at three points on the morning of the accident: before launch, en route, and near the end of the flight. At each of these points, there were indicators that the weather may not be conducive to safe flight. Updated forecast information before launch showed that conditions were deteriorating; the pilot could have decided to cancel the flight. En route photographs showed that fog and low clouds were visible along the flight route; the pilot could have decided to select a suitable landing location while still in visual contact with the ground. Lastly, once above clouds that obstructed the view of the ground, the pilot decided to land in reduced visibility conditions that diminished his ability to see and avoid obstacles.

The National Transportation Safety Board (NTSB) identified the following safety issues as a result of this accident investigation:

- **Lack of medical oversight for commercial balloon pilots.** Commercial balloon pilots are not required to hold a medical certificate of any kind. The accident pilot had been diagnosed with medical conditions, including depression and attention deficit hyperactivity disorder, known to cause cognitive deficits that may affect decision-making and, ultimately, safety of flight. These conditions would likely have led an aviation medical examiner

(AME) to either defer or deny a medical certificate. In addition, medications were found in the pilot's system that are known to cause impairment and are listed on the Federal Aviation Administration's (FAA) "Do Not Issue" and "Do Not Fly" lists. An AME would likely have deferred or denied a medical certificate to a pilot reporting use of these medications. The FAA stated the primary mitigator of risk in balloon operations is the commercial pilot certificate, yet there is no requirement for balloon pilots to hold a medical certificate to indicate that they are medically fit to fly.

- **Lack of targeted FAA oversight of potentially risky commercial balloon operations.** The FAA conducted 98% of its oversight of balloon operators at balloon gatherings between January 1, 2014, and December 15, 2016. Thus, those operators who do not attend the gatherings, such as the accident pilot, are likely not to receive any FAA oversight. Such focus on balloon gatherings does not support the FAA's risk-based, data-informed approach to oversight. It also does not provide the FAA with opportunities to educate all commercial balloon operators and mitigate risk before an accident occurs.

The NTSB determines that the probable cause of this accident was the pilot's pattern of poor decision-making that led to the initial launch, continued flight in fog and above clouds, and descent near or through clouds that decreased the pilot's ability to see and avoid obstacles. Contributing to the accident were (1) the pilot's impairing medical conditions and medications and (2) the FAA's policy to not require a medical certificate for commercial balloon pilots.

As a result of this investigation, the NTSB makes two safety recommendations to the FAA.

# 1. Factual Information

## 1.1 History of the Flight

On July 30, 2016, about 0742 central daylight time (CDT), a Balóny Kubíček BB85Z hot air balloon, N2469L, operated by Heart of Texas Hot Air Balloon Rides, struck power lines and crashed in a field near Lockhart, Texas.[1] The pilot and 15 passengers died, and the balloon was destroyed by impact forces and postcrash fire. The balloon was owned and operated by the pilot, and the flight was conducted under the provisions of 14 *Code of Federal Regulations* (*CFR*) Part 91 as a sightseeing passenger flight. The flight originated about 0658, just after sunrise, from Fentress Airpark, Fentress, Texas.[2]

The pilot, a ground crew (consisting of 1 crew chief and 2 crewmembers), and 15 passengers met in a commercial parking lot in San Marcos, Texas, about 0545 on the morning of the accident flight.[3] The passengers checked in with the pilot, signed liability release forms, and received a briefing from the ground crew chief.[4] The pilot released a pibal and, from his observation of the pibal, selected Fentress Airpark as the launch site for the flight.[5] The pilot and ground crew chief then drove the ground crewmembers and passengers to the launch site in a van and sport utility vehicle, towing the balloon in a trailer. The ground crew and other witnesses reported seeing patchy fog along the route to and near the launch site.

The pilot made the final decision to launch at Fentress Airpark. In a postaccident interview with NTSB investigators, the ground crew chief stated that the weather at the launch site was clear.[6] A ground crewmember stated that fog was visible near the launch site but that vertical visibility was unobscured. A ground crewmember reported that it was the pilot's habit to determine if visibility was acceptable by observing white utility poles located nearby, stating that on days

[1] (a) All times in this report are CDT. (b) For the remainder of the report, Balóny Kubíček will be referred to as Kubíček.

[2] On December 9, 2016, the National Transportation Safety Board (NTSB) held a 1-day hearing to examine the circumstances of this accident as well as issues relating to the safety of hot air ballooning. A full transcript of the hearing and additional supporting documentation referenced in this report are available in the public docket for this accident, accessible from the NTSB's Accident Dockets web page by searching DCA16MA204. NTSB documents referenced in this report are accessible from the NTSB's Aviation Information Resources web page (www.ntsb.gov/air).

[3] The meeting location allowed the pilot to delay the choice of the launch site to evaluate the wind direction as close to launch time as possible.

[4] A subject matter expert testified at the investigative hearing that liability release forms were likely used to meet an insurance requirement. For more information, see the Transcript—Public Hearing, p. 68, in the public docket for this accident.

[5] An aid in selecting launch and/or landing sites, a pibal (pilot balloon) is a small, helium-filled balloon used to determine wind direction and velocity and to identify windshear.

[6] For more information and complete statements from the ground crew chief and ground crewmembers, see the Interview Summaries in the public docket for this accident.

that the pilot could not see the poles, he would cancel the flight.[7] The NTSB could not identify the poles that the pilot used to verify that visibility was acceptable. However, a passenger photograph of launch preparation showed mostly clear conditions with unrestricted visibility in the immediate vicinity; clouds/fog can be seen in the distance (see figure 1). After the pilot decided that visibility was acceptable, the balloon was inflated. The pilot also released another pibal at the launch site to evaluate the wind before making the final decision to launch.

**Figure 1.** Weather conditions during launch preparation (about 0635).

[7] Heart of Texas Hot Air Balloon Rides operated near San Marcos in an area consisting of Class G (uncontrolled) airspace from the surface to 700 or 1200 ft above ground level (agl), depending on proximity to airports. The visual flight rules (VFR) weather minimums for day balloon operations in Class G airspace, specified in 14 *CFR* 91.155, require a balloon to remain clear of clouds with 1 statute mile visibility.

The balloon launched about 0658 on a northerly course.[8] The ground crew reported that the balloon launch was normal. The crew chief reported that he and the crewmembers watched the flight from the launch site for about 10 minutes before beginning to follow the balloon in the vehicles. Landing was planned for an off-airport location that the pilot would select in flight. A ground crewmember stated that flights typically lasted about 1 hour and that the pilot usually began looking for a landing site about 50 minutes into a flight. The flight was expected to fly over sparsely populated terrain of mostly open fields.

Passengers' cameras and portable electronic devices (PEDs) recorded both still and video images during various portions of the flight that depict weather conditions encountered along the route of flight and pilot/passenger activity.[9] In addition, the video images, and their accompanying audio, depict the pilot actively controlling the balloon.

Fog and low clouds were visible from the balloon along the flight route within minutes of launch. A passenger photograph taken 2 minutes after launch (about 0700), facing in the direction of travel, showed low clouds and fog (see figure 2). A photograph taken about 0703 showed the balloon much closer to the clouds (see figure 3). The ground crew chief stated that he saw the balloon enter "a little bit of fog" soon after it passed over a tollway (about 1.5 miles north of the launch site) and that the fog became "thicker" until he could only see the basket beneath low clouds; he stated that the basket was just above the treetops at this point. About 0717 (19 minutes after launch), a passenger captured a photograph showing reduced visibility when compared to earlier conditions (see figure 4).

**Figure 2.** In-flight conditions 2 minutes after launch (about 0700).

Note: The photograph was taken facing north; fog and low-level clouds can be seen along the route of flight.

8 Data retrieved from a tablet the pilot used during flight indicated the launch time. For more information, see Electronic Devices—Pilot—Specialist's Factual Report in the public docket for this accident.

9 For a detailed description of the video and still images, see the Onboard Image Recorder—Specialist's Factual Report in the public docket for this accident. The report includes the image data used to identify the time each photograph was recorded.

**Figure 3.** In-flight conditions 5 minutes after launch (about 0703).

Note: This photograph was taken 5 minutes after launch, facing north. The balloon was closer to the fog/clouds; however, the ground was visible.

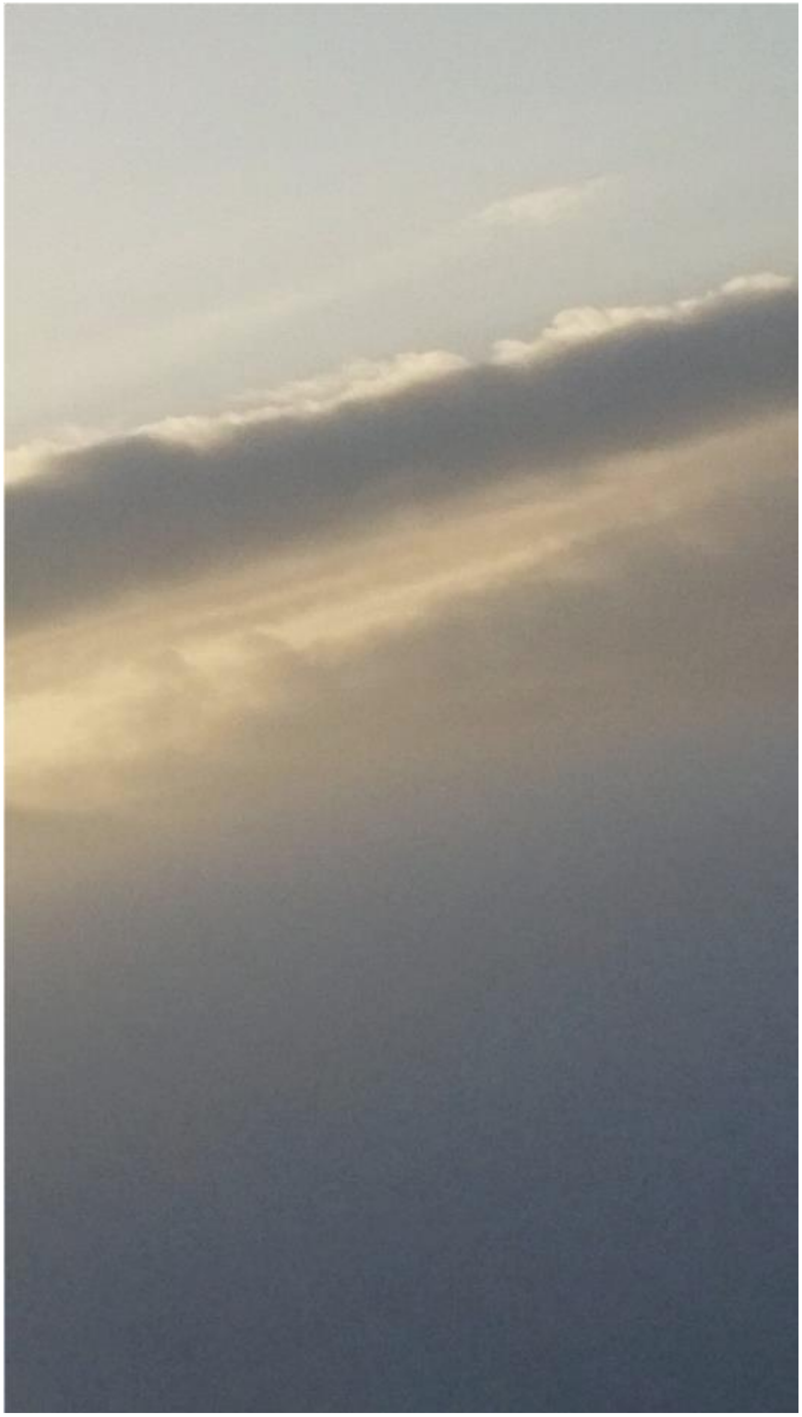

**Figure 4.** In-flight conditions 19 minutes after launch (about 0717).

Note: The balloon was in mist/fog/clouds; however, the ground was still visible. The direction from which the photograph was taken could not be determined.

The ground crew stated they watched the progress of the flight until losing sight of the balloon when it climbed into the clouds. Sometime later, the ground crew saw the balloon emerge from clouds and watched it fly in and out of the clouds as they continued to follow it. Multiple witnesses also reported seeing the balloon flying in and out of fog and clouds. A ground crewmember stated that he saw the balloon go in and out of the clouds three times before he lost sight of it for the last time.

Passenger photographs taken throughout the flight show that the ground was visible (although at times visibility was noticeably reduced) for significant portions of the flight.[10] The first photograph showing the balloon above thin clouds was taken 24 minutes after launch, about 0722 (see figure 5). The ground is also visible through thin clouds in photographs taken 26 minutes after launch, about 0724 (see figure 6) and 27 minutes after launch, about 0725 (see figure 7).

[10] Additional photographs can be viewed in the Onboard Image Recorder—Specialist's Factual Report in the public docket for this accident.

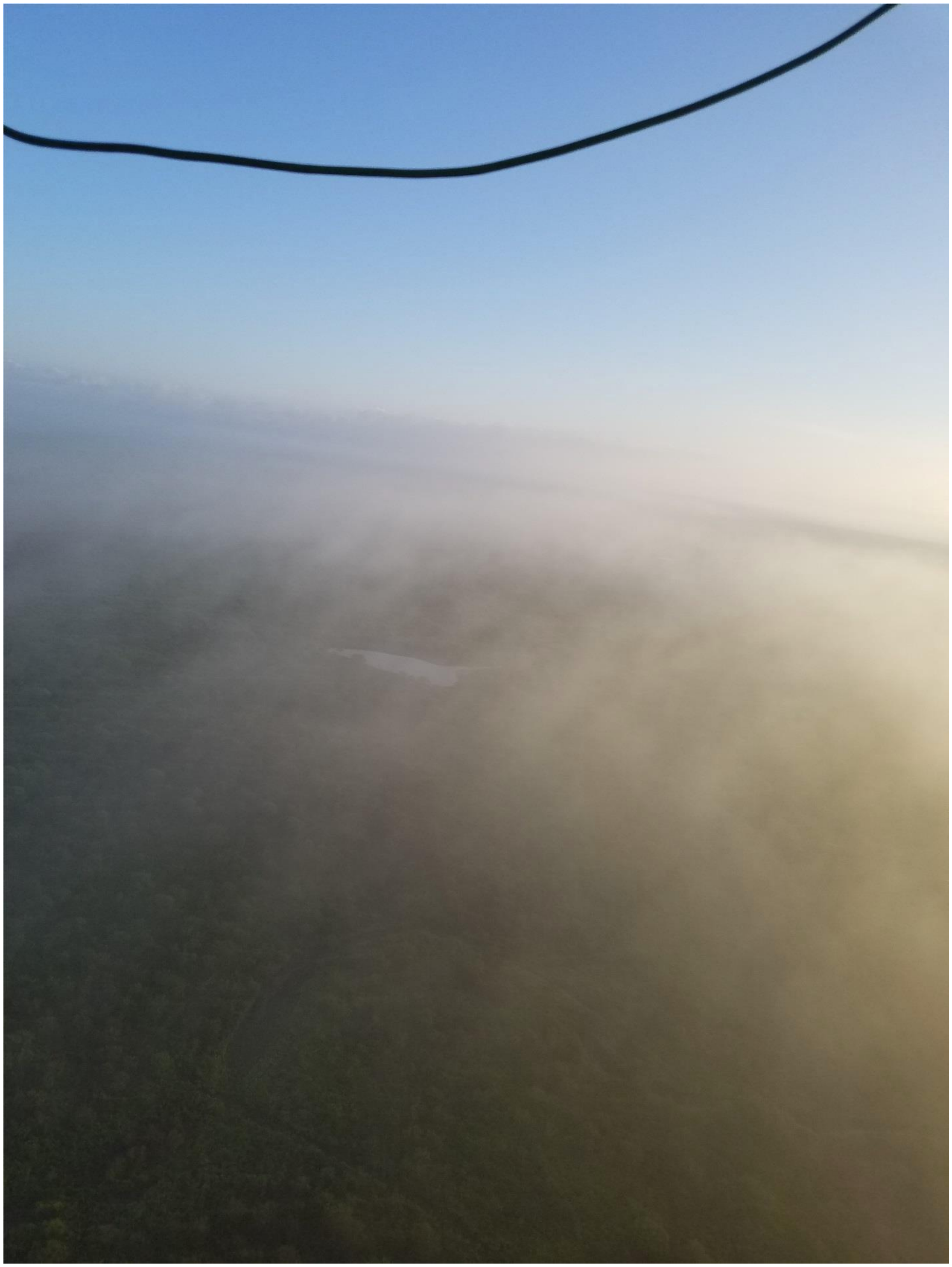

**Figure 5.** In-flight conditions 24 minutes after launch (about 0722).

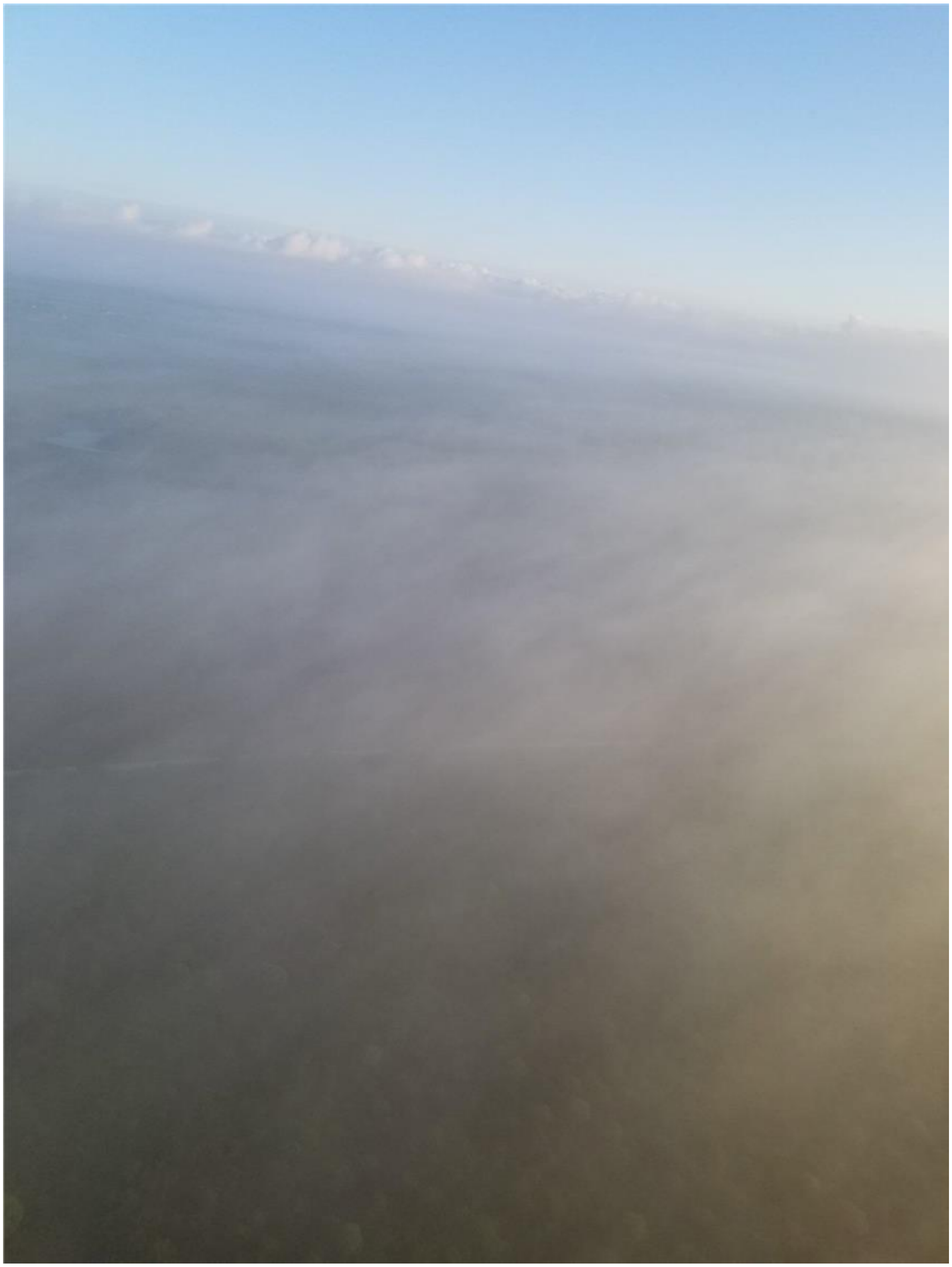

**Figure 6.** In-flight conditions 26 minutes after launch (about 0724).

Note: The ground is again visible through thin clouds.

**Figure 7.** In-flight conditions 27 minutes after launch (about 0725).

Note: The ground remains visible through thin clouds.

About 0726 (about 28 minutes after launch and about 16 minutes before the accident), the pilot sent a position signal to the ground crew chief's cell phone using a navigation application on his tablet.[11] A ground crewmember stated that they received the position transmission from the pilot about 5 minutes after losing visual contact with the balloon for the last time. The ground crew chief stated that, after receiving the signal, they tried to send messages back to the pilot but were unsuccessful.

A passenger photograph taken about 0738 (40 minutes after launch and 4 minutes before the accident) showed the balloon flying above an overcast cloud layer that appeared to extend to the horizon (see figure 8). Another photograph taken about 0740 (2 minutes before the accident) showed the shadow of the balloon near a hole in the clouds that reveals a power line tower (see figure 9).

[11] According to a ground crewmember, the pilot often used the navigation application (which can transmit position and ground track data to other PEDs and is called *Hot Air*) to communicate to the ground crew that he would be landing soon. More information about the application can be found in section 1.8.1.

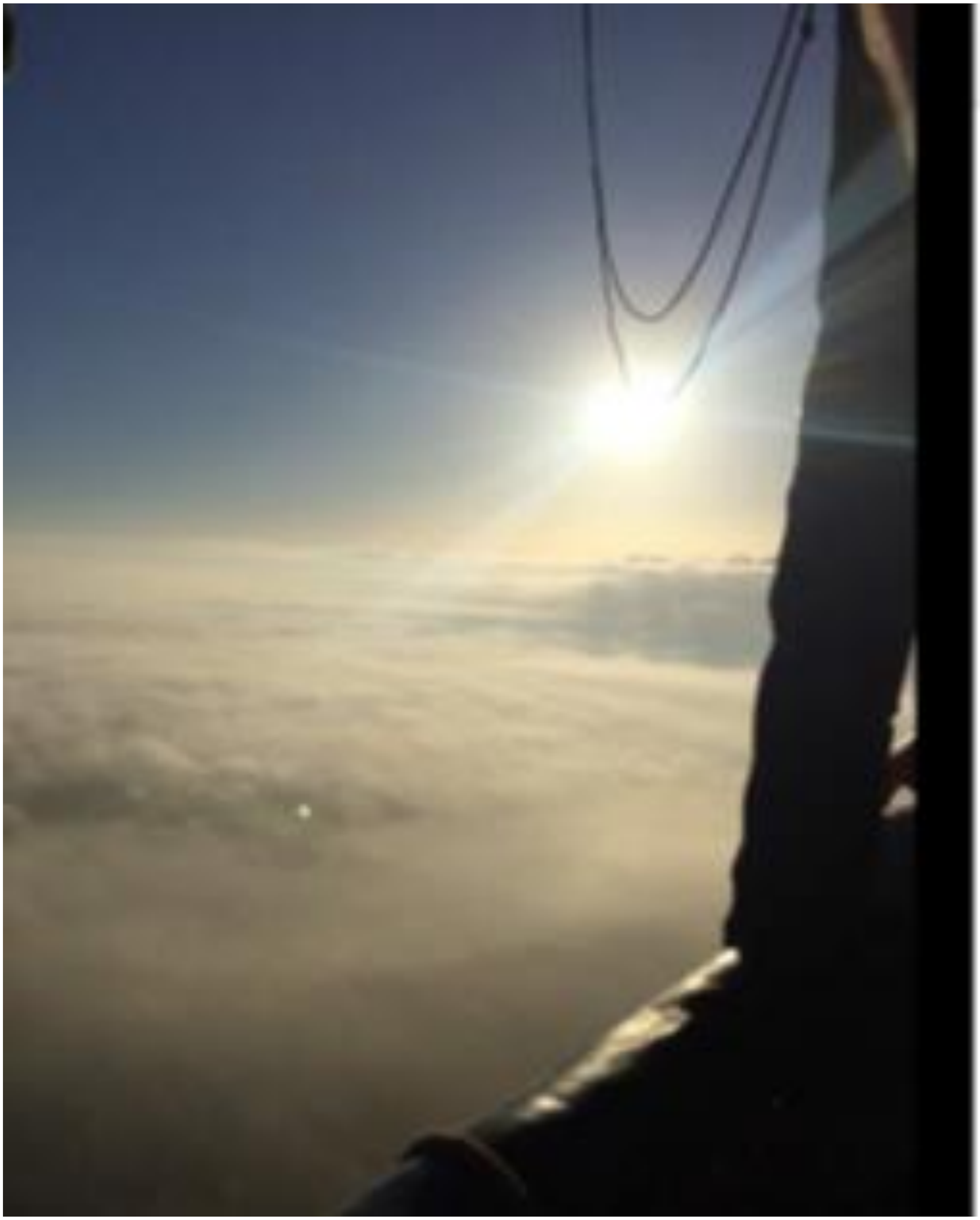

**Figure 8.** In-flight conditions 40 minutes after launch and 4 minutes before the accident (about 0738).

Note: This photograph was taken facing east; the balloon was tracking north. The cloud layer appears to extend to the horizon.

**Figure 9.** In-flight conditions 42 minutes after launch and 2 minutes before the accident (about 0740).

Note: This photograph was taken facing west. The balloon’s shadow (circled) can be seen just below the break in the clouds. A power line tower is visible through the break in the clouds.

Data from *Hot Air*, the navigation application on the pilot’s tablet, indicated that the balloon’s flightpath intersected power lines about 0742; the power line operator reported a power trip on the line at that same time.

The ground crew chief stated that the ground crew was very busy trying to regain visual contact with the balloon and that, about 35 minutes after receiving the position transmission, he began trying to call passenger phone numbers, but all attempts went to voice mail. The ground crew chief said that he and the ground crewmembers went into “panic mode” when they were unable to contact the pilot; they tried to locate the balloon visually and then eventually started to drive toward San Marcos. They encountered law enforcement personnel blocking the road and learned that the balloon had crashed.

The crash site was located about 8 miles north of the launch site in an open field crossed by power lines. The power lines were oriented east/west, nearly perpendicular to the balloon’s flightpath. The lines were configured with a single, noncharged, grounded line on each side at the top with three phased pairs of charged lines below on each side (see figure 10). The balloon’s basket was located beneath the power lines. The balloon’s burner assembly and envelope were located about 0.5 mile downwind (north) of the basket (see section 1.6 for wreckage and impact information).


**Figure 10.** Power lines at the accident site.

## 1.2 Injuries to Persons

The pilot and 15 passengers all received fatal injuries. Autopsy results indicated the causes of death for the occupants included various combinations of blunt force trauma, thermal burns, and inhalation injuries.

## 1.3 Pilot Information

### 1.3.1 Federal Aviation Administration Certificates, Flight Experience, and Flight Reviews

The pilot was issued a student pilot (free balloons only) certificate on February 6, 1992. On October 19, 1993, the pilot passed the commercial pilot free balloon-hot air written examination. On October 22, 1993, he applied for a commercial pilot certificate with a lighter-than-air balloon rating after completing the Federal Aviation Administration (FAA) checkride. He received the certificate on October 24, 1993.

An FAA medical certification examination is a comprehensive, subjective review of a pilot's medical history and medications and an objective examination of a pilot by a certified aviation medical examiner (AME) to determine if a pilot meets established medical standards to safely operate an aircraft. To exercise the privileges of their pilot certificate, a person must (with limited exceptions) hold a corresponding medical certificate, as described in 14 *CFR* 61.23. Medical certification is divided into three certificate classes: first-class medical certificates are generally required for airline transport pilots, second-class medical certificates are generally required for commercial pilots, and third-class medical certificates are generally required for private pilots. Although 14 *CFR* 61.23 requires most pilots exercising the privileges of a commercial pilot certificate to maintain a second-class medical certificate, 14 *CFR* 61.23(b) exempts balloon pilots from all medical certificate requirements. (Additional information about FAA medical certificate requirements can be found in section 1.7.2.) However, the accident pilot applied for and obtained a third-class medical certificate on July 29, 1996.[12]

The pilot's personal logbook was not located. Based on data recovered from the pilot's tablet and information from business records, the pilot's flight time in the 1 year, 90 days, and 7 days before the accident were 118.02 hours, 25.89 hours, and 1.15 hours, respectively. His total flight experience could not be determined.

To act as pilot-in-command of an aircraft, a person must have completed a flight review consisting of 1 hour of flight training and 1 hour of ground training within the preceding 24 calendar months. No records could be found to indicate that the accident pilot had a current flight review or had completed other training or evaluations that could be substituted for a flight review.[13]

### 1.3.2 Medical Information

At the time of the accident, the pilot was receiving medical care from providers in both Texas and Missouri (where he had resided previously and continued to manage another commercial balloon operation).[14] Appendix B lists the medications that the pilot had recently been prescribed by these physicians. The pilot's medical treatment is summarized by state below.

**Texas.** The pilot's last medical visit in Texas occurred on July 28, 2016, to a primary care physician. During that visit, the pilot requested refills of prescriptions for back pain (oxycodone and diazepam) and attention deficit hyperactivity disorder (ADHD) (methylphenidate). Although the pilot had not recently been evaluated for his ADHD symptoms, about 3 years before the accident, an examining psychologist documented that the treatment regimen did not appear to effectively control the pilot's symptoms. (Additional information about the pilot's medical conditions and medications can be found in sections 1.3.2.1 and 1.3.2.2.) Records indicated that the Texas provider was aware that the pilot was also being treated by health care providers in Missouri but did not indicate that the provider was aware that the pilot was an active commercial balloon pilot.

**Missouri.** The pilot's last medical appointment in Missouri occurred on April 26, 2016, to a primary care provider. The reason for the visit was noted as "medication refills." The visit documented ongoing treatment for type 2 diabetes (treated with insulin and metformin), fibromyalgia (treated with piroxicam and cyclobenzaprine), high blood pressure, and high cholesterol (treated, respectively, with losartan and simvastatin). The medical records indicated good compliance with diabetic treatment and no evidence of renal disease, peripheral

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[12] The pilot's third-class medical certificate was valid for 3 years.

[13] Title 14 *CFR* 61.56 paragraphs (d) and (e) outline alternatives to a flight review.

[14] For a detailed description of the pilot's medical conditions and medications, see the Medical Factual Report in the public docket for this accident.

neuropathy, or vision changes associated with diabetes. About 1 year before the accident, an eye examination found no evidence of diabetic eye disease. The pilot reported unchanged symptoms of muscle and joint pain, generalized fatigue, and widespread moderate pain associated with fibromyalgia. Control of high blood pressure and high cholesterol was noted as "good." The medical records did not indicate that the provider was aware the pilot was being treated in Texas or that he was an active commercial balloon pilot.

Records from November 2013 through April 2016 detailed eight visits to a psychiatrist in Missouri, the last of which occurred on April 25, 2016. Records indicated that the pilot had previously been diagnosed with major depressive disorder, ADHD, insomnia, and alcohol dependence. The pilot reported to his psychiatrist that he was experiencing recurrent symptoms of poor sleep, low mood, poor motivation, social isolation, and irritability; the psychiatrist documented the patient's mood as "not good." The records documented that the pilot had not used the medication that he had been prescribed for major depressive disorder in the 3 months preceding the visit. The psychiatrist wrote prescriptions to treat major depressive disorder (fluoxetine and bupropion) and insomnia (zolpidem). There was no indication that the psychiatrist was aware that the pilot was an active commercial balloon pilot.

The pilot's records from the psychiatrist also documented counseling visits that had occurred in June and July 2013. The documented goals of the sessions were to manage anxiety, depression, inability to focus, interpersonal relationships, and fibromyalgia effects. Counseling was terminated after four sessions due to the pilot's failure to attend any further sessions.

#### 1.3.2.1 Potentially Disqualifying Medical Conditions

The degree to which the pilot's documented medical conditions may be considered disqualifying for pilot medical certification according to FAA guidance is discussed below.

**ADHD.** ADHD is characterized by deficits in attention and susceptibility to distraction. ADHD symptoms can also include impulsivity and impairments in motor inhibition, reaction time, visual-motor coordination, rule-governed behavior, and decision-making (APA 2013). When involved in automobile accidents, drivers diagnosed with ADHD are more likely to be the at-fault driver than drivers with no known psychopathology and tend to incur greater damage to their vehicles (Aduen et al. 2015).

The FAA *Guide for Aviation Medical Examiners* explicitly requires AMEs to defer medical certification for pilots who report ADHD until they have undergone extensive neuropsychological evaluation and review because ADHD "…and medications used for treatment may produce cognitive deficits that would make an airman unsafe to perform pilot duties" (FAA 2017).[15]

**Depression.** Major depressive disorder is characterized by depressed mood or the loss of interest or pleasure in nearly all activities. Additional symptoms can include changes in weight,

[15] See, specifically, the Decision Considerations—Disease Protocols, Attention Deficit/Hyperactivity Disorder page and the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page. The latest revision date for the FAA *Guide for Aviation Medical Examiners* is August 30, 2017. For a detailed list of the revisions to the guide, see Archives and Updates—Guide for Aviation Medical Examiners. The July 27, 2016, update was the closest update to the date to the accident.

sleep, and psychomotor activity; decreased energy, feeling of worthlessness, or guilt; difficulty thinking, concentrating, or making decisions; and may include thoughts of death or suicidal ideations (APA 2013). Cognitive degradation may not improve even with remission of the depressed episode, and patients with major depression are more significantly affected than those with fewer symptoms or episodes (Nakano et al. 2008; Paelecke-Habermann et al. 2005). Additionally, major depression is associated with significant cognitive degradation, particularly in executive functioning (Snyder 2013).

Depression is a disqualifying condition for pilot medical certification, and, according to the FAA *Guide for Aviation Medical Examiners*, an AME should not issue a medical certificate to a depressed pilot because depression "…may produce cognitive deficits that would make an airman unsafe to perform pilot duties" (FAA 2017).[16] However, FAA policy permits special issuance of medical certificates to pilots who meet specific criteria (FAA 2017).[17]

**Diabetes.** Diabetes is a group of diseases resulting in elevated blood glucose. Diabetes treated with insulin (as in the pilot's case) can result in acute hypoglycemia or low blood sugar. Hypoglycemia symptoms include shakiness, nervousness, irritability, sleepiness, and fatigue and can progress to unconsciousness over several minutes. The FAA *Guide for Aviation Medical Examiners* identifies specific requirements for various diabetic conditions (FAA 2017). Diabetes treated with insulin requires an FAA medical certificate decision.[18]

**Fibromyalgia.** Fibromyalgia, a neurological condition, is a common cause of chronic pain characterized by widespread musculoskeletal pain often accompanied by fatigue and cognitive and psychiatric disturbances (Goldenberg 2016). Fibromyalgia is not specifically addressed in the FAA *Guide for Aviation Medical Examiners.* Generally, the guide indicates the following:

> A history or the presence of any neurological condition or disease that potentially may incapacitate an individual should be regarded as initially disqualifying. Issuance of a medical certificate to an applicant in such cases should be denied or defer [*sic*], pending further evaluation. [FAA 2017][19]

Additionally, the guide states that chronic conditions may be incompatible with safety in aircraft operation because of long-term unpredictability, severe neurologic deficit, or psychological impairment (FAA 2017).[20]

#### 1.3.2.2 Toxicology

Postaccident forensic toxicology analysis detected multiple compounds in the pilot's blood. Analysis detected both prescription and over-the-counter medications; no alcohol or illegal

[16] See, specifically, the Specifications for Neuropsychological Evaluations for Treatment with SSRI Medications page.

[17] See specifically, the Decision Considerations—Aerospace Medical Dispositions, Item 47. Psychiatric Conditions—Use of Antidepressant Medications page.

[18] See specifically, the Decision Considerations—Aerospace Medical Dispositions page.

[19] See, specifically, the Decision Considerations—Aerospace Medical Dispositions, Item 46. Neurologic page.

[20] See, specifically, the Decision Considerations—Aerospace Medical Dispositions, Item 46. Neurologic page.

drugs were detected. Medications found in the toxicology testing are identified in tables 1 and 2 (later in this section). Those with potentially impairing effects are described below the tables.[21] In addition, the FAA's determination whether a pilot may use each of the potentially impairing medications is discussed. Potentially impairing medication classes and some specific medications are listed on the "Do Not Issue" or "Do Not Fly" lists published in the FAA *Guide for Aviation Medical Examiners* (FAA 2017). Medications that a pilot should not use while flying and that require FAA clearance for a medical certificate are listed on the "Do Not Issue" list. Medications that may be used when not flying but that require an acceptable wait time between ending use and resuming flying are found on the "Do Not Fly" list. The FAA states that AMEs should provide additional safety information concerning medications on the "Do Not Fly" list, noting the following:

> All of these medications may cause sedation (drowsiness) and impair cognitive function, seriously degrading pilot performance. This impairment can occur even when the individual feels alert and is apparently functioning normally—in other words, the airman can be "unaware of impair." [FAA 2017][22]

The lists are not all inclusive but address most common concerns.

**Table 1.** Pilot's prescription medications detected by toxicology.

| Medication | Condition Treated | Potentially Impairing Yes/No |
|---|---|---|
| Bupropion | Depression | Yes |
| Cyclobenzaprine | Fibromyalgia | Yes |
| Diazepam | Anxiety | Yes |
| Methylphenidate | ADHD | Yes |
| Oxycodone | Fibromyalgia | Yes |
| Fluoxetine | Depression | No |

**Bupropion.** Bupropion is a prescription antidepressant marketed with the name Wellbutrin. It carries a warning of increased risk of seizures (NIH 2017 Wellbutrin). The FAA will consider a special issuance of a medical certificate for a pilot with a diagnosis of depression after 6 months of treatment if the applicant is clinically stable on one of four approved medications; bupropion is not one of these medications (FAA 2017).[23]

**Cyclobenzaprine.** Cyclobenzaprine is a sedating prescription muscle relaxant marketed under various names including Amrix and Flexmib. It carries the warning "[cyclobenzaprine], especially when used with alcohol or other [central nervous system] CNS depressants, may impair mental and/or physical abilities required for performance of hazardous tasks, such as operating machinery or driving a motor vehicle" (NIH 2013). Cyclobenzaprine is specifically identified on

[21] For additional details about toxicology analysis, including data for substances that are not considered to be potentially impairing, see the Medical Factual Report in the public docket for this accident.

[22] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

[23] See, specifically, the Decision Considerations—Aerospace Medical Dispositions, Item 47. Psychiatric Conditions—Use of Antidepressant Medications page.

the FAA's "Do Not Fly" list (FAA 2017).[24] Diazepam, diphenhydramine, and oxycodone are CNS depressants and may enhance the adverse toxic effects of cyclobenzaprine (Lexicomp Interaction Analysis).[25]

**Diazepam.** Diazepam is a long-acting sedating benzodiazepine available by prescription and used to treat anxiety and painful muscle spasms (NIH 2014). It is commonly marketed under the name Valium. The performance effects of diazepam have been demonstrated in laboratory studies that showed single doses of diazepam (5 to 20 milligrams [mg]) can cause significant performance decrements.[26] Decreases in divided attention, slowed reaction time (auditory and visual), and decreased eye-hand coordination and impairment of tracking, vigilance, information retrieval, psychomotor skills, and cognitive skills have been recorded.[27] Lengthened reaction times have been observed up to 9.5 hours after dosage. Reduced concentration, impaired speech patterns and content, and amnesia can also occur. Diazepam may produce some effects that last for days.[28] Cyclobenzaprine, diphenhydramine, and oxycodone may enhance the adverse toxic effects of diazepam (Lexicomp Interaction Analysis). Diazepam is an anti-anxiety drug, all of which are included on the FAA's "Do Not Issue" list (FAA 2017).[29]

**Methylphenidate.** Methylphenidate is a prescription stimulant used to treat narcolepsy and ADHD. It is marketed under various names, including Ritalin and Concerta, and carries several warnings including the following: "…should be given cautiously to patients with a history of drug dependence or alcoholism. Chronic abusive use can lead to marked tolerance and psychological dependence with varying degrees of abnormal behavior" (NIH 2017 Concerta). As a psychiatric medication, methylphenidate is included on the FAA's "Do Not Issue" list (FAA 2017).[30]

**Oxycodone.** Oxycodone is a prescription synthetic narcotic pain medication marketed under various names, including Percocet and Oxycontin. It carries warnings, including the following:

> Profound sedation, respiratory depression, coma, and death may result if [oxycodone] is used concomitantly with alcohol or other central nervous system (CNS) depressants (e.g., non-benzodiazepines sedatives/hypnotics, anxiolytics, tranquilizers, muscle relaxants, general anesthetics, antipsychotics, other opioids, alcohol). [NIH 2016]

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[24] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

[25] Lexicomp is an online database that provides drug information including dosing, administration, warnings, and precautions. See, specifically, www.wolterskluwercdi.com for detailed information (accessed Aug. 31, 2017).

[26] For more information, see the National Highway Traffic Safety Administration (NHTSA) Drugs and Human Performance Fact Sheets—Diazepam in the public docket for this accident.

[27] For more information, see the NHTSA Drugs and Human Performance Fact Sheets—Diazepam in the public docket for this accident.

[28] For more information, see the NHTSA Drugs and Human Performance Fact Sheets—Diazepam in the public docket for this accident.

[29] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

[30] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

Additionally, warnings state the following about the medication:

> …may impair the mental or physical abilities needed to perform potentially hazardous activities such as driving a car or operating machinery. Warn patients not to drive or operate dangerous machinery unless they are tolerant to the effects of [oxycodone] and know how they will react to the medication. [NIH 2016]

Cyclobenzaprine, diphenhydramine, and diazepam may enhance the adverse toxic effects of oxycodone (Lexicomp Interaction Analysis). Oxycodone is specifically identified on the FAA's "Do Not Fly" list (FAA 2017).[31]

**Table 2.** Pilot's over-the-counter medications detected by toxicology.

| Medication | Commonly Treated Conditions | Potentially Impairing Yes/No |
|---|---|---|
| Diphenhydramine | Allergy, insomnia | Yes |
| Dextromethorphan | Cough | Yes* |
| Acetaminophen | Pain, fever | No |

* May be impairing at high levels but is not specifically listed on the FAA "Do Not Issue" or "Do Not Fly" lists.

**Diphenhydramine.** Diphenhydramine is a sedating antihistamine used to treat allergy symptoms and as a sleep aid. It is available over the counter under the trade names Benadryl and Unisom. Compared to other antihistamines, diphenhydramine causes marked sedation, which is the rationale for its use as a sleep aid. Altered mood and impaired cognitive and psychomotor performance may also be observed. In a driving simulator study, a single dose of diphenhydramine (50 mg) impaired driving ability more than a blood alcohol concentration of 0.1% (Weiler et al. 2000). Cyclobenzaprine, oxycodone, and diazepam may enhance the adverse toxic effects of diphenhydramine (Lexicomp Interaction Analysis). The FAA includes sedating antihistamines, specifically diphenhydramine, on its "Do Not Fly" list (FAA 2017).[32]

**Dextromethorphan**. Dextromethorphan is a cough suppressant found in many over-the-counter cough, cold, and flu preparations including Robitussin and Delsym. Increased sedation can be seen at high levels, but it is not specifically listed on the FAA's "Do Not Issue" or "Do Not Fly" lists.

### 1.3.3 Criminal Offenses and Security Review

Federal Bureau of Investigation National Crime Information Center and Missouri driving records indicated that the pilot had been arrested, convicted, and incarcerated multiple times (see table 3). At the time of the accident, the pilot did not hold a valid driver's license. He had previously been issued a Missouri driver's license, which had been revoked and was not eligible for reinstatement until 2020.

[31] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

[32] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

**Table 3.** Pilot's criminal offenses.

| Year | Offense |
|---|---|
| 1987 | Possession of Drugs |
| 1996 | Interfering with an arrest |
| 1998 | Driving While Intoxicated (DWI)/Alcohol and possession of a controlled substance |
| 1999 | Possession of a controlled substance<br>Distribution and delivery of manufactured substance |
| 2000 | DWI/Alcohol "persistent offender" |
| 2007 | Leaving the scene of an accident and operating with suspended driver's license |
| 2010 | DWI/Alcohol "aggravated offender" and operating with a revoked driver's license |

When the pilot applied for an FAA third-class medical certificate in 1996, he answered "no" to the question regarding history of nontraffic convictions.[33] Although the pilot's third-class medical certificate would have expired in 1999, after receiving third-party letters in 2012 and 2013 that reported the pilot had a history of alcohol-related infractions and identifying alcohol-related convictions and license actions, the FAA initiated a security review of the pilot's driving record. The FAA's review of the pilot's convictions and license actions resulted in a letter to the pilot, dated July 29, 2013, that identified his violation of the *CFR*s, stating, in part, the following:[34]

> When completing your next Application for an Airman Medical Certificate, FAA Form 8500-8, please read Question 18v carefully and follow the instructions attached when answering the question. Question 18v seeks information regarding arrests, convictions, and/or administrative actions (such as, driver license suspensions, cancellations, revocations, denials) or loss of driving privileges, and any required attendance at a substance abuse program or an alcohol education or rehabilitation class.

## 1.4 Balloon Information

### 1.4.1 General

The balloon envelope and basket were both manufactured in June 2014 by Kubíček in the Czech Republic. The balloon's standard airworthiness certificate was dated August 15, 2014. The ground crew chief provided the original certificate to the NTSB because it was not in the balloon at the time of the accident, although required by 14 *CFR* 91.203(a).

The Kubíček flight manual, page 7-1, prescribed an inspection every 100 flight hours or 12 calendar months, whichever came first. Further, 14 *CFR* 91.409 required annual aircraft inspections. The balloon's logbook indicated an annual inspection date of May 23, 2015. The ground crew chief also provided a work order for a "Complete Annual" dated August 9, 2015. However, the inspector listed on the work order reported that the document represented an invoice for unpaid repair services and that he had not inspected N2469L since the May 23, 2015, annual

[33] In addition to responding "yes" or "no" to a question relating to history of arrest or conviction for driving while intoxicated or impaired, applicants for all medical certificates are required to authorize the National Driver Register (NDR) to furnish driving record information to the FAA.

[34] For additional details about the FAA's letter, see FAA Memo Details in the public docket for this accident.

inspection. The NTSB was unable to locate any records documenting an annual inspection current at the time of the accident.

### 1.4.2 Components

The balloon was comprised of three main components: (1) the envelope, (2) the burner and fuel system, and (3) the basket.

The envelope was constructed of various materials that differed by location and purpose. Most of the envelope consisted of silicone-impregnated nylon taffeta that ran from the apex to the lowest 15 ft of the envelope. The balloon's control vents were in this portion of the envelope. The parachute vent, located at the apex of the envelope, was used to release air from the envelope to speed descents and ground deflation. The maneuvering vent, located near the equator of the envelope, was used to rotate the balloon and basket in flight. The vents were controlled by lines routed through pulleys to the pilot station in the basket. The lower 15 ft of the envelope was constructed of a ripstop, flame-resistant polyester fabric. The throat of the envelope (nearest the burner) consisted of flame-resistant aramid fabric.[35]

The envelope was connected to the basket by 28 braided stainless-steel envelope load cables, which attached at the burner support frame via carabiners; 24 cables were connected in pairs, and 4 cables were connected singly.

The balloon's burner and fuel system consisted of three propane burners mounted to a burner assembly, a fuel manifold, connecting hoses, and four Ultra Magic Balloon model M40D propane fuel cylinders. Each of the burners was identified by color: red, white, or blue. The three mechanically identical burners were mounted to a burner block attached to the burner support frame. The burners were activated by hand levers and could be operated individually or all at once. The fuel manifold connected the red burner to two of the four installed fuel cylinders. The white and blue burners were each connected directly to a single fuel cylinder. The fuel supply hoses consisted of an inner tube covered by two layers of braided steel and an outer rubberized coating. Each fuel cylinder had a capacity of 95 liters and was rated to a pressure of 30 bar (about 435 lbs per square inch). The balloon was not delivered with Ultra Magic fuel cylinders, and the FAA type certificate data sheet for the Kubíček BB85Z did not list these cylinders as an approved type. Further, the FAA aircraft registry did not include a supplemental type certificate record approving the use of the Ultra Magic cylinders on the accident balloon. When equipped with the four fuel cylinders, the balloon was capable of about 1.5 hours of flight.

The accident balloon's basket was a Kubíček K60TT capable of carrying 18 people: 2 in the crew compartment and 16 divided among the four passenger compartments. The basket was constructed of rattan woven in a wicker-basket style over a stainless-steel welded tube frame with a wood floor. The lower portion of tubular frame and an upper portion of tubular frame were spaced about 4 ft apart vertically. The basket was supported by six stainless-steel wire rope cables

[35] (a) According to MMI Textiles, ripstop is "a type of woven fabric, often made of nylon, which uses a special reinforcing technique to make it tear and ripping resistant" (www.mmitextiles.com, accessed Sept. 5, 2017). (b) According to Fibermax Composites, aramid fiber is characterized by high strength and heat resistance. It is used in various applications, including structural composites, body armor, and protective clothing (www.aramid.eu, accessed Aug. 10, 2017).

(routed around and underneath the basket) connected on each end to the burner support frame, resulting in a 12-point connection. Figure 11 shows an exemplar Kubíček K60TT basket.

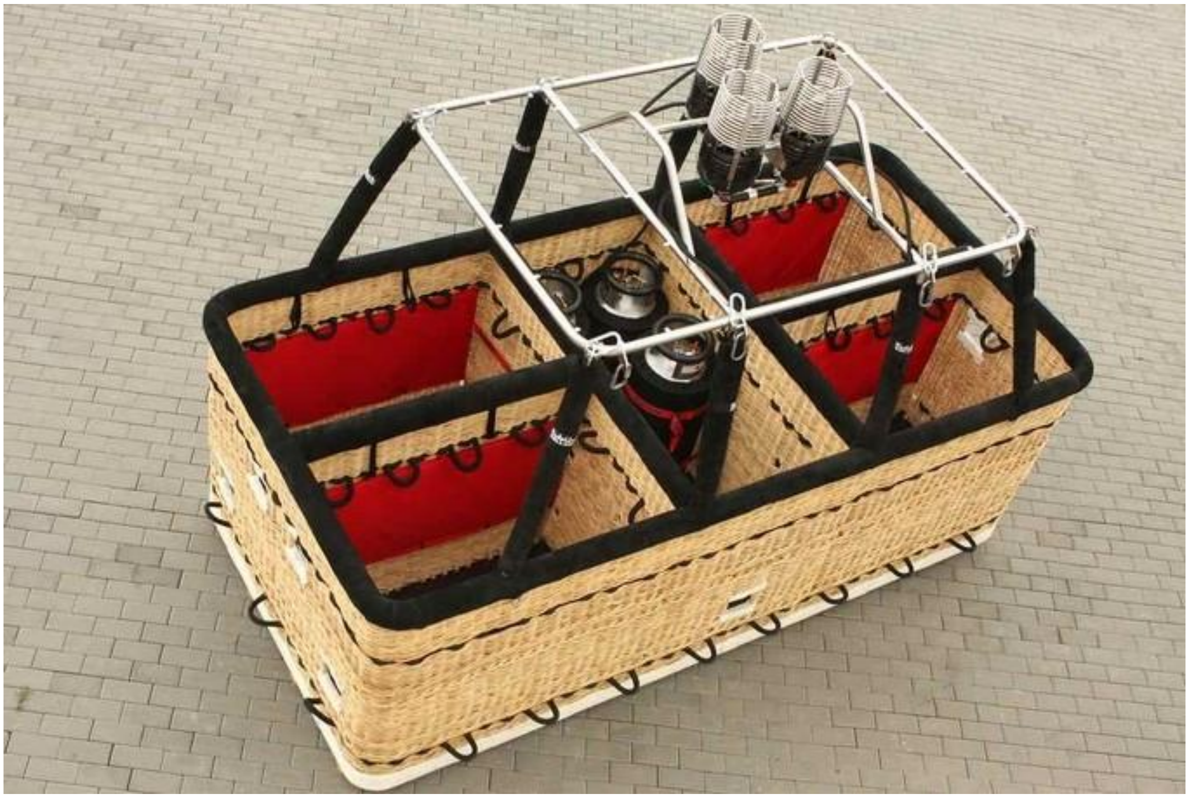

**Figure 11.** Exemplar Kubíček K60TT basket.

Source: Kubíček

### 1.4.3 Characteristics Unique to Balloons

The FAA *Balloon Flying Handbook*, 7-7, "Maneuvering," states, "The balloon is officially a nonsteerable aircraft" (FAA 2008). Although a hot air balloon has no direct controls for steering, a balloon's flightpath can be indirectly influenced using the burner and parachute valve. Continuing in the same paragraph on page 7-7, the handbook also states the following:

> Being knowledgeable of the wind at various altitudes, both before launch and during flight, is the key factor for maneuvering. Maneuvering, or steering, comes indirectly from varying one's time at different altitudes and different wind directions. [FAA 2008]

To initiate a climb, a balloon pilot activates one or more of the balloon's propane fuel burners. Rate of climb is adjusted by the duration and/or frequency of burner activations. Level flight is achieved by executing a series of burns that minimizes changes in vertical velocity. Descent is achieved either by allowing the air in the envelope to cool or by opening the parachute valve to allow hot air to escape. The rate of descent can be increased by leaving the parachute valve open longer or reopening the valve. Rate of descent can be slowed or stopped by activating the burner(s).

Because the pilot cannot always predict where he will be able to land the balloon, it is imperative that conditions be suitable for detection of potential obstacles (clear of clouds or fog) throughout the flight. The FAA recognizes power lines as perhaps the most significant obstacle to balloon flight.[36] During the NTSB's investigative hearing, a balloon pilot testifying about the difficulty of detecting power lines stated, "You're not so much looking for power lines… you're looking for towers."[37] Another balloon pilot stated that his ground crew is always trained to watch for power lines.[38]

## 1.5 Meteorological Information

### 1.5.1 Forecasts and Observations

Data from the pilot's tablet indicated that, on the morning of the accident, he checked two ballooning websites, Blastvalve.com and ryancarlton.com, to obtain weather observations and winds aloft information.[39] The pilot then called a flight service station (FSS) about 0506 and requested a weather briefing for the period from 0630 to 0830 in the vicinity of San Marcos Regional Airport (HYI), San Marcos, Texas.[40] The FSS weather briefing included air mass information, a radar summary, the surface observation for the airport with weather reporting capability closest to the route of flight, an area forecast, a terminal aerodrome forecast (TAF) for the nearest airport to the route of flight covered by a forecast, and a winds aloft forecast.

HYI, located 5 miles west of the crash site, had the closest official weather station to the accident balloon's flightpath. The HYI automated weather observing system (AWOS) report was supplemented by observations made by air traffic control personnel when the control tower was in operation. At 0455, the HYI AWOS recorded calm wind, 10 statute miles visibility, scattered clouds at 1,100 ft agl, temperature 23°C, dew point temperature 22°C, and altimeter setting 30.04 inches of mercury.[41] This observation was provided to the pilot in the 0506 FSS weather briefing and would have likely been posted on the websites that the pilot accessed before his call to the FSS.

The area forecast issued at 0444 (provided to the pilot in the 0506 FSS weather briefing) was valid for the period of the accident flight and forecasted a broken ceiling at 2,500 ft mean sea level (msl) with tops at 6,000 ft msl and isolated rain showers with tops to flight level 200. At 0700, the 2,500-ft msl broken ceiling was forecast to become a 2,000-ft msl scattered cloud layer.

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[36] For more information, see Powerlines and Thunderstorms Balloon Safety Tips (www.faa.gov/regulations_powerlines_and_thunderstorms, accessed Aug. 7, 2017).

[37] For more information, see the Transcript—Public Hearing, p. 26, in the public docket for this accident.

[38] For more information, see the Transcript—Public Hearing, p. 39, in the public docket for this accident.

[39] The NTSB could not retrieve the actual information the pilot viewed on the morning of the accident but determined that the websites provided information that would have likely mirrored information provided in the weather briefing he later received.

[40] An FSS is an air traffic facility that provides weather information and other services to aircraft pilots.

[41] Cloud layers are reported by fraction of sky covered, using the following terms: clear (no layer), few (1/8 – 2/8 coverage), scattered (3/8 – 4/8 coverage), broken (5/8 – 7/8 coverage), and overcast (8/8 coverage).

The TAF for Austin-Bergstrom International Airport (AUS), Austin, Texas, located about 30 miles north of the accident site, issued at 0027 (and provided to the pilot in the 0506 FSS weather briefing) forecasted wind from 170° at 4 knots, greater than 6 statute miles visibility, and a broken ceiling at 1,200 ft agl.

The pilot did not seek additional weather information after receiving the FSS weather briefing and before launch. At 0635 (about 23 minutes before the balloon's launch), the HYI AWOS recorded wind from 140° at 3 knots, 5 statute miles visibility, few clouds at 700 ft agl, temperature 22°C, dew point 22°C, and altimeter setting 30.05 inches of mercury. At 0637 (about 21 minutes before launch), a TAF was issued for AUS that forecast wind from 170° at 3 knots, 6 statute miles visibility, and scattered clouds at 1,200 ft agl. This forecast included temporary conditions between 0700 and 0900 consisting of 5 statute miles visibility, mist, and an overcast ceiling at 900 ft agl. At 0646 (about 12 minutes before launch), an observation from the HYI AWOS, supplemented by air traffic control personnel observations, reported wind from 160° at 4 knots, 2 statute miles visibility, mist, a broken ceiling at 700 ft agl, temperature 23°C, dew point 23°C, and altimeter 30.05 inches of mercury.

In a postaccident interview, a nearby balloon operator with multiple flights scheduled for the morning of the accident stated that his company cancelled all scheduled flights for the day of the accident based on "existing and forecast conditions."[42]

### 1.5.2 Additional Information

The FAA *Balloon Flying Handbook*, 4-41, "Chapter Summary," states the following:

> A thorough understanding of the weather is a "make or break" item for the balloon pilot; without a complete picture of the weather, a pilot may make an ill-advised decision to launch that may result in injury, damage to the balloon, or worse. It is imperative that a pilot use as many resources as he can, understanding the variables potentially affecting the flight, and making an informed decision to conduct a safe flight. [FAA 2008]

Further, although fog was not forecast, fog formation is most likely when the temperature/dew point spread is 2°C or less. Fog formation after sunrise is a well-documented phenomenon; the FAA *Balloon Flying Handbook*, 4-4, "Temperature Variations," states that "Minimum temperature usually occurs after sunrise, sometimes as much as one hour after. The continued cooling after sunrise is one reason that fog sometimes forms shortly after the sun is above the horizon."

## 1.6 Wreckage and Impact Information

The NTSB's postaccident examination of the balloon found impact damage, fire damage, and electrical arcing damage. Arcing occurs when an object completes a circuit between two transmission lines or between a transmission line and a ground line. The power lines that were

[42] For more information, see the Witness Statements document in the public docket for this accident.

struck carried 340,000 volts in 3 phases. High voltage can arc across an air gap of about 3 inches. This occurred twice in this accident: once between the top transmission line and ground line on the south set of lines and, 21 seconds later, between the top transmission line pair and ground line on the north set of lines.

The balloon components did not show evidence of preaccident component failure or damage that would have precluded normal operation.

As previously stated, the envelope was found about 0.5 mile downwind (north) of the basket; the parachute valve was open. The most prevalent damage noted on the envelope was thermal. The throat was mostly destroyed, while lower panels were charred and discolored. The lower portions of the remainder of the envelope were scorched or ripped; some sections were missing. The envelope support cables were found with the envelope. Of the 28 cables, 14 were found intact. Some of the remaining 14 cables exhibited electrical arcing damage in the form of severed ends with strand fusing.

The burners and burner support frame were found with the envelope; the fuel tanks were found with the basket. The red burner assembly exhibited impact damage and electrical arcing damage but was found to operate normally; the blue and white assemblies were undamaged and operated normally. The red burner showed evidence of abrasion on the coil and electrical arcing damage on its underside. The fuel hoses attached to the blue and white burners had separated at the burner. The red burner was connected to a length of fuel hose that ended at a “T” fitting; there was evidence of fuel hoses having detached from the fitting. All four fuel cylinders exhibited thermal damage. The valves on the cylinders were melted, and the cylinders were empty; the preaccident positions of the valves could not be determined. All four fuel cylinders had some length of fuel hose attached to them; one was found with 8 inches of hose attached, one with 18 inches, and two with 8 ft.

The basket was almost entirely consumed by fire; the upper and lower stainless-steel frames remained intact but were bent from ground impact (see figure 12). The basket support cables exhibited multiple severed ends with strand fusing. Evidence of electrical arcing was found on the carabiners that attached the basket support cables to the burner frame. Evidence of electrical arcing was also noted on the basket at the forward left corner of the upper and lower basket frames (see figure 13).

**Figure 12.** Postaccident photograph of the basket.

Note: All combustible basket components were completely burned; the remaining components were badly charred.

**Figure 13.** Arcing damage on the basket frame.

## 1.7 Organizational and Management Information

### 1.7.1 Heart of Texas

Heart of Texas Hot Air Balloon Rides was owned and operated by the pilot. He primarily conducted flights near San Marcos, Texas. The company had operated in other locations (including 1 week per month near Houston) but was not known to have operated at any balloon gatherings or festivals. Passenger scheduling was coordinated, via website, by the pilot's mother from her home in Florida. The website was also used to provide e-mail scheduling updates (usually based on weather) to passengers the night before a scheduled flight. The pilot was the only employee of the company at the time of the accident; for flights, the pilot was assisted by the three ground crewmembers who were compensated per flight by the pilot and who received tips from passengers.

The accident pilot had a reported history of flying near clouds. Near the conclusion of the FSS weather briefing, the briefer said to the pilot, "clouds may be a problem for you, I don't know how low you want to stay." The pilot replied, "well we just fly in between them" and "we find a hole and we go."[43] A pilot who had been previously employed by the company stated the accident pilot would "go up through a hole in the clouds."[44]

Fifteen passengers, in six groups of two and one group of three, were aboard the balloon for the July 30 flight. Two additional groups of two had been scheduled for July 30, but the manifest showed them as cancelled. Five of these seven passenger groups had experienced multiple schedule changes (ranging from 1 to 14 changes and dating from as early as May 2015) before the accident flight. The reasons for Heart of Texas Hot Air Balloon Rides' multiple schedule changes were not apparent from website data; most had been moved later from one or more previously scheduled dates (as would be seen for weather cancellations), but some had been moved to the date of the accident flight from previously scheduled future dates. A balloon pilot participating in the NTSB investigative hearing on this accident stated that weather cancellations are common for balloon sightseeing flights and that flights are sometimes cancelled at the very last minute, even after the balloon is inflated.[45]

### 1.7.2 FAA Oversight

#### 1.7.2.1 Medical

Medical certificate requirements for commercial balloon pilots differ from those for most other commercial pilots. Title 14 *CFR* 61.23(b) states that "A person is not required to hold a medical certificate… When exercising the privileges of a pilot certificate with a glider category rating or balloon class rating in a glider or a balloon, as appropriate."

Detailed requirements for each of the three levels of medical certificates are published in 14 *CFR* Part 67. Specifically, disqualifying conditions are listed in this part for each level of medical certificate. In addition, detailed guidance for AMEs is published in the FAA's *Guide for Aviation Medical Examiners*, which expands on 14 *CFR* Part 67. For example, the guide states that "Airmen should not fly while using any medication listed in the schedule I-V as well as mood stabilizers, most antidepressants, [attention deficit disorder] or ADHD medications, sedative hypnotics and tranquilizers" (FAA 2017).[46]

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[43] For more information, see the Meteorology Factual Report and Meteorology—Attachment 4 in the public docket for this accident.

[44] For more information, see the Operations Group Factual Report, Attachment 1—Interview Summaries, in the public docket for this accident.

[45] For more information, see the Transcript—Public Hearing, p. 79, in the public docket for this accident.

[46] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

The NTSB asked the FAA to provide a basis for excluding commercial balloon pilots from medical certificate requirements. The FAA indicated that the balloon pilot exclusion in 14 *CFR* 61.23 has been in place since the 1930s and that the FAA does not have information documenting the basis of the exclusion.[47] When asked at the investigative hearing if the FAA had reviewed the balloon pilot exclusion at any time since it was first incorporated into 14 *CFR* 61.23, an FAA medical representative stated that it had not been reviewed during the 13 years he had worked for the FAA.[48]

Although not required to hold a medical certificate, balloon pilots are required to follow regulations regarding prohibition on operations during medical deficiency. Title 14 *CFR* 61.53 states that "A person shall not act as pilot in command, or in any other capacity as a required pilot flight crewmember, while that person knows or has reason to know of any medical condition that would make the person unable to operate the aircraft in a safe manner." In addition, relating to alcohol and drugs,14 *CFR* 91.17 states the following:

> No person may act or attempt to act as a crewmember of a civil aircraft –
>
> 1. Within 8 hours after the consumption of any alcoholic beverage;
> 2. While under the influence of alcohol;
> 3. While using any drug that affects the person's faculties in any way contrary to safety; or
> 4. While having an alcohol concentration of 0.04 or greater in a blood or breath specimen. Alcohol concentration means grams of alcohol per deciliter of blood or grams of alcohol per 210 liters of breath.

Title 14 *CFR* 61.15 requires certificate holders to report within 60 days of action any conviction or operator's license cancellation, suspension, revocation, or denial related to motor vehicle operation while intoxicated, impaired, or under the influence of alcohol or a drug. Failure to comply with this requirement is grounds for suspension, revocation, or denial of an application for a certificate.

[47] For more information about the FAA's Nov. 4, 2016, e-mail received by the NTSB Operational Factors Group Chairman, see the Group Chairman's Factual Report—Operational Factors in the public docket for this accident.

[48] For more information, see the Transcript—Public Hearing, p. 144, in the public docket for this accident.

#### 1.7.2.2 Operational

FAA oversight of commercial balloon operations, like all FAA oversight, is based on the agency's assessment of risk. When asked at the investigative hearing for this accident how the FAA conducts operational oversight of commercial balloon operations, an FAA representative stated the following:

> We determine where we will use our resources based on an operational risk evaluation of the system, and we have used for a long time something we refer to as a safety continuum. At the high end of the continuum is large scale commercial operations, Part 121, we spend a great deal of resources dealing with that because of the exposure there. At the other end of the scale, in the general aviation industry, we spend a lesser amount of resource dealing with those.[49]

Concerning commercial balloon operations specifically, the FAA representative stated, "Our folks have a charge to look at commercial balloon operations, but they do it at a much lower frequency than we would other operations because of the lower risk involved in those kinds of operations."

When asked how they determined risk, the FAA representative stated, "…we use a risk-based approach to deal with that and part of that is exposure…. one of the elements of that exposure is the relative amount of activity that's going on in the NAS [National Airspace System]." He also stated that "the primary mitigator of risk in balloon operations is the commercial pilot certificate."

All ballooning operations in the United States fall under 14 *CFR* Part 91, regardless of whether paying passengers are onboard or not. The FAA conducts surveillance of commercial balloon operations randomly, just as it conducts surveillance of other Part 91 operations; however, in practice, most commercial balloon surveillance takes place when a number of operators are co-located, such as at one of the approximately 33 balloon gatherings of various sizes that take place each year throughout the United States.[50]

In response to an NTSB request for detailed information on commercial ballooning surveillance activity, the FAA stated that 2,300 balloon inspections had been conducted between January 1, 2014, and December 16, 2016.[51] The FAA could not specifically determine which inspections had been conducted in conjunction with balloon gatherings but reported that, for 2,258 of the 2,300 inspections (more than 98%), multiple balloons were inspected on the same date in the same location.

According to the ground crew chief and the pilot's mother, they had never seen the FAA conduct an inspection during any of the pilot's flight operations. Further, a review of FAA Program

[49] For more information, see the Transcript—Public Hearing, p. 73, in the public docket for this accident.

[50] For more information, see the FAA Party Submission in the public docket for this accident.

[51] A balloon inspection could consist of an operations review (observation of inflation and launch, etc.), an airworthiness review (examination of pilot and aircraft certificates), or both. For more information, see the Transcript—Public Hearing, p. 77, in the public docket for this accident.

Tracking and Reporting Subsystem (PTRS) data found no records identifying the pilot or operator as a subject of inspection.[52]

Some balloon gatherings require proof of current FAA certificates for participants. An FAA representative speaking at the investigative hearing on this accident stated that the Albuquerque International Balloon Fiesta™ requires balloonists to furnish copies of their most recent envelope annual inspection and flight review when they apply to participate.[53] A participant who completes a flight review or annual inspection between the application deadline and beginning of the event must provide proof upon registration.[54]

## 1.8 Additional Information

### 1.8.1 Tablet-Based Tracking and Navigation Application

*Hot Air*, the navigational application found installed on the pilot's tablet, is marketed to hot air balloon pilots. The application provides a means to overlay balloon position on a moving map consisting of satellite imagery. *Hot Air* is integrated with another application, *Glympse*, which is a location-sharing service that allows other devices to track the location of a device running *Hot Air*.

The *Hot Air* application was active when the pilot's tablet was accessed after the accident. When opened, the application showed a satellite map overview page of the accident region and a tracklog of the accident flight. The scale of satellite imagery overlaid on the device when working within the application is dependent on user input. Users can "pinch to zoom" and scroll to various locations by moving their fingers across the device's screen. It was not possible to tell the exact scale that the pilot used at the time of the accident. Using the application on a surrogate tablet showed that powerline support towers at the accident site were visible in the application; when zoomed in, however, individual powerlines were not.

### 1.8.2 Operational and Accident Data

FAA data indicated that the number of balloon flight hours per year is decreasing and that the accident rate for balloon flights is decreasing, as well. In its submission regarding this investigation, the FAA compared the fatal accident rate for balloons to the rate for all general aviation aircraft and concluded that both rates are similar and declining.[55] The data the FAA provided showed that, between 2004 and 2015, the fatal accident rates for both balloons and

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[52] According to the FAA, the PTRS is a comprehensive information management and analysis system used in many flight standards service (AFS) job functions. It provides the means for the collection, storage, retrieval, and analysis of data resulting from the many different job functions performed by aviation safety inspectors in the field, the regions, and headquarters. This system provides managers and inspectors with current data on airmen, air agencies, air operators, and many other facets of the air transportation system.

[53] According to the New Mexico tourism department, the Albuquerque International Balloon Fiesta is the largest annual international balloon event held in the United States. For additional information, see www.newmexico.org (accessed Aug. 14, 2017).

[54] For more information, see the Transcript—Public Hearing, p. 106, in the public docket for this accident.

[55] For more information, see the FAA Party Submission in the public docket for this accident.

general aviation have decreased from slightly above 1.5 fatal accidents per 100,000 flight hours to just below 1.0 fatal accidents per 100,000 flight hours. FAA statistics based on 2012-2014 general aviation survey data indicate that 23,916 flight hours were flown for "lighter than air" sightseeing, which represents 0.057% of all US aviation hours flown.

# 2. Analysis

## 2.1 Exclusions

Postaccident examination of the balloon and its components found no evidence of any preimpact structural or system failures that would have precluded normal operation.

The pilot had a long history of alcohol- and drug-related convictions that led to his incarceration and the revocation of his driver's license. However, the last of these occurred several years before the accident; his blood tested negative for alcohol and illicit drugs.

The pilot had high blood pressure and high cholesterol that were treated with losartan and simvastatin, respectively. The treating physician documented that the conditions were well controlled. Further, the medications are not impairing and would not have affected the pilot's performance.

The pilot had diabetes treated with the oral medication metformin and injectable insulin. The treating physician documented that the pilot had good compliance with his diabetic treatment and did not identify any evidence of renal disease or peripheral neuropathy. About 1 year before the accident, an eye examination found no evidence of diabetic eye disease. Thus, there is no evidence the pilot had any chronic complications from diabetes.

The pilot's clinical records contained no evidence that he suffered from episodes of symptomatic low blood sugar from diabetes treatment with insulin. In addition, photographs and videos from passengers' PEDs showed the pilot actively controlling the balloon; thus, he was not acutely impaired or incapacitated by symptomatic hypoglycemia at the time of the accident.

The pilot had fibromyalgia and chronic back pain, which resulted in repeated visits to his physicians and treatment with multiple pain medications. Review of passenger photographs and videos demonstrated that the pilot did not exhibit any evidence of impaired physical ability; he appeared to be able to perform all operations needed to control the balloon.

The pilot had the antidepressants fluoxetine and bupropion in his blood at the time of the accident. Although any psychoactive medications can be impairing, fluoxetine is not known to directly cause sleepiness or other impairing symptoms; however, bupropion may be associated with seizures.[56] The FAA has listed fluoxetine as one of four approved medications for treatment of pilots with depression, but bupropion is prohibited because of the associated seizure risk (FAA 2017).[57] In this accident, the pilot was actively controlling the balloon, and there is no evidence bupropion caused a seizure at or about the time of the accident. Thus, the NTSB concludes that the pilot was not under the influence of alcohol or illicit drugs at the time of the accident, and his high blood pressure, high cholesterol, diabetes, chronic back pain, and

[56] According to Science*Daily*, a psychoactive drug or psychotropic substance is a chemical substance that acts primarily upon the CNS where it alters brain function, resulting in temporary changes in perception, mood, consciousness, and behavior (www.sciencedaily.com, accessed June 27, 2017).

[57] See, specifically, the Decision Considerations—Aerospace Medical Dispositions, Item 47. Psychiatric Conditions—Use of Antidepressant Medications page.

fibromyalgia did not affect his performance. Further, although he was taking other drugs that may have been impairing, the prescribed medications that the pilot used to treat his high blood pressure, high cholesterol, diabetes, and depression did not affect his performance.

Although the NTSB has concluded that some of the conditions the pilot was diagnosed with and some of the medications he was taking did not lead to impairment during the accident flight, we have determined that other conditions and medications likely did. Impairing conditions and medications are discussed in section 2.4 of this report.

## 2.2 The Accident and Pilot Decision-Making

Because balloons are nonsteerable aircraft (as indicated in the FAA's *Balloon Flying Handbook*), weather is an extremely important factor in balloon pilot decision-making; the pilot must fly in visual conditions because there are no instruments to aid in flight, and the balloon's ground track is dictated by the wind pushing it. A balloon pilot can only directly control the balloon's altitude, not its flightpath, to avoid obstacles. A balloon's flightpath changes only when the wind changes or if the balloon climbs or descends into different wind conditions. A balloon pilot cannot turn away from obstacles or clouds/fog that might hinder obstacle detection and has no other way to identify obstacles other than visually. Thus, to be able to see and avoid obstacles during landing, balloon pilots must ensure weather conditions are compatible with the limitations of balloon maneuverability; because they cannot always predict where they will be able to land the balloon, it is imperative that conditions be suitable (clear of clouds or fog) throughout the flight. Upon identifying weather or forecasts that might hinder their ability to see and avoid obstacles, balloon pilots must determine whether it is appropriate to launch. Once airborne, balloon pilots must quickly decide to continue the flight or land.

The accident pilot had the opportunity to make decisions based on the weather conditions at three points on the morning of the accident: prelaunch, en route, and end of flight. Figure 14 depicts locations (previously introduced as figures 1, 2, 3, 7, and 8) that show weather conditions along the flight route. Each of the pilot's decisions, related to these points, is discussed in the following sections.

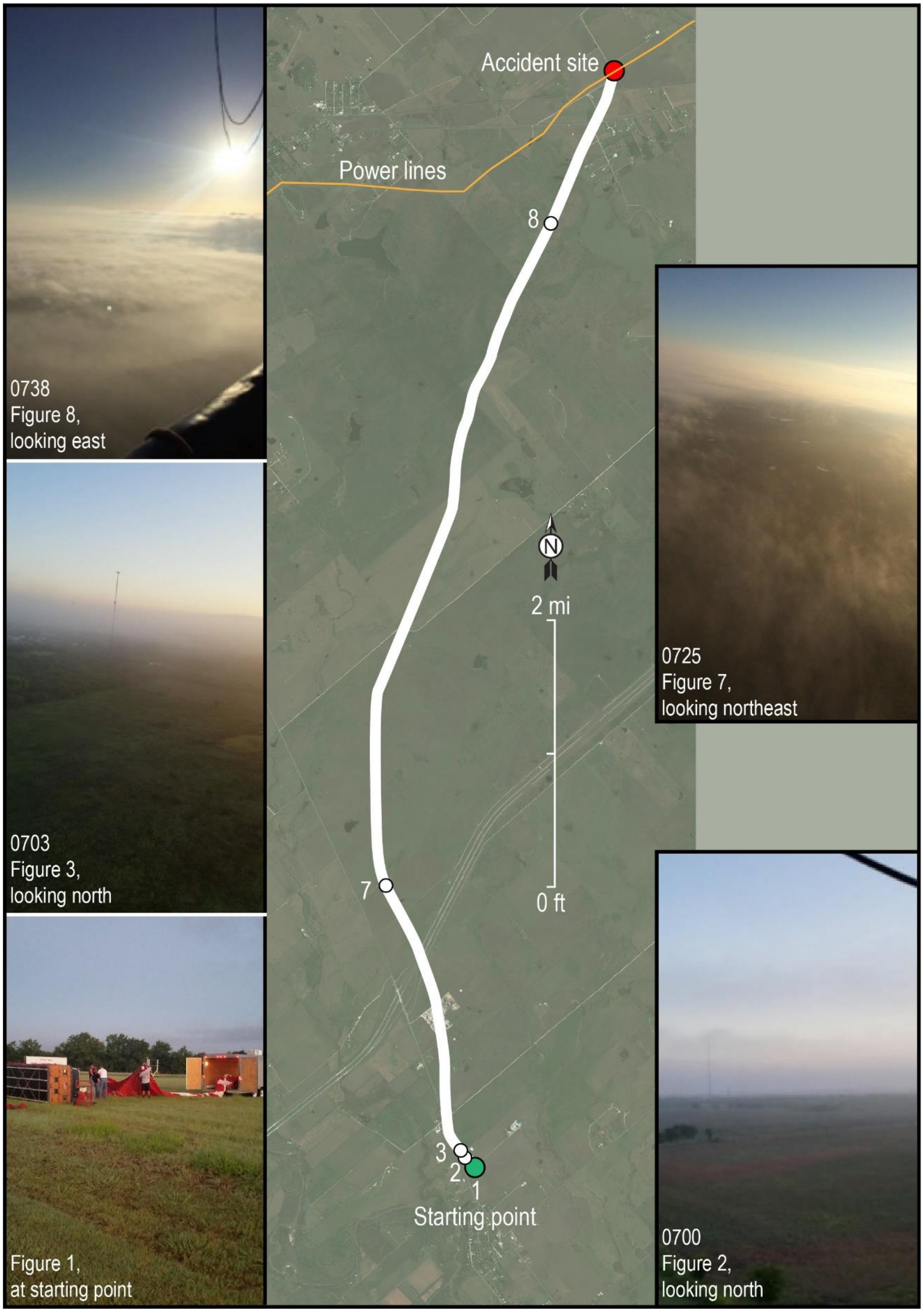


**Figure 14.** Photographs and map overlay illustrating the pilot's weather-related decision points.

### 2.2.1 Prelaunch Decision-Making

The weather information that the pilot received from the FSS weather briefer and likely viewed online indicated that clouds were possible just above 1,000 ft agl near the planned route. The 0027 AUS TAF forecasted a 1,200 ft agl broken ceiling to the north, beyond the end of the planned route, and the 0455 HYI AWOS recorded scattered clouds at 1,100 ft agl, closer to the launch point. Passenger photographs taken during balloon inflation showed that, about the launch time, the sky appeared clear (see figure 1 on figure 14). In addition, a ground crewmember stated that the pilot followed his normal habit of assessing visibility at the launch site by viewing nearby white poles to determine if visibility was acceptable. Based on the ceiling and visibility information the pilot received in the FSS weather briefing and the conditions as photographed and observed at the launch site, the pilot likely believed that the balloon could remain clear of clouds with at least 1 statute mile visibility (as required by 14 *CFR* 91.155) at launch.

However, other weather information available to the pilot indicated the possibility for reduced ceilings and/or visibility that would make it less likely that the balloon could remain clear of clouds for the planned duration of the flight. The 0455 HYI AWOS, which the pilot received in the FSS weather briefing and likely viewed online, recorded a temperature/dew point spread of 1°C. The FAA *Balloon Flying Handbook*, 4-19, "Fog Formation," states that "Fog rarely occurs when the spread is more than 2.2 °C. It is most frequent when the spread is less than 1.1 °C" (FAA 2008). Also, the FSS weather briefer had raised the issue of clouds, stating, "clouds may be a problem for you, I don't know how low you want to stay." The pilot replied, "well we just fly in between them" and "we find a hole and we go." These statements imply that the pilot had possibly flown at or near the weather minimums of clear of clouds with 1 statute mile visibility before and was unconcerned by the potential for low clouds. Finally, ground crewmembers stated that they saw fog at or near the launch site.

While reported and forecast ceiling and visibility information that the pilot accessed before the flight indicated that a launch in compliance with 14 *CFR* 91.155 requirements was possible, the temperature/dew point spread included in the AWOS report indicated that fog formation was likely. In addition, the weather information the pilot used to make his go/no-decision was not the most current available before launch; the forecast was issued more than 6 hours before launch, and the observation was issued about 2 hours before launch. HYI AWOS was updated at 0635 and 0646, and a new TAF for AUS was issued at 0637. Concerning weather, the FAA *Balloon Flying Handbook*, 4-41, "Chapter Summary," states, "It is imperative that a pilot use as many resources as he can, understanding the variables potentially affecting flight…" (FAA 2008). The pilot did not follow this guidance in two ways: he did not obtain the most recent forecasts and observations, thus not using as many resources as possible, and he apparently disregarded or discounted the possible effects of a 1°C temperature/dew point spread.

The 0635 HYI AWOS recorded few clouds at 700 ft agl and the temperature/dew point spread as 0°C. According to the FAA *Balloon Flying Handbook*, 4-19, "Fog Formation," a decrease in the temperature/dew point spread to 0° indicates increasing fog density or likeliness of fog (FAA 2008). The 0637 AUS TAF forecast temporary conditions between 0700 and 0900 consisting of 5 statute miles visibility, mist, and an overcast ceiling at 900 ft agl. Finally, at 0646, an observation from the HYI AWOS reported 2 statute miles visibility, mist, a broken ceiling at 700 ft agl, and a temperature/dew point spread of 0°C. A representative of another balloon sightseeing company in the area with multiple flights scheduled the morning of the accident stated they used these weather observations and forecasts as their basis for cancelling their flights that day.[58] The pilot should have interpreted the weather information that he obtained to indicate the possibility of fog formation and lower ceilings than those observed; a prudent pilot would have obtained an updated forecast. If the pilot had sought updated weather information just before launch, he might have recognized that conditions for the area were not suitable for flight because, in addition to the possible formation of fog, the balloon likely could not remain clear of clouds, compromising the pilot's ability to see and avoid obstacles during landing. Thus, the NTSB concludes that, although earlier forecasts, observations, and conditions present at the launch site indicated VFR weather, sufficient information was available (observed fog and a temperature/dew point spread of 1°C) to anticipate that conditions might deteriorate. Thus, the pilot's failure to obtain updated weather information denied him information that indicated conditions were deteriorating and might not remain VFR, which resulted in his decision to launch when he should have cancelled.

### 2.2.2 En Route Decision-Making

Photographs recorded on some passengers' PEDs indicated that fog and low clouds were visible along the flight route by 2 minutes after launch (see figure 2 on figure 14). In addition, open fields that appear suitable for landing are visible in passenger photographs taken about the same time (see figures 2 and 3 on figure 14). The balloon is shown in reduced visibility conditions about 23 minutes later (see figure 7 on figure 14), suggesting that the transition into the clouds was not abrupt and, based on the generally open terrain along the flight route, that other safe landing sites, although not photographed, were likely available before the balloon entered the clouds.

The pilot did not decide to land during the portions of flight that occurred before passenger photographs show the balloon encountered widespread clouds. In addition, the pilot had landing opportunities after first encountering the widespread clouds. The ground was visible for significant portions of the flight after the balloon first encountered widespread clouds and long before the pilot elected to climb above them. The ground was still visible through thin clouds in photographs taken at 0722 and 0724 (some of the last photographs taken before the balloon climbed above the overcast cloud layer). Earlier photographs, not reproduced in this report, also showed the ground visible in clear condition or through thin clouds.[59] Further, as previously indicated, the terrain over which the balloon was flying was mostly open fields. Thus, the pilot had many opportunities to descend while maintaining visual contact with the ground and potential obstacles. However, instead of selecting a suitable landing location while still in visual contact with the ground, the pilot continued the flight, flying in and out of clouds and decreased visibility conditions until climbing above the clouds.

[58] The other balloon sightseeing company operated north of Austin, but two employees traveled near the accident site on the morning of the accident flight, directly observing the weather conditions encountered by the accident balloon. For more information, see the Group Chairman's Factual Report—Operational Factors in the public docket for this accident.

[59] Images 23-40 in the Onboard Image Recorder—Specialist's Factual Report in the public docket for this accident depict the varying cloud conditions encountered during the flight.

The first photograph showing the balloon flying over what appears to be an overcast cloud layer was taken 40 minutes after launch about 0738 (see figure 8 on figure 14). By continuing the flight in and out of reduced visibility conditions until climbing above the clouds where in-flight visibility was better but the ground was barely, or not, visible, the pilot greatly limited his ability to identify suitable landing sites and likely could not continuously see and avoid obstacles on the ground to safely land. Thus, the NTSB concludes that the pilot exhibited poor decision-making (1) when he did not land the balloon despite having had suitable opportunities to land safely in visual conditions and (2) when he decided to climb above the clouds.

### 2.2.3 End-of-Flight Decision-Making

The pilot's position transmission to the ground crew 28 minutes after launch (16 minutes before the accident) was interpreted by the ground crew as the pilot's normal signal of his intent to land. Passenger photographs taken about that time showed that the ground was visible through thin clouds, which would likely have allowed a visual descent to land. However, the pilot did not land the balloon. While the pilot's intentions in sending the signal remain unclear, the NTSB notes that it is possible that the pilot did not transmit the position to signal his intent to land but instead sent the signal to the ground crew to indicate the position of the balloon after it had flown through clouds. If this were the case, he may have elected to extend the flight to meet passenger expectations of a flight lasting about 1 hour. Regardless of the reason for sending the position transmission, 12 minutes later, the balloon was over much denser clouds that restricted visual contact with the ground (see figure 8 on figure 14).

Once in these conditions, the pilot had two choices: (1) continue flight over the clouds, hoping to reestablish visual contact with the ground or (2) descend in current conditions with likely visibility restrictions. Both courses of action presented significant risks. If the pilot had chosen to continue flight above the clouds, the conditions might not have improved. Figure 8 on figure 14 appears to show clouds extending to the horizon, a greater distance than the balloon could fly with less than 1 hour of fuel remaining. If the pilot had chosen to continue, he might have found himself in similar conditions but with less fuel to maneuver or adjust the landing approach. Descending in the current conditions (from above a ceiling) presented hazards as well. Descending through a hole in the clouds, or in reduced visibility, would have made it more difficult to select an appropriate landing site and would have decreased the possibility that the pilot would be in a position to continuously see and avoid obstacles. Both choices presented hazards that could only have been avoided had the pilot not decided to climb above the clouds.

The pilot's earlier decision to climb above the clouds led to his subsequent decision to descend the balloon through, or very near to, clouds that obscured potential obstacles along the balloon's descent path. Because of the clouds, towers and, to an even greater degree, power lines would be difficult for the pilot to see as he descended. Further, because his ground crew could not see the balloon, they were not aware of where he was making the descent. As a balloon pilot testifying at the NTSB's investigative hearing stated, his ground crew is always trained to watch for power lines.[60] Such coordination provides an extra safety layer as the balloon descends, and that was not present in this accident. The FAA recognizes power lines as perhaps the most

[60] For more information, see the Transcript—Public Hearing, p. 39, in the public docket for this accident.

significant obstacle to balloon flight.[61] In addition, during the hearing, another balloon pilot testifying about the difficulty of detecting power lines stated, “You’re not so much looking for power lines… you’re looking for towers.”[62] Thus, having clear visibility of the landing area is critical to a safe landing so that the balloon pilot can detect, then maneuver to avoid, obstacles including power lines and towers; the pilot did not ensure that he had such visibility. Thus, the NTSB concludes that the pilot’s decision to land in reduced visibility conditions that diminished his ability to see and avoid obstacles resulted in the balloon impacting power lines that were obscured by low clouds and/or fog.

## 2.3 Impact Sequence

Electrical arcing damage was found on the envelope support cables, the bottom of the red burner assembly, the basket support cables, and the basket support frame. The location of the arcing damage indicated that the balloon impacted the power lines at or near the burner support frame and basket, severing enough of the support cables to separate the basket from the burner support frame and envelope. The fact that all the fuel lines separated at or near their connection to the burners suggests that they failed under load as the basket fell away from the burner support frame, pulling the lines apart and allowing liquid propane to spray from the severed lines, igniting a fire. The basket fell about 100 ft to the ground after separation from the envelope and burner assembly, which flew a short distance farther. The NTSB concludes that the balloon’s support cables struck power lines, causing separation of the basket from the envelope and burner assembly, the release of fuel, and the subsequent fire and ground impact.

## 2.4 Pilot Impairment

Given the pilot’s poor decision-making, the NTSB examined how his medical conditions may have affected his decision-making ability. The pilot had been diagnosed with major depression, which is associated with significant cognitive degradation, particularly in executive functioning (Snyder 2013). Cognitive degradation may not decrease, even with remission of the depressed episode, and patients with severe depression are more significantly affected than those with fewer symptoms or episodes (Nakano et al. 2008; Paelecke-Habermann et al. 2005). Further, about 3 months before the accident, the pilot reported to his psychiatrist that he was experiencing recurrent symptoms of poor sleep, low mood, poor motivation, social isolation, and irritability; the psychiatrist documented the patient’s mood as “not good.” The pilot was restarted on fluoxetine and bupropion (antidepressant medications) and zolpidem (a sleep aid) but was not evaluated further before the accident. However, due to the chronic debilitating disease and the possibility of persistent cognitive degradation even after restarting treatment, it is likely the pilot was impaired by the symptoms of depression at the time of the accident.

Additionally, the pilot had been diagnosed with ADHD, which is also associated with impaired decision-making and rule-governed behavior (APA 2013). His ADHD was treated with methylphenidate. Although the pilot had not recently been evaluated for his symptoms, about

[61] For more information, see Powerlines and Thunderstorms Balloon Safety Tips (www.faa.gov/regulations_powerlines_and_thunderstorms, accessed Aug. 7, 2017).

[62] For more information, see the Transcript—Public Hearing, p. 26, in the public docket for this accident.

3 years before the accident, an examining psychologist documented that the treatment regimen did not appear to effectively control the pilot's symptoms. The pilot's treatment had not changed since the evaluation; therefore, it is likely that his ADHD symptoms were not effectively controlled at the time of the accident.

Postaccident toxicology detected therapeutic levels of diazepam, cyclobenzaprine, and oxycodone, the medications that had been prescribed to treat his diagnosed fibromyalgia, in the pilot's peripheral blood. Nonprescription diphenhydramine, an antihistamine used to treat allergy, common cold symptoms, and insomnia, was also detected at a therapeutic level. These drugs degrade multiple psychomotor and cognitive skills including, but not limited to, vigilance and decision-making. When used in combination, the CNS depressant effect of any single drug can be exacerbated.

The pilot demonstrated poor and potentially impaired decision-making when he decided to fly the balloon when forecast weather was unfavorable for VFR flight, when he decided to continue the flight when actual conditions included ground fog and clouds, and when he decided to fly above the clouds, obstructing his view of the ground and degrading his ability to see and avoid obstacles when landing. Thus, the NTSB concludes that depression, ADHD, and the combined effects of multiple CNS-impairing drugs likely affected the pilot's ability to make safe decisions.

## 2.5 FAA Medical Requirements

Both of the pilot's diagnosed psychiatric conditions (depression and ADHD) are known to cause cognitive deficits that may affect safety of flight. Depression is a disqualifying condition for pilot medical certification and, according to the FAA *Guide for Aviation Medical Examiners*, an AME should not issue a medical certificate to pilots reporting depression unless it has been adequately treated. The guide also explicitly requires AMEs to defer medical certification for pilots who report ADHD or use medications to treat it until the pilot has undergone extensive neuropsychological evaluation and review (FAA 2017).[63] Thus, if not effectively treated with approved medications, the pilot's diagnosed depression and ADHD would likely have led an AME to either defer or deny a medical certificate if the pilot had applied for one. Further, the pilot was using medications to treat his back pain and fibromyalgia (oxycodone and valium) that would have been disqualifying had he reported their usage to an AME during a medical review.

However, as a commercial balloon pilot, the accident pilot was expressly exempted from medical certificate requirements by 14 *CFR* 61.23(b). (Commercial glider and balloon pilots are the only commercial pilots who are not required to hold a medical certificate.) The NTSB notes that although balloon pilots are not required to hold a medical certificate, they are required to follow the broad medical fitness requirements applicable to all pilots.

Title 14 *CFR* 61.53 states that, for operations not requiring a medical certificate, "A person shall not act as pilot in command, or in any other capacity as a required pilot flight crewmember, while that person knows or has reason to know of any medical condition that would make the person unable to operate the aircraft in a safe manner." In addition, 14 *CFR* 91.17 states, "No

[63] See, specifically, the Decision Considerations—Disease Protocols, Attention Deficit/Hyperactivity Disorder page and the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

person may act or attempt to act as a crewmember of a civil aircraft… While using any drug that affects the person's faculties in any way contrary to safety." These requirements communicate the FAA's intent to ensure safety by prohibiting pilots from flying when adversely affected by a medical condition or medication; as a result, pilots must personally assess their own medical conditions.

However, the FAA also recognizes that pilots may have difficulty assessing their own fitness. In its *Guide for Aviation Medical Examiners*, the FAA states, "…impairment can occur even when the individual feels alert and is apparently functioning normally - in other words, the airman can be 'unaware of impair'" (FAA 2017).[64] The NTSB is concerned that the lack of a requirement for a medical certificate for balloon pilots removes an opportunity for an AME, a highly qualified medical professional, to identify potentially adverse conditions and medications that a pilot has not recognized might affect his ability to operate the balloon in a safe manner.

Medical conditions and their treating medications not only impair aeronautical decision-making, as discussed previously, but also affect all decision-making. The accident pilot made poor weather-related decisions before and during the flight. The same conditions and medications that potentially affected his aeronautical decision-making on the day of the accident may have also affected his assessment of whether his medical conditions and medications affected his ability to operate the balloon safely. The pilot had been diagnosed with potentially impairing medical conditions (major depression, ADHD, chronic pain, and fibromyalgia) and had used the medications to treat them for several years. Had the pilot been required to hold a medical certificate, an AME would have been able to review his conditions and medications and make an appropriate certification decision in accordance with the FAA's *Guide for Aviation Medical Examiners* to ensure the safety of the pilot and flying public.

The FAA did not detect the pilot's history of drug and alcohol convictions for over 20 years. The FAA also did not identify the pilot's failure to properly report his history of offenses on his 1996 application for a third-class medical certificate, and, because the pilot was not required to obtain a medical certificate as a commercial balloon pilot, the FAA did not have further opportunities to identify his convictions via the medical certification process during which an applicant both answers a question concerning drug and alcohol arrest or conviction and grants permission for release of NDR information to the FAA. In addition, the pilot did not report to the FAA his drug- and alcohol-related convictions and driver's license actions as directed in 14 *CFR* 61.15, which requires reporting within 60 days regardless of medical certificate status. The FAA became aware of the pilot's unreported criminal record via third-party letters it received in 2012 and 2013. At that time, the FAA responded by reminding the pilot to properly complete future medical applications and warning that enforcement action was possible if he did not. However, because 14 *CFR* 61.23(b) exempts balloon pilots from holding a medical certificate, the letter essentially had no effect on the accident pilot; he did not make any future medical applications.

The accident pilot was not, and never had been, required to hold a medical certificate of any kind to operate a balloon. At the NTSB's investigative hearing on this accident, a representative of the FAA stated that the primary mitigator of risk in balloon operations is the

[64] See, specifically, the Pharmaceuticals (Therapeutic Medications), Do Not Issue—Do Not Fly page.

commercial pilot certificate.[65] Yet no commercial balloon pilot must meet the medical certificate requirements of other commercial pilots that help ensure flight safety. Thus, the NTSB concludes that the FAA's exemption of balloon pilots from medical certification requirements eliminated the potential opportunity for (1) an AME to identify the pilot's potentially impairing medical conditions and medications and/or (2) FAA awareness of his history of drug- and alcohol-related offenses, which could have led to certificate action until satisfactorily resolved. Therefore, the NTSB recommends that the FAA remove the medical certification exemption in 14 *CFR* 61.23(b) for pilots who are exercising their privileges as commercial balloon pilots and are receiving compensation for transporting passengers.

## 2.6 FAA Oversight

As described above, the pilot's poor decision-making adversely affected this flight. He was not only the pilot but also the owner and operator of the sightseeing operation. He was required to comply with FAA regulations, yet, at least on the day of the accident, he did not stay clear of clouds, and no evidence exists that he had either a current flight review or a current annual inspection of his balloon.[66] According to the ground crew chief and the pilot's mother, they had never seen the FAA conduct an inspection during any of the pilot's flight operations. Further, a review of FAA PTRS data found no records identifying the pilot or operator as a subject of inspection. Thus, the FAA did not engage with the accident pilot to ensure that he (as both pilot and operator) was complying with regulations and had no way of enhancing the safety of an operator who was providing sightseeing flights to the public.[67]

Instead, the FAA conducted most of its 2,300 balloon-related surveillance events between January 1, 2014, through December 15, 2016, coincident with nearly 100 balloon gatherings.[68] Only 2% of the FAA's balloon-related surveillance activity occurred at individual operators, likely at a location other than balloon gatherings. The NTSB is concerned that not all operators attend festivals or gatherings, and some operators may intentionally stay away to avoid surveillance. Concentrating balloon surveillance at high-profile events leaves a void in the industry where small operators flying balloons in various geographic areas operate absent any FAA oversight, as evidenced by the circumstances of this accident in which the pilot did not conduct operations at festivals and events that the FAA typically attended. Further, testimony at the investigative hearing for this accident indicated that, at the Albuquerque International Balloon Fiesta, operators are already required, per the organizers, to have proof of a current flight review and the balloon's annual

[65] For more information, see the Transcript—Public Hearing, p. 108, in the public docket for this accident.

[66] The accident pilot's logbook was not located, and no records could be found to indicate that he had completed a flight review within the previous 24 calendar months or had completed other training or evaluations that could be substituted for a flight review.

[67] As stated on its website, the FAA's view of compliance stresses a problem-solving approach (for instance, engagement, root-cause analysis, transparency, and information exchange) where the goal is to enhance the safety performance of individual and organizational certificate holders (https://www.faa.gov/about/initiatives/cp/, accessed Aug. 14, 2017).

[68] For more information, see the FAA Surveillance Activity Summary in the public docket for this accident.

inspection.[69] Thus, the NTSB questions how many operators at such festivals would be identified as having at-risk operations.

At the NTSB's investigative hearing on this accident, an FAA representative stated that the FAA bases its oversight on an operational risk evaluation of the aviation system and spends fewer resources on the general aviation industry. Concerning commercial balloon operations specifically, the FAA representative stated, "Our folks have a charge to look at commercial balloon operations, but they do it at a much lower frequency than we would other operations because of the lower risk involved in those kinds of operations." When asked how they determined risk, the FAA representative stated, "So we use a risk-based approach to deal with that and part of that is exposure… one of the elements of that exposure is the relative amount of activity that's going on in the NAS."[70] The FAA provided data to indicate that 0.057% of all flight hours in the United States occur in hot air balloons.[71]

The NTSB acknowledges that the overall exposure risk presented to the general public by commercial balloon sightseeing activities compared to other segments of commercial aviation is small, in part, because fewer members of the public participate in commercial ballooning activities. However, even though this facet of the industry is small, the FAA should design its oversight to identify and correct the balloon operations that present the highest risk to members of the general public. At present, this is not the case for balloon operations.

The FAA's Integrated Oversight Philosophy, introduced in June 2017, will implement a standardized safety oversight system in which decisions about oversight scope, frequency, and emphasis on service provider risk profiles will be developed, and oversight data collection and analysis will be improved.[72] As part of the Integrated Oversight Philosophy, the FAA has implemented a risk-based decision-making strategic initiative that "uses consistent, data-informed approaches to enable the agency to make smarter, system-level, risk-based decisions. It is the overarching guidance for implementing an engaged, solution-oriented, outcome-based approach to reduce risk in a rapidly-changing NAS."[73]

Although the need for the FAA to consider public exposure in determining the number of surveillance events it conducts each year is understandable, given its limited resources, the strategy for conducting this oversight must be targeted to the greatest extent possible on the highest-risk operations. However, this accident reveals that operators and operations that pose significant safety risk to the public are being missed in surveillance efforts. The NTSB believes that the FAA's risk-based decision-making model, applied to commercial balloon operations, would identify at-risk operators (like the one involved in this accident) and promote oversight that more

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[69] For more information, see the Transcript—Public Hearing in the public docket for this accident.

[70] For more information, see the Transcript—Public Hearing in the public docket for this accident.

[71] For more information, see the FAA Data Report—Rev1—Balloon Operations in the public docket for this accident.

[72] The Integrated Oversight Philosophy applies to the safety oversight programs of all FAA organizations that have regulatory oversight responsibilities. This policy embraces risk-based decision-making, safety management systems (SMS), the FAA Compliance Philosophy, and voluntary safety reporting programs (https://www.faa.gov/about/initiatives/iop/, accessed Aug. 14, 2017).

[73] For more information, see https://www.faa.gov/about/initiatives/cp/ (accessed Aug. 11, 2017).

effectively identifies deficiencies before they contribute to an accident. As the FAA implements this philosophy, the NTSB encourages the FAA to ensure that its risk assessments rely on and seek out multiple data sources that include not only accident occurrence rates but also information beyond balloon festival inspections to determine where surveillance needs to take place.

For example, in this accident, the FAA was aware that the pilot had a history of driving convictions, yet this information was only handled by the Aviation Security division, which only issued a letter reminding the pilot to report any convictions on his next medical application. Had this information been shared with AFS, which performs oversight of operators, it could have used this information to identify increased risk and conduct an inspection of this pilot or operation. However, the FAA is not consistently sharing and using all available data and information internally to identify risk. By using an oversight strategy that primarily targets operators who attend balloon gatherings, where compliance with regulations is sometimes required by organizers, the FAA is focusing on certificate holders who are less likely to be noncompliant with regulations and is not producing data likely to identify regulatory gaps that may allow significant safety hazards to go unmitigated, as seen in this accident.

Further, FAA Order 8000.368A states that, at the individual level (pilots and small operations), ongoing operational oversight primarily concentrates on safety promotion efforts, increasingly with respect to education on SMS basics and safety risk management techniques.[74] Had the FAA conducted oversight activities of this operator/pilot, it would have had an opportunity to educate him on risk and the role that the pilot plays in balloon operations.

According to a specialist in safety management and system development,

> Regulators must also take the time to collect information and analyze the results of their oversight activities, not only to determine the level of compliance with regulations but also their effectiveness. This may entail a recalibration of the assumptions that went into the design assumptions of the regulations and the oversight approach. [Arendt 2017]

The specialist also stated that “Oversight approaches that do not match the actual situations of those populations (the reality of their work-as-done) may be ineffective as risk controls” (Arendt 2017). The NTSB believes these statements are relevant to ongoing FAA efforts to modify its oversight approaches to better incorporate risk-based decision-making and the changes necessary to improve oversight within the commercial balloon industry.

In summary, although the FAA’s current strategy for determining compliance with regulations is based on inspecting a sample of balloon operators who attend festivals, these operators know there is a higher chance they may be subject to inspection, so the operating environment is not truly indicative of nationwide operations. Additionally, the FAA’s oversight process does not always ensure that information collected during oversight or other activities is proactively shared within the FAA and analyzed to assess compliance with and, ultimately, the

[74] FAA Order 8000.368A provides guidance for FAA offices to meet the FAA’s internal SMS guidance and requirements documents. It describes AFS statutory responsibilities with respect to aviation safety oversight and evolving system safety and SMS-based initiatives that contribute to enhanced methodologies for managing risk and improving safety in aviation.

adequacy of regulations, such as medical fitness for commercial balloon pilots. Considering this, the NTSB does not believe that the FAA's oversight approach for commercial balloon operations is strategically focused on identifying the highest safety risks.

Thus, the NTSB concludes that the FAA's primary method of oversight—sampling balloon operators at festivals—does not effectively target the operations that pose the most significant safety risks to members of the public who choose to participate in commercial balloon sightseeing activities. Therefore, the NTSB recommends that the FAA analyze its current policies, procedures, and tools for conducting oversight of commercial balloon operations in accordance with its Integrated Oversight Philosophy, taking into account the findings of this accident; based on this analysis, develop and implement more effective ways to target oversight of the operators and operations that pose the most significant safety risks to the public.

## 2.7 Previously Issued Safety Recommendations

On April 7, 2014, the NTSB issued Safety Recommendations A-14-11 and A-14-12, which asked the FAA to do the following:[75]

> Amend 14 *Code of Federal Regulations* Section 91.147 to require commercial balloon operators to obtain and maintain a letter of authorization to conduct air tour flights. (A-14-11)
>
> Through appropriate revisions to FAA Order 1800.56J, "National Flight Standards Work Program Guidelines," encourage principal operations inspectors to include in their general surveillance activities commercial balloon operators that hold letters of authorization (LOA), especially upon initial issuance of the LOA and then as necessary, particularly if the operator is involved in an accident. (A-14-12)

On November 6, 2015, the FAA responded that requiring commercial balloon operators to obtain LOAs under 14 *CFR* 91.147 would not result in a higher level of safety because the primary purpose of 14 *CFR* 91.147 is to require pilots to be covered by a drug testing program. The FAA stated that there is no compelling evidence to show that drugs or medications not approved by the FAA have led to balloon accidents. (The NTSB notes that this accident is now evidence that drugs and medications not approved by the FAA have led to balloon accidents. However, as stated earlier, we believe that a second-class medical certificate would address this issue.) The FAA also stated that, because the level of balloon activity is so low, its nontraditional surveillance activities centered around major ballooning events effectively address oversight of commercial balloon operations.

On March 4, 2016, the NTSB replied that the intent of the recommendations was not to require drug testing programs but to ensure that commercial balloon tour operators are included in principal operations inspectors' general surveillance activities. The NTSB stated that the

[75] These recommendations were issued as part of the NTSB's investigation of a series of commercial hot air balloon accidents. The NTSB determined that greater regulatory oversight of balloon tour operators would help ensure compliance with procedures and regulations, reducing the likelihood of similar future accidents. For more information, see the correspondence history for A-14-11 and -12.

requirement to maintain an LOA with the flight standards district office would motivate operators to comply with regulations and the operating agreements in their LOAs to avoid enforcement actions that might result in a loss of business. The NTSB urged the FAA to reconsider its position on the recommendations and classified them "Open—Unacceptable Response."

Because of the FAA's inaction on Safety Recommendations A-14-11 and -12 and the new recommendation discussed above for a more risk-based approach to identifying balloon operators for oversight, Safety Recommendations A-14-11 and -12 are reclassified "Closed—Unacceptable Action/Superseded."

# 3. Conclusions

## 3.1 Findings

1. Postaccident examination of the balloon and its components found no evidence of any preimpact structural or system failures that would have precluded normal operation.

2. Although earlier forecasts, observations, and conditions present at the launch site indicated visual flight rules (VFR) weather, sufficient information was available (observed fog and a temperature/dew point spread of 1°C) to anticipate that conditions might deteriorate. Thus, the pilot's failure to obtain updated weather information denied him information that indicated conditions were deteriorating and might not remain VFR, which resulted in his decision to launch when he should have cancelled.

3. The pilot exhibited poor decision-making (1) when he did not land the balloon despite having had suitable opportunities to land safely in visual conditions and (2) when he decided to climb above the clouds.

4. The pilot's decision to land in reduced visibility conditions that diminished his ability to see and avoid obstacles resulted in the balloon impacting power lines that were obscured by low clouds and/or fog.

5. The balloon's support cables struck power lines, causing separation of the basket from the envelope and burner assembly, the release of fuel, and the subsequent fire and ground impact.

6. The pilot was not under the influence of alcohol or illicit drugs at the time of the accident, and his high blood pressure, high cholesterol, diabetes, chronic back pain, and fibromyalgia did not affect his performance. Further, although he was taking other drugs that may have been impairing, the prescribed medications that the pilot used to treat his high blood pressure, high cholesterol, diabetes, and depression did not affect his performance.

7. Depression, attention deficit hyperactivity disorder, and the combined effects of multiple central nervous system-impairing drugs likely affected the pilot's ability to make safe decisions.

8. The Federal Aviation Administration's (FAA) exemption of balloon pilots from medical certification requirements eliminated the potential opportunity for (1) an aviation medical examiner to identify the pilot's potentially impairing medical conditions and medications and/or (2) FAA awareness of his history of drug- and alcohol-related offenses, which could have led to certificate action until satisfactorily resolved.

9. The Federal Aviation Administration's primary method of oversight—sampling balloon operators at festivals—does not effectively target the operations that pose the most significant safety risks to members of the public who choose to participate in commercial balloon sightseeing activities.

## 3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's pattern of poor decision-making that led to the initial launch, continued flight in fog and above clouds, and descent near or through clouds that decreased the pilot's ability to see and avoid obstacles. Contributing to the accident were (1) the pilot's impairing medical conditions and medications and (2) the Federal Aviation Administration's policy to not require a medical certificate for commercial balloon pilots.

# 4. Recommendations

## 4.1 New Recommendations

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

**To the Federal Aviation Administration:**

Remove the medical certification exemption in 14 *Code of Federal Regulations* 61.23(b) for pilots who are exercising their privileges as commercial balloon pilots and are receiving compensation for transporting passengers. (A-17-34)

Analyze your current policies, procedures, and tools for conducting oversight of commercial balloon operations in accordance with your Integrated Oversight Philosophy, taking into account the findings of this accident; based on this analysis, develop and implement more effective ways to target oversight of the operators and operations that pose the most significant safety risks to the public. (A-17-45)

## 4.2 Previously Issued Recommendations Classified in This Report

Safety Recommendations A-14-11 and -12 are classified "Closed—Unacceptable Action/Superseded" in section 2.7 of this report. The recommendations are superseded by Safety Recommendation A-17-45.

**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

**ROBERT L. SUMWALT**
Chairman

**EARL F. WEENER**
Member

**CHRISTOPHER A. HART**
Member

**BELLA DINH-ZARR**
Member

**Adopted: October 17, 2017**

# Board Member Statement

**Chairman Sumwalt filed the following concurring statement on October 19, 2017.**

As tragic as this accident was, it would be equally tragic to have suffered the loss of 16 lives and then not take action to prevent future tragedies. Apparently, and sadly, not taking action appears to be the position of the Federal Aviation Administration (FAA).

In the 14 months since the accident, the FAA has given no indication that they intend to require air tour balloon pilots to possess a valid FAA medical certificate. This, despite such a requirement for pilots conducting air tours in airplanes and helicopters.

Instead of invoking their regulatory responsibility, four days before NTSB's board meeting for this accident, FAA issued a press release to herald what they described as "proactive steps to increase the safety of hot-air balloon tourism." The press release stated: "As the result of a year-long FAA 'Call to Action' with the commercial hot-air balloon industry, the Balloon Federation of America (BFA) has developed an 'Envelope of Safety' accreditation program for balloon ride operations." One of the steps specified by BFA is for commercial balloon pilots to hold an FAA medical certificate.

Although the BFA's outlined steps seem positive and may provide a greater level of safety for operators who voluntarily choose to comply, I am troubled that the FAA seems to be approaching this as the "be-all, end-all" solution. The FAA has the statutory responsibility to regulate, but here they appear to be abdicating their critically important role.

Voluntary standards such as those outlined by BFA are, by definition, voluntary. Had this BFA program been in effect before the July 30, 2016, crash, it is doubtful that this pilot would have attempted to meet those guidelines. After all, he was not a member of BFA. Furthermore, he had a record of skirting even the minimal regulatory requirements for balloon operations. Had he been required to periodically undergo an FAA medical exam, his alcohol and drug-related convictions, as well as his disqualifying medical conditions and drug use, would have been detected. These conditions would have prevented him from legally piloting a balloon.

For these reasons, the FAA must not rely solely on voluntary third-party guidelines. Instead, they must step up to the plate and do their job. That regulatory function begins with the FAA requiring commercial balloon pilots to possess a valid FAA medical certificate. Until then, the FAA is simply abandoning its responsibility to maximize safety for balloon passengers.

# 5. Appendixes

## Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified of this accident on July 30, 2016. An investigator from NTSB headquarters in Washington, DC, arrived on scene at 1130 central daylight time that day.

The following investigative groups were formed: operational factors, airworthiness, and meteorology. Also, specialists were assigned to evaluate pilot medical issues and to examine portable electronic devices. The team was accompanied by then-Member (now Chairman) Robert Sumwalt.

The Federal Aviation Administration (FAA) was a party to the investigation. The Ústav pro odborně technické zjišťování příčin leteckých nehod (Air Accidents Investigation Institute, AAII), the NTSB's counterpart agency in the Czech Republic, served as an accredited representative to the investigation as the state of manufacture of the balloon. Kubíček Balloons participated in the investigation as the technical advisor to the AAII.

An investigative hearing was held for this accident on December 9, 2016. Parties to the hearing were the FAA, the Balloon Federation of America, and Kubíček Balloons.

# Appendix B: Pilot Prescription Medications

Table 4 lists the pilot's active prescriptions in the order last filled.

**Table 4.** Pilot's prescription medications.

| Medication | Description (Trade Name) | Date Filled |
|---|---|---|
| Losartan | Blood pressure (Cozaar) | July 25, 2016 |
| Simvastatin | Cholesterol-lowering medication (Zocor) | July 25, 2016 |
| Metformin | Oral diabetes medication (Glucophage) | July 25, 2016 |
| Insulin, long and short acting | Injected diabetic medication used to regulate blood sugar | July 2016<br>Mail order - Exact date not determined |
| Piroxicam | Nonsedating medicine used to treat pain and inflammation (Feldene) | July 25, 2016 |
| Fluoxetine* | Antidepressant medication (Prozac) | July 25, 2016 |
| Bupropion XL* | Antidepressant medication (Wellbutrin XL) | July 25, 2016 |
| Cyclobenzaprine | Sedating muscle relaxant (Amrix) | June 27, 2016 |
| Zolpidem | Sedating short-acting sleep aid (Ambien) | June 27, 2016 |
| Methylphenidate | Central nervous system stimulant used to treat attention deficit hyperactivity disorder and narcolepsy (Ritalin) | June 19, 2016 |
| Oxycodone | Sedating opioid pain medication (OxyContin) | June 19, 2016 |
| Diazepam | Sedating benzodiazepine for anxiety and muscle spasms (Valium) | June 19, 2016 |
| Pregabalin | Sedating anticonvulsant drug for seizures and nerve pain (Lyrica) | May 23, 2016 |

* The NTSB reviewed available clinical and pharmacy records and determined that over the past year, the pilot had regularly refilled his identified prescribed medications. However, there was no evidence he had filled his fluoxetine or bupropion prescriptions in February, March, or May 2016.

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