Aviation Investigation Final Report

Location:	Norfolk, Virginia	**Accident Number:**	ERA15FA144
Date & Time:	March 4, 2015, 04:13 Local	**Registration:**	N66BB
Aircraft:	Mooney M20F	**Aircraft Damage:**	Substantial
Defining Event:	Controlled flight into terr/obj (CFIT)	**Injuries:**	3 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

In preparation for the night cross-country flight from southern Florida to Virginia, the private pilot contacted flight service to file instrument flight rules (IFR) flight plans for each of the two planned legs. The pilot was advised that instrument meteorological conditions (IMC), moderate turbulence, and possible low-level wind shear would prevail for the second leg of the trip (the accident flight). Although the pilot indicated to the briefer that he was aware of these conditions, the extent to which he had familiarized himself with the forecast weather could not be determined because there was no record of a complete weather briefing from an official, access-controlled source.

The first leg of the flight departed about 2030 and landed uneventfully about 2240. After obtaining fuel, the pilot and his two passengers departed on the accident flight about 2353. The airplane reached the destination airport about 0300. The airport was under low IFR weather conditions, and the pilot requested an RNAV GPS instrument approach, even though the airplane was only equipped with a handheld GPS receiver. During the approach, the air traffic controller twice noted that the pilot was having difficulty maintaining alignment with the final approach course. When asked about this by the controller, the pilot first attributed the issue to problems displaying the instrument approach charts on his GPS receiver and second to the wind correction angle necessary to hold the course. At the conclusion of the unsuccessful approach, the pilot failed to comply with the published missed approach procedure and descended to an estimated 100 ft above ground level (agl) before subsequently climbing. When asked by the controller to fly the published missed approach procedure, the pilot responded that he was unable to do so because he was "off course."

With the assistance of air traffic controllers, the pilot diverted to a nearby airport equipped with an instrument landing system (ILS) even though similar weather conditions prevailed. The pilot was provided radar vectors for an ILS approach, but he again had difficulty maintaining the approach's prescribed altitudes and courses, and the controller cancelled the approach clearance. About 0400, during the pilot's second attempted approach to the diversion airport, the airplane descended to within 1 mile of the runway and about 200 ft agl. About that time, the pilot reported that he had the airport in

sight, consistent with the airplane descending below the cloud ceiling. A plot of the airplane's GPS-derived ground track and the recorded air traffic control radio transmissions showed that, about the time the pilot reported the airport in sight, the airplane was about 1/4 mile offset from the localizer but tracking toward the runway. However, instead of continuing its track toward the runway, moments later, the airplane made an abrupt, 90-degree right turn before turning left back toward the approach runway several seconds later. During the final 9 seconds of the flight, the airplane descended at a calculated descent rate of 900 ft per minute to ground impact. The airplane's maneuvering and its final descent occurred over a relatively unlit area of water and forest. The diminished lighting conditions likely provided the pilot with limited external cues to draw from in his attempt to maintain control of the airplane and complete the visual portion of the landing approach.

Postaccident examination of the airframe and engine revealed no evidence of any preimpact mechanical malfunctions or failures. A technical performance assessment of the diversion airport's ILS equipment revealed no discrepancies associated with the systems in use by the pilot during the attempted approach.

Throughout the approaches to both airports, the pilot repeatedly described the extreme nature of the turbulence and the high wind velocity that the airplane was encountering. Forecast and observed weather were consistent with this assessment. The pilot also described that he was having difficulty maintaining a heading due to precession of the airplane's gyroscopic heading indicator. Detailed examination of the vacuum-system-driven gyroscopic heading indicator revealed no anomalies, and a functional test displayed no abnormal precession. It is most likely that the gyroscopic precession cited by the pilot was directly attributable to the turbulence.

The pilot's personal flight logs were not recovered, and neither his recent flight experience nor instrument flight currency could be determined; however, his inability to maintain assigned headings and altitudes and to fly navigational courses indicated that his level of proficiency in flying the airplane in IMC was inadequate for the flight, particularly given the extremely challenging nature of the weather conditions that prevailed on the night of the accident. Additionally, the pilot decided to conduct the flight using a handheld GPS receiver, which was not suitable for IFR navigation and instrument approaches.

Although toxicological testing revealed the presence of amphetamine in the pilot's blood and urine, the investigation was unable to determine whether the pilot's use of amphetamine or the effects of any underlying condition contributed to the accident.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's failure to properly execute the instrument approach procedure. Contributing to the accident were the pilot's improper preflight planning and his decision to conduct the flight in instrument meteorological conditions at night into forecast moderate turbulence and with inadequate avionics equipment for the planned flight.

Findings

Aircraft	Descent/approach/glide path - Not attained/maintained
Personnel issues	Aircraft control - Pilot
Personnel issues	Decision making/judgment - Pilot
Personnel issues	Flight planning/navigation - Pilot
Environmental issues	Dark - Effect on personnel
Environmental issues	(general) - Effect on operation
Environmental issues	Low ceiling - Effect on operation
Aircraft	(general) - Not specified

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Approach-IFR final approach	Controlled flight into terr/obj (CFIT) (Defining event)

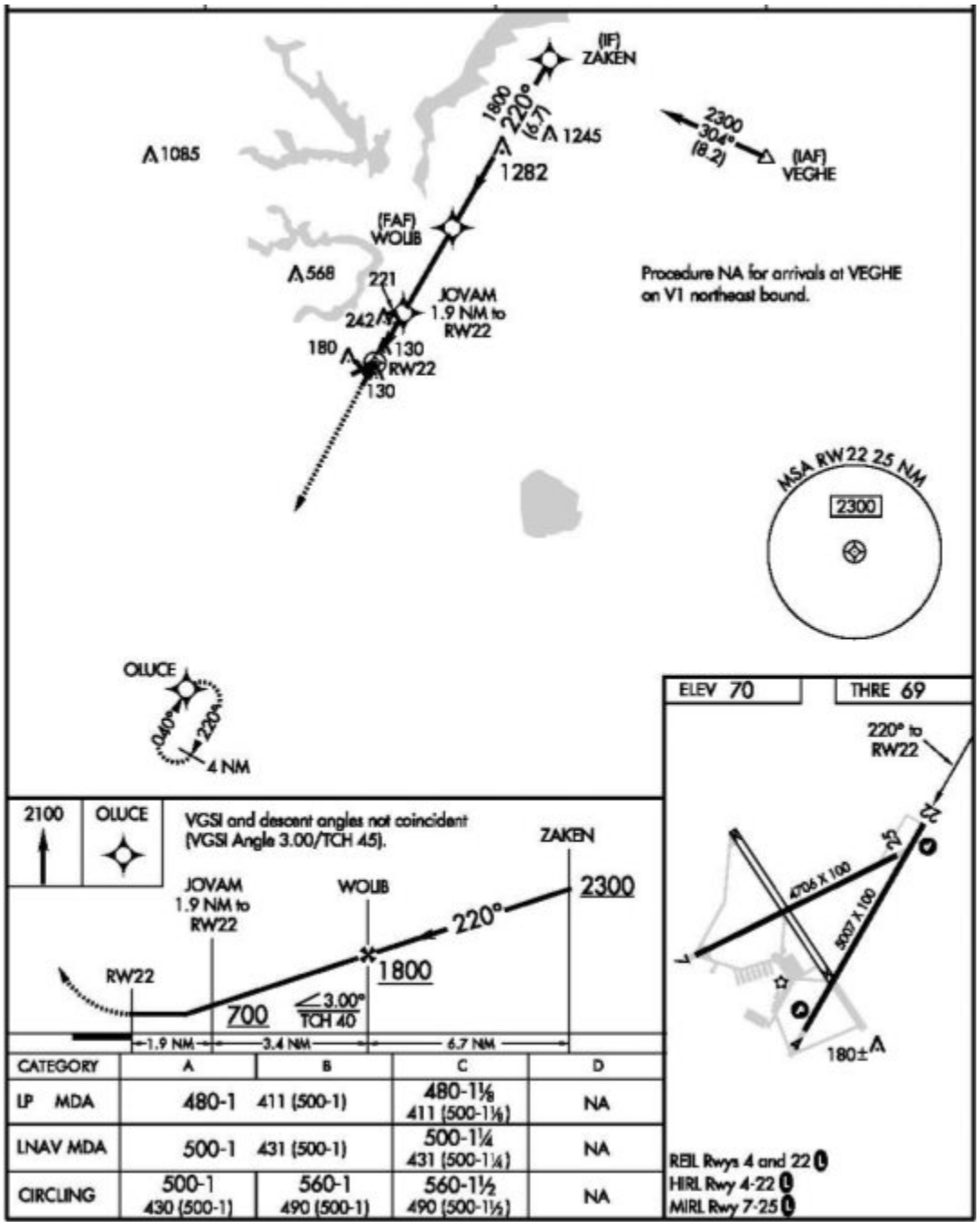
On March 4, 2015, about 0413 eastern standard time, a Mooney M20F, N66BB, was substantially damaged when it impacted trees and terrain while conducting an instrument approach to Norfolk International Airport (ORF), Norfolk, Virginia. The private pilot and two passengers were fatally injured. The personal flight was conducted under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. Dark night instrument meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed and active for the flight, which originated from Palatka Municipal Airport (28J), Palatka, Florida, about 2353 on the preceding day.

According to the owner of the airplane, the pilot and two friends had borrowed the airplane and departed from its home base of Suffolk Executive Airport (SFQ), Suffolk, Virginia on February 25. The group flew to Key West International Airport (EYW), Key West, Florida.

At 1916 on the evening of March 3, the pilot contacted Flight Service to file two IFR flight plans for the return trip to SFQ. The first flight plan requested GPS-direct routing from EYW to 28J, and the second requested GPS-direct routing from 28J to the Brunswick, Georgia (SSI) VOR and then direct to SFQ. For the flight to SFQ, the pilot declared a planned departure time of 2300, an estimated time en route of 3 hours 30 minutes, and an estimated 5 hours of fuel onboard. He did not specify an alternate destination airport. When asked if he would like a standard weather briefing, the pilot declined, stating that he would like the NOTAMS at 28J and SFQ.

After filing the flight plan for the SFQ flight leg, the briefer provided the pilot with a partial weather briefing for that leg. The pilot was advised of AIRMETs forecasting instrument meteorological conditions and mountain obscuration, moderate turbulence, and possible low-level windshear beginning in the Carolinas and extending to the planned destination. After being provided with these advisories, the pilot stated, "I'm familiar with that, I've looked it over," and "I got weather earlier." There was no record of the pilot obtaining a complete weather briefing from an official, access-controlled source. The flight subsequently departed EYW about 2030 and arrived at 28J about 2240. According to self-service fueling records, while at 28J, the pilot purchased 31 gallons of 100LL aviation fuel at 2244. The flight departed 28J for SFQ at 2353.

According to air traffic control (ATC) voice communication and radar data provided by the Federal Aviation Administration (FAA), along with data recovered from a handheld GPS receiver, the pilot contacted the approach control facility at ORF at 0253, while en route to SFQ. The controller asked the pilot to advise when he had obtained the weather conditions at SFQ. The pilot subsequently asked the controller for permission to change frequencies so that he could obtain the weather information and said, "I can't get it on my phone." About 3 minutes later, the pilot requested the RNAV GPS RWY 22 instrument approach to SFQ. (See figure 1 for the instrument approach procedure.)



CATEGORY	A	B	C	D
LP MDA	480-1	411 (500-1)	480-1⅛ 411 (500-1⅛)	NA
LNAV MDA	500-1	431 (500-1)	500-1¼ 431 (500-1¼)	NA
CIRCLING	500-1 430 (500-1)	560-1 490 (500-1)	560-1½ 490 (500-1½)	NA

Figure 1 - SFQ RNAV RWY 22 instrument approach procedure (excerpt).

At 0307, the pilot was given a radar vector and cleared to execute the instrument approach (see figure 2 for the GPS-derived ground track plotted on the instrument approach procedure). About 1 minute later, the controller noted that the flight had not intercepted the proper final approach course and queried the pilot. The pilot responded, "we're having a problem with our GPS plates." The controller provided the

pilot with another radar vector to intercept the course and re-issued the approach clearance. At 0312, the controller again advised the pilot that the flight was not tracking along the correct final approach course, and the pilot responded, "we're trying to get our wind correction angle dialed in here." The controller subsequently provided the pilot with another radar vector to intercept the final approach course and advised him to climb to 2,300 ft.

At 0313, the controller asked the pilot if he was established on the final approach course, and the pilot replied, "we're having to put in a heck of a wind correction angle, it's really howling up here, we got it now." The controller then terminated radar services and asked the pilot to cancel his instrument clearance when he was able.

According to GPS track log data, the airplane passed abeam WOLIB, the final approach fix for the approach, at 0319:43. The airplane's GPS-derived altitude was 1,571 ft, and its groundspeed was 50 knots. The airplane continued toward JOVAM and passed abeam JOVAM at 0322:41, at a GPS altitude of 600 ft and a groundspeed between 75 and 85 knots.

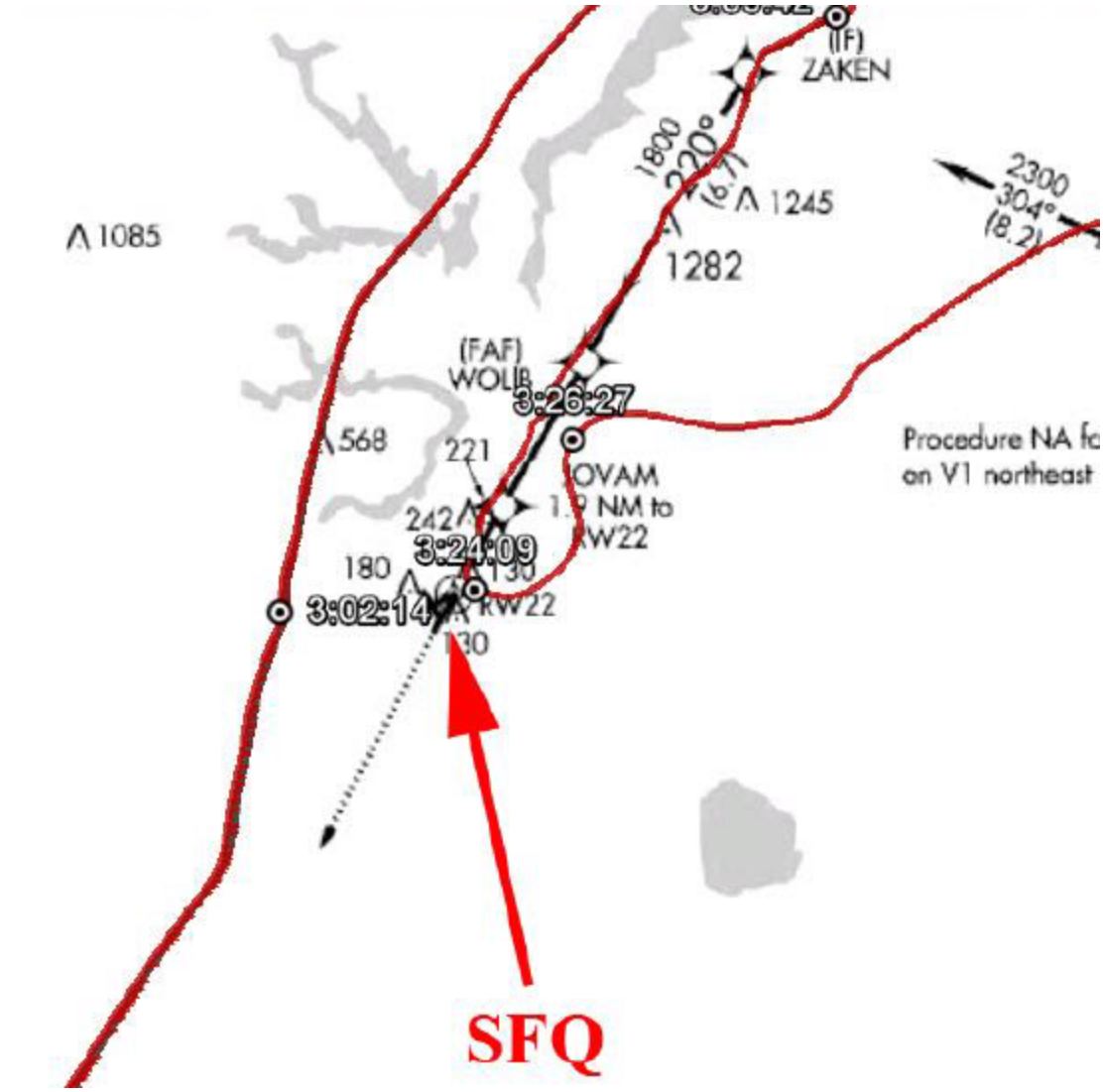


Figure 2 - The airplane's GPS-derived ground track overlaid onto the SFQ RNAV GPS 22 instrument approach procedure plan view.

The airplane continued toward the runway 22 threshold, passing abeam it at 0323:54 and turning to the east. At this time, track log data showed that the airplane had a groundspeed of about 80 knots and a GPS altitude of 331 ft. The airplane continued descending to a lowest-recorded GPS altitude of 167 ft (about 100 ft above ground level [agl]) at 0324:16, at which time the ground speed was 109 knots. The airplane was about 3/4 nautical miles east of the runway 22 threshold and tracking to the east away from the runway threshold (see figure 3).

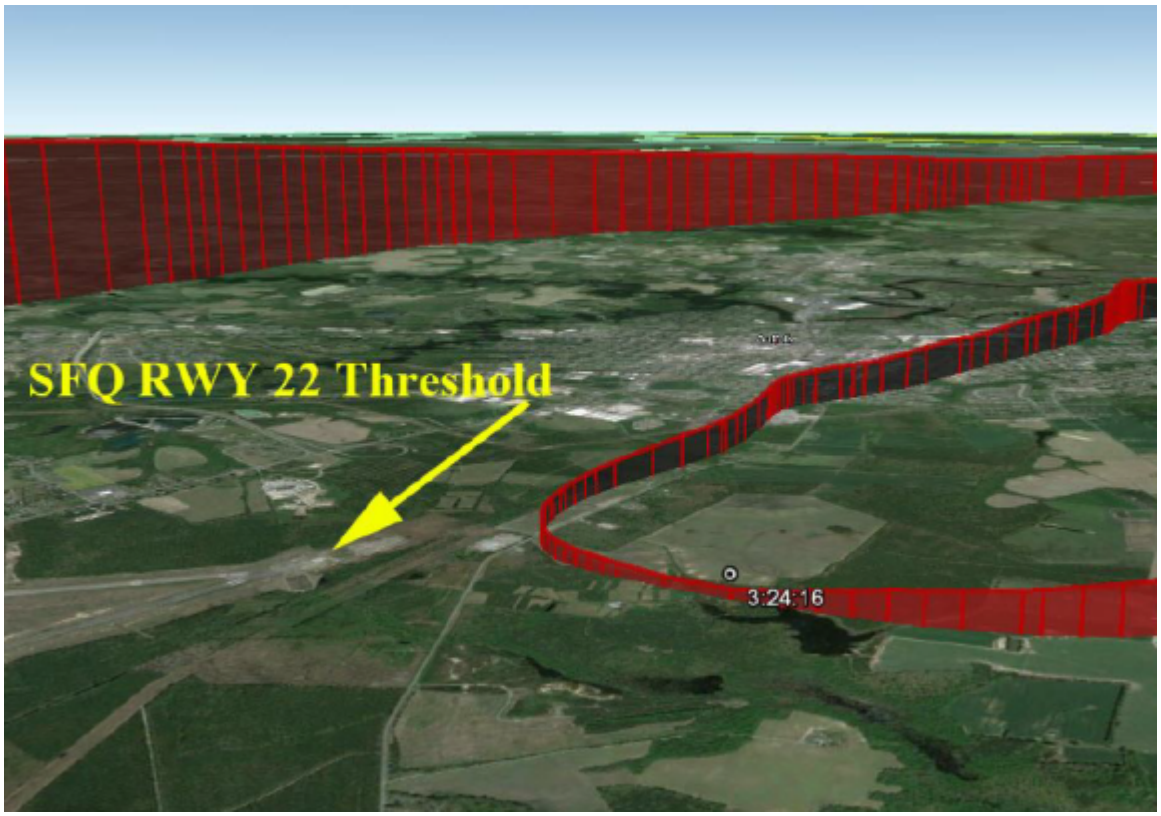


Figure 3 - Orthographic projection of the airplane's final approach to SFQ, descent to 167 feet GPS altitude, and flight away from the airport.

The airplane subsequently began climbing, and at 0324, the pilot contacted ATC and advised that he was executing a missed approach and would like to divert to ORF. The controller advised the pilot to fly the published missed approach procedure (a straight ahead climb to 2,100 ft, then to the OLUCE fix) and to climb to 3,000 ft. The pilot responded by asking for a radar vector and stating, "we're really bouncing around." The controller responded that he needed the pilot to climb to at least 1,600 ft before he could provide a vector. The pilot responded that he was currently flying at 900 ft and again asked for a radar vector. The controller again responded that the pilot should continue to fly the published missed approach procedure and climb to 3,000 ft. The pilot then responded, "I can't, I'm off course." The controller then provided the pilot with a radar vector of 090°.

At 0326, the controller provided the pilot with the current weather conditions at ORF, which included wind from 220° at 15 knots, gusting to 23 knots, visibility 6 statute miles in mist, and an overcast ceiling at 400 ft. Shortly thereafter, the pilot asked the controller for the weather conditions in Newport News, Virginia, to which the controller responded that the wind was 230° at 14 knots, 7 statute miles visibility, with an overcast ceiling at 400 ft. The pilot then responded that he would like to continue to ORF. The controller advised the pilot to expect the ILS RWY 23 instrument approach there and provided radar vectors toward the downwind portion of the approach.

At 0328, the controller solicited a pilot report from another airplane arriving at ORF via the ILS RWY 23 instrument approach. The pilot of the arriving airplane responded that the localizer was "varying around." The controller advised that pilot that he had not received any other reports from other arriving

aircraft in the previous 2 hours. The pilot of the arriving airplane then advised the controller that the final approach was "bumpy" with "moderate chop." Additionally, upon landing, the arriving pilot advised the controller that he was able to see the airport's approach lights when he had descended to an indicated altitude of 350 ft. The controller then passed along the arriving pilot's report of the ceilings and turbulence to the accident pilot, who responded, "we got hammered on the way down into Suffolk."

At 0332, the controller offered the pilot a report of the weather conditions at two other airports in the area and stated that, across the area, the ceilings were generally at 400 ft. Over the next 2 minutes, the controller provided descent instructions to the pilot and advised him of the reported fluctuation of the localizer, adding that it was the first such report he had received from the three arriving aircraft during the previous hours. The pilot acknowledged the information and stated, "the air is mixing down in the bottom layers, I imagine the needles are bouncing around."

The controller continued to provide the pilot with radar vectors toward the final approach course. At 0340, the pilot asked the controller for a report of the winds at ORF, and the controller responded 230° at 14 knots, gusting to 18 knots, and that the airplane had a groundspeed of 30 knots. The pilot confirmed that he observed a similar groundspeed indication. Shortly thereafter, the controller advised the pilot to change radio frequencies, and, after the pilot reported that he was on the frequency, the controller asked the pilot to verify the airplane's altitude, told him to maintain 1,600 ft, and stated that the airplane was south of the final approach course. He then provided the pilot with a radar vector back toward the final approach course.

At 0342, the controller confirmed that the pilot had established the airplane on the localizer course. The pilot responded, "we are on the localizer at 1,300 ft, glideslope is coming down to us." The controller reiterated that the pilot should maintain 1,600 ft until reaching LUFSY (see figure 4) and stated, "once you get to LUFSY, you can follow the glideslope down, but the proper height now is 1,600." The controller then advised the pilot that he had adjusted the runway lights to their maximum intensity.

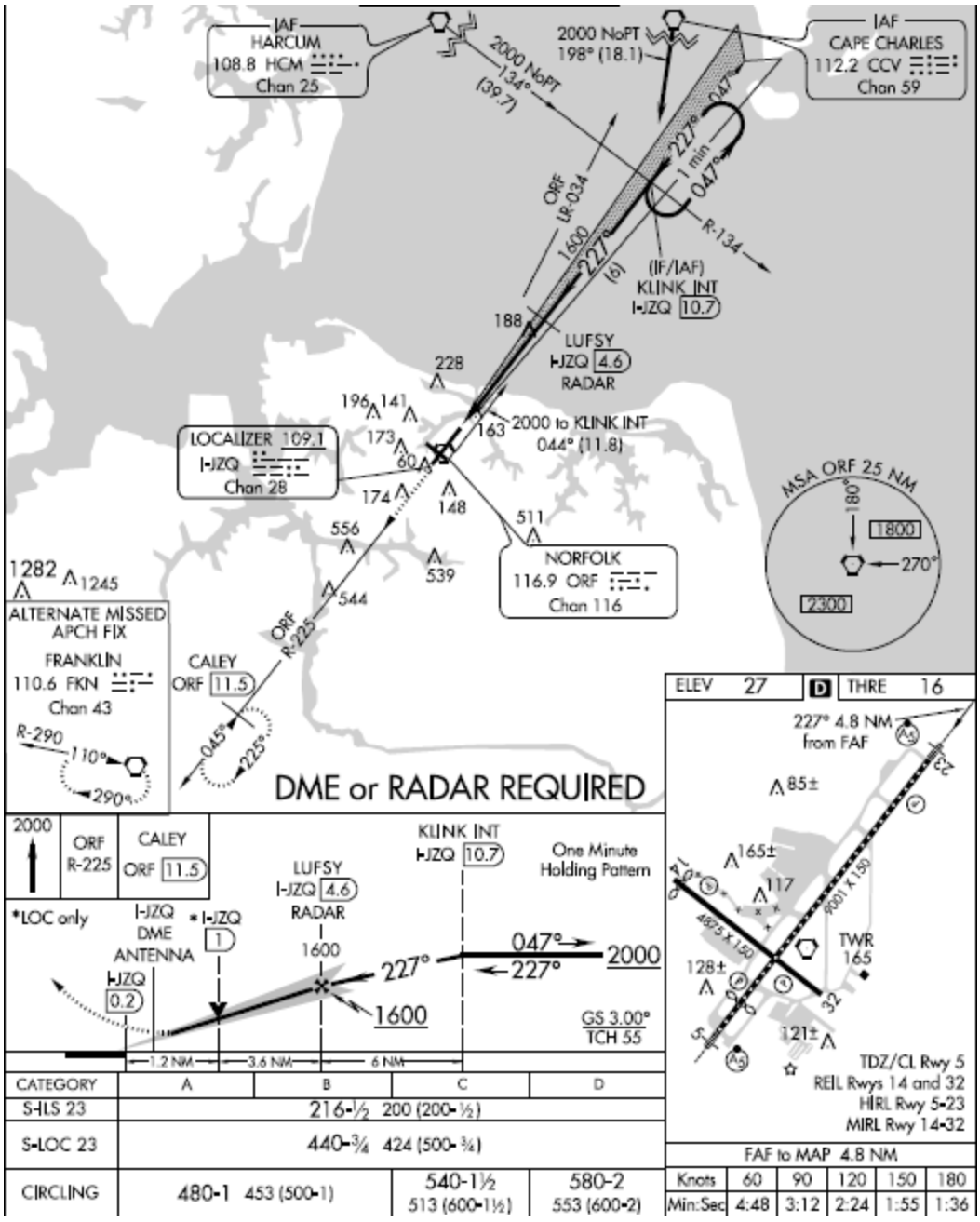


Figure 4 - ORF ILS RWY 23 instrument approach procedure (excerpt).

The controller contacted another air traffic controller at Norfolk Naval Station (NGU), Norfolk, Virginia, at 0345, and inquired whether that facility had the capability to provide a precision approach radar (PAR) instrument approach. He added that it may be necessary for the accident pilot to make an emergency approach there based on the difficulty he had experienced during the previous approach to SFQ and was experiencing during the current approach to ORF. The NGU controller acknowledged the situation and the contact terminated shortly thereafter. Between 0348:22 and 0348:51, the controller provided the pilot with two lateral position warnings and suggested corrections back toward the localizer course. At 0349, the controller canceled the approach clearance and instructed the pilot to climb to 2,000

ft.

When asked his intentions, the pilot advised the controller that he would like to attempt the approach a second time, stating, "we'll take another swing at it." The controller then provided radar vectors and altitude instructions. About this time, personnel at NGU contacted the approach controller inquiring about the airplane's situation. The controller advised that the pilot was having difficulty maintaining courses and altitudes and stated that, "we could have an emergency situation." At 0351, the controller asked the pilot to advise of the airplane's fuel state, and the pilot replied that about 1 hour 15 minutes of fuel remained. When asked by the controller if he was experiencing any equipment problems, the pilot stated, "It's literally a washing machine as soon as we go through the cloud deck, the cloud deck's at 1,200 ft, before that everything's very easy, but once we get to 1,200 ft it's a washing machine." The controller then asked the pilot if it would be easier to attempt the RNAV approach, to which the pilot replied, "no localizer's way better."

At 0354, the controller instructed the pilot to descend to 1,600 ft. About that time, the pilot stated that he had encountered, "…moderate turbulence, there was things floating around in the cabin on these approaches." After radar vectoring the airplane to a point about 3 miles from the final approach fix, the controller issued the pilot another clearance for the ILS RWY 23 instrument approach. The pilot acknowledged the clearance and stated, "…we're having a lot of precession with our gyro, don't know if the turbulence disrupted it, if at all possible radar vectors would be appreciated on the glide slope, I mean it's a very very wild ride." The controller asked the pilot if he was requesting no-gyro radar vectors for the approach or just radar vector corrections on the ILS approach. The pilot responded, "We have some gyro, it appears we have to reset the gyro periodically in a descent, but yeah if you could give us some vector feedback that would be wonderful." The controller acknowledged the request.

At 0357, the pilot advised the controller that the airplane's airspeed was 105 knots, while its groundspeed was 32 knots. The controller then relayed that, due to the airplane's low groundspeed, he was having difficulty interpreting its track across the ground, and asked the pilot if he had intercepted the localizer course. The pilot confirmed that he was joining the localizer course. At 0359, the controller provided the pilot with an update on the weather conditions at ORF, stating that the wind was from 220° at 19 knots, gusting to 23 knots, the visibility was 2 1/2 miles in mist, the ceiling was overcast at 300 ft, and the altimeter setting was 29.92 inches of mercury. The pilot responded, "roger two niner niner two, we had it set higher."

At 0403, the controller advised the pilot that the airplane was left of the localizer course, and asked if he wanted "standard rate no gyro vectors." The pilot answered in the affirmative, stating, "we're having a real problem with precession." At 0405, the pilot clarified the airplane's fuel state to the controller stating, "…got about half hour, not an hour and a half as I advised you earlier." The controller continued to provide the pilot with radar vectors, and, at 0407, the pilot advised the controller that he had intercepted the glideslope for the approach. The controller advised the pilot to descend via the glideslope for the approach, and, at 0411, the controller stated that the airplane was about 2 miles from the approach end of the runway. At 0411, the controller reminded the pilot of the ceiling height reported by the pilot who had previously landed at the airport and stated that he had turned the airport lighting to its maximum intensity. After the controller provided the pilot with several additional radar vectors, at 0413:07, the pilot stated, "have the field mooney six six bravo bravo." At 0413:07, the airplane was about 0.7 nautical mile north of the runway 23 threshold, at a GPS altitude of 265 ft, and on a ground

track oriented roughly toward the runway threshold. No further radio transmissions were received from the pilot.

At 0413:20, the airplane began tracking westward and away from the runway, while its GPS altitude varied between 180 and 280 ft. At 0413:34, the airplane began tracking back toward the runway and entered a descent. During the final 9 seconds of recorded GPS data, the airplane descended from a GPS altitude of 269 ft to 134 ft, and the calculated average descent rate during this period was 900 ft per minute. The final recorded point was nearly coincident with the as-found position of the airplane at the accident site, and the final GPS-depicted location was also consistent with the debris path observed there.

Pilot Information

Certificate:	Private	**Age:**	61,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	March 27, 2013
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 1160 hours (Total, all aircraft)		

The pilot, age 61, held a private pilot certificate with ratings for airplane single and multi-engine land, as well as instrument airplane. He held an FAA third-class medical certificate, which was issued in March 2013 with the limitation "must wear corrective lenses for near and distant vision." On that date, the pilot reported that he had accumulated 1,160 total hours of flight experience, 18 hours of which were accumulated in the 6 months prior. The pilot's personal flight logs could not be located, and his currency and recency of flight experience could not be verified.

According to the owner of the accident airplane, shortly before the accident pilot initially departed from Virginia on the trip to Florida, the owner acted as a safety pilot during a flight in the accident airplane while the accident pilot practiced instrument approaches. The pair practiced two ILS approaches at ORF and a GPS RNAV approach to SFQ.

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	**Registration:**	N66BB
Model/Series:	M20F	**Aircraft Category:**	Airplane
Year of Manufacture:	1975	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	22-1253
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	May 1, 2014 Annual	**Certified Max Gross Wt.:**	2740 lbs
Time Since Last Inspection:	54 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	948 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C91A installed, not activated	**Engine Model/Series:**	IO-360A1A
Registered Owner:	On file	**Rated Power:**	200 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

According to FAA airworthiness and aircraft maintenance records, the airplane was manufactured in 1975 and was equipped with a Lycoming IO-360-A1A engine. The airplane was also equipped with a King KX155 VHF navigation/communication radio, a Narco COM 120 VHF communication radio, and a JPI EDM-830 engine data management system. No distance measuring equipment (DME) receiver was installed. The airplane was not equipped with an instrument panel-mounted GPS receiver.

The altitude indicating system was most recently tested per the requirements of 14 CFR 91.411 on October 17, 2013. The airplane's most recent annual inspection was completed on May 1, 2014. At the time of the inspection, the airframe had accumulated 894 total hours of operation, and the engine had accumulated 84 hours since its most recent overhaul. An overhauled directional gyro was installed June 2014, and the KX-155 was repaired following an issue with the glideslope indication on January 26, 2015.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	ORF,30 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	04:20 Local	**Direction from Accident Site:**	157°
Lowest Cloud Condition:		**Visibility**	2 miles
Lowest Ceiling:	Overcast / 200 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	20 knots / 27 knots	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	220°	**Turbulence Severity Forecast/Actual:**	/ Moderate
Altimeter Setting:	29.92 inches Hg	**Temperature/Dew Point:**	8°C / 7°C
Precipitation and Obscuration:	Moderate - None - Mist		
Departure Point:	PALATKA, FL (28J)	**Type of Flight Plan Filed:**	IFR
Destination:	SUFFOLK, VA (SFQ)	**Type of Clearance:**	IFR
Departure Time:	23:53 Local	**Type of Airspace:**	Class C

The weather conditions reported at SFQ, at 0315 (when the pilot was conducting the attempted instrument approach there), included wind from 230° at 10 knots, 2 1/2 statute miles visibility in mist, an overcast ceiling at 300 ft, a temperature of 6° C, a dew point of 5° C, and an altimeter setting of 29.98 inches of mercury.

The weather conditions reported at ORF at 0420 included wind from 230° magnetic at 20 knots, gusting to 27 knots, 2 1/2 statute miles visibility in mist, an overcast ceiling at 200 ft, a temperature of 8° C, a dew point of 7° C, and an altimeter setting of 29.92 inches of mercury.

A pilot report from an airplane climbing in the vicinity of ORF about 1.5 hours after the accident reported that the overcast cloud layer was between 200 ft and 1,500 ft.

The closest upper air sounding was from Wallops Island, Virginia, located 72 miles northeast of the accident site. The sounding for 0700 depicted a lifted condensation level at 700 feet agl, with a relative humidity greater than 90% from this level through 13,000 ft. A defined temperature inversion associated with a front was identified from the surface to 2,000 ft. The freezing level was identified at 10,600 ft.

The sounding wind profile indicated a surface wind from 275° at 13 knots, with wind speeds rapidly increasing with height, and little variation in direction. The mean 18,000-foot wind was from 255° at 65 knots. The wind profile supported light low-level wind shear through 2,000 ft and light to moderate turbulence in multiple layers through 18,000 ft. The sounding also indicated that instrument meteorological conditions with strong crosswinds would prevail throughout the altitudes associated with both instrument approaches, with winds at 1,000 ft from 250° at 43 knots, temperature 8.5° C, relative humidity 98%.

The GOES-13 infrared satellite image for 0415, covering the accident site, depicted an area of low stratiform clouds extending over the region with a radiative cloud top temperature of +9.8° C. This

corresponded to cloud tops near 1,200 ft, based on the Wallops Island upper air sounding.

At the time of the accident, there were AIRMETs available warning of ceilings below 1,000 ft and visibility below 3 statute miles in precipitation and mist, moderate turbulence below 12,000 ft, and sustained surface winds greater than 30 knots.

According to the US Naval Observatory, moonrise occurred at 1624 on the day preceding the accident, and the moon set at 0544 on the day of the accident. At the time of the accident, the moon was 16 degrees above the horizon, at an azimuth of 267°, and was 98% illuminated. The phase of the moon was a waxing gibbous with a full moon expected on March 5, 2015. The beginning of civil twilight occurred at 0606, and sunrise occurred at 0632.

Forecast Conditions

A terminal area forecast (TAF) for ORF was issued at 1840. The weather conditions at 2300 were forecast to include surface wind from 220° at 12 knots, visibility 4 statute miles in light rain and mist, and an overcast ceiling at 800 ft. By 0300, the conditions were forecast to deteriorate to wind from 220° at 14 knots, visibility 4 statute miles in light drizzle and mist, and an overcast ceiling at 400 ft.

The winds aloft forecast for ORF, valid from 1500 through 2300, included wind at 3,000 ft from 200° at 46 knots, and at 6,000 ft from 250° at 44 knots.

Airport Information

Airport:	NORFOLK INTL ORF	**Runway Surface Type:**	Asphalt;Concrete
Airport Elevation:	27 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:	23	**IFR Approach:**	ILS
Runway Length/Width:	9001 ft / 150 ft	**VFR Approach/Landing:**	None

SFQ was served by five instrument approach procedures, a localizer approach to runway 4 and four area navigation (GPS) instrument approaches, including the RNAV (GPS) RWY 22 approach. Runway 22 was 5,007 ft long by 100 ft wide and was equipped with high-intensity runway edge and end identifier lights.

ORF was served by numerous ILS and RNAV instrument approaches, including the ILS RWY 23 approach. Runway 23 was 9,001 feet long by 150 feet wide and was equipped with high intensity runway edge lights, runway centerline lights, a 1,400-foot-long medium intensity approach lighting system with runway alignment indicator lights, and a precision approach path indicator.

The FAA conducted a postaccident technical performance review of the ORF runway 23 instrument approach system components, including the localizer, glide slope, and approach lighting systems. The review revealed that each system was operating within the prescribed tolerances.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal	**Latitude, Longitude:**	36.909721,-76.195556

The accident site was located about 2,300 ft northwest of the ORF runway 23 threshold. The immediate area was surrounded by a forest and a lake, and featured relatively little ground lighting when compared with the surrounding residential and industrial areas. The initial impact point was identified as a tree with numerous branches broken from its top at a height of about 80 ft. The tree was located about 20 ft from the shoreline of Lake Whitehurst. A wreckage path extended for about 260 ft on a magnetic heading of 210°. Broken tree branches, paint chips, and small pieces of metal were distributed along the wreckage path. The main wreckage came to rest inverted at the base of a tree oriented roughly 210° magnetic. All major components of the airplane were accounted for at the accident site, and the wreckage did not display any evidence of a pre- or post-impact fire. The outboard 3 feet of both wings were separated from the airplane and were found adjacent to the main wreckage. The left wing displayed a concave depression of its leading edge, outboard of the landing gear, oriented perpendicular to the spar, about 16 inches in diameter. The left fuel tank was ruptured and absent of fuel, and a trace amount of fuel remained in the right fuel tank. The landing gear were extended, and the flaps were retracted. Control continuity was traced though separations consistent with overload from the cockpit controls to each of the flight control surfaces. The State of Virginia, Office of the Chief Medical Examiner reported that both front seat occupants were restrained with lap belts. No shoulder restraints were installed. The emergency locator transmitter remained secured to its mount and was found in the armed position about 36 hours after the accident.

Both of the propeller blades displayed aft tip curling and s-bending. One of the blades exhibited chord-wise scratching, and its tip was torn away. A significant quantity of freshly-cut pine needles and tree branches less than 4 inches in length were found inside the engine cowling on top of the engine. Continuity of the powertrain and valvetrain were confirmed through rotation of the propeller by hand, and thumb compression was observed on all cylinders. The spark plug electrodes exhibited normal wear and were dark gray to black in color. A trace amount of liquid consistent in color and odor with 100LL aviation fuel was found within the flow divider and fuel servo inlet screen, and no significant debris or other contamination was noted. The oil inlet screen and fuel filter element were absent of metallic debris, and no other significant contamination was noted.

The directional gyro displayed impact-related damage to its external case. The instrument compass card was free to rotate, and the bug setting knob was bent upward with the bug set at 232°. Functional testing of the unit revealed no evidence of any pre-impact mechanical malfunctions or failures, nor did it display signatures indicative of excessive precession. Disassembly of the engine-driven vacuum pump revealed that the rotor, veins, and drive mechanism were intact and undamaged.

A handheld GPS receiver was recovered from the wreckage and forwarded to the NTSB Vehicle Recorders Laboratory for data extraction. A track history was recovered from a flash memory card

within the device. The track history file contained 71 log files for multiple flights, including the flight that preceded the accident flight (EYW to 28J), as well as the entirety of the accident flight.

Medical and Pathological Information

An autopsy was performed on the pilot by the Office of the Chief Medical Examiner, Norfolk, Virginia. The medical examiner determined that the cause of death was "multiple blunt trauma."

Toxicological testing performed by the FAA's Civil Aerospace Medical Institute found no ethanol or carbon monoxide in the samples submitted. The tests were positive for the presence of amphetamine in the pilot's urine and blood.

Administrative Information

Investigator In Charge (IIC):	Diaz, Dennis
Additional Participating Persons:	Jay Venable; FAA/FSDO; Richmond, VA
Original Publish Date:	March 29, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=90817