National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 20, 2011

In reply refer to: A-11-32 through A-11-34

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
Washington, DC 20591

On October 25, 2010, about 1352 mountain daylight time,[1] a Mooney M20J airplane, N201HF, collided with mountainous terrain near Lander, Wyoming.[2] The pilot and three passengers were fatally injured, and the airplane sustained substantial damage. The airplane was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91 as a personal flight. Instrument meteorological conditions likely prevailed at the time of the accident,[3] which operated on an instrument flight rules (IFR) flight plan to Pierre Regional Airport (PIR), Pierre, South Dakota. The flight originated from Jackson Hole Airport (JAC), Jackson Hole, Wyoming, at 1305.

After review of the air traffic control (ATC) services provided to the pilot by Jackson Hole Air Traffic Control Tower and Salt Lake City Air Route Traffic Control Center (Salt Lake Center), the National Transportation Safety Board (NTSB) is concerned that the published IFR departure procedures available to aircraft departing JAC may be inadequate. In addition, the NTSB believes that the en route automation modernization (ERAM) ATC software in use at Salt Lake Center needs improvement to ensure that IFR aircraft are afforded necessary en route minimum safe altitude warning (E-MSAW) protection.

Background

According to Federal Aviation Administration (FAA) records, the pilot of the Mooney filed an IFR flight plan from JAC to PIR, departing from JAC to the north. When the airplane was ready for departure, the wind was from the south and JAC was using runway 19. At the time of the accident, the published departure procedures had restrictions that required the pilot to

[1] All times in this letter are mountain daylight time.

[2] Preliminary information about this accident, WPR11FA032, can be found on the National Transportation Safety Board's (NTSB) website at <http://www.ntsb.gov>.

[3] The exact weather conditions are not known because the airplane was not near a weather reporting station. Available meteorology information indicates that instrument meteorological conditions likely existed at the time of the accident.

amend the original route to account for the southbound departure. At 1257, the pilot called the JAC ground controller for his IFR clearance and requested taxi instructions. The ground controller issued the revised routing (which required a more southerly routing than originally planned) and instructed the pilot to maintain 16,000 feet after departure. The controller then noted that the pilot's flight plan requested 9,000 feet and asked the pilot if he could accept 16,000 feet. The pilot responded, "…we'd prefer 14,000, 16 is going to be tough." The controller revised the pilot's filed altitude and flight plan and amended the route to follow the southbound departure to the KICNE intersection and then fly direct to Riverton, Wyoming, to rejoin the original routing. No published transition route from KICNE to Riverton was available, and no information was readily available to the pilot that showed the minimum IFR altitude (MIA) along that route segment. The JAC air traffic controller did not inform Salt Lake Center about the changed routing and the pilot's stated need to stay at 14,000 feet. If this information had been conveyed to Salt Lake Center during the handoff, the receiving controller might have realized that the planned route and altitude were not viable.

The Mooney was cleared for takeoff on runway 19 at 1305, and the pilot was instructed to contact Salt Lake Center at 1308. According to recorded radar data, the flight proceeded to KICNE, turned eastbound toward Riverton, and reached 14,000 feet shortly thereafter. The airplane entered an area of no radar coverage at 1335:44. At 1337, the Salt Lake Center controller advised the pilot that radar contact was lost; the pilot confirmed that the Mooney was level at 14,000 feet.

Radar targets for the Mooney became visible on radar again at 1345:38. At 1346:13, the Salt Lake Center controller made a computer entry to restart automatic tracking of the airplane based on the renewed availability of radar data. Immediately after the automatic tracking was restored, an E-MSAW alert was displayed to the controller, which indicated that the airplane was too low for IFR operations in the area. At 1346:47, the controller contacted the pilot, stating, "…the minimum IFR altitude in your area is 16,000—are you just climbing to 16,000?" The pilot responded, "…uh, wilco, 16,000." At 1349:06, the pilot reported, "…I might not be able to uh, make it to 16,000, uh, [unintelligible]." The controller asked the pilot to repeat the message, and the pilot transmitted, "…at 16, 14,000, 14,300 and I'm getting a low rate of climb and I may not be able to uh, achieve 16,000."

At 1349:39, the controller advised the pilot that he was in an area where the MIA was 15,800 feet and asked the pilot if he was "… able to maintain your own terrain and obstruction clearance?" The pilot responded that he was at 14,500 feet. The controller then asked if the pilot could maintain his own terrain and obstruction clearance for the next 10 minutes. The pilot responded, "…affirmative, I can do that," and the controller acknowledged.[4]

At 1351:32, the pilot transmitted, "…I'm in severe mountain wave." The controller acknowledged. The pilot then reported his altitude as 13,700 feet. The controller asked the pilot to repeat the message, and the pilot responded, "…descending rapidly out of 13,700." The controller then asked, "…are you able to maintain altitude?" but the pilot did not respond. At 1352:17, the controller again called the pilot, who replied, "[unintelligible]…severe… ." There

[4] Controllers are responsible for ensuring that aircraft operate at or above MIAs while on an IFR flight plan and cannot ask the pilot to voluntarily operate below the MIA.

were no further contacts with the pilot. The airplane wreckage was located 6 days after the accident in rough mountainous terrain just east of the last contact with the controller.

Discussion

Minimum Instrument Flight Rules Altitude

When the pilot's filed route was changed by the JAC air traffic controller, he did not discuss with Salt Lake Center the changed routing or the minimum altitude needed to safely navigate the revised routing to Riverton. The KICNE-Riverton route passed through an MIA polygon with terrain extending to 13,800 feet above sea level. Because 14 CFR 91.177 requires aircraft flying under IFR to maintain 2,000 feet above the highest obstacle in mountainous areas, aircraft flying that route segment would have to fly no lower than 15,800 feet. Although the pilot had previously declined a clearance to cruise at 16,000 feet, he was then immediately cleared on a route that could not be legally or safely flown at 14,000 feet.

FAA Order 8260.46D, "Departure Procedure (DP) Program," describes requirements and procedures for the establishment of published IFR departure procedures. There are two types of procedures available: Obstacle Departure Procedures (ODP), which are established to assist pilots in avoiding obstructions during the initial phase of flight but are not necessarily required for ATC purposes, and Standard Instrument Departures (SID), which incorporate both obstruction avoidance and ATC clearance instructions.[5] The JAC runways 1 and 19 departure procedures are published as ODPs, which, according to the order, are not permitted to include transition routes (multiple routings that end at different navigational fixes). The ODP used by the accident pilot depicted only one route and provided minimum altitude guidance only for aircraft departing KICNE for Idaho Falls, Idaho. SIDs may include multiple transition routes with published minimum altitudes for each route. If an SID for JAC runway 19 had existed and had included a transition from KICNE to Riverton, the pilot and JAC air traffic controller would have had a clear indication, before the airplane took off, that the route segment traversed an MIA polygon that required a climb to at least 16,000 feet. Further, the floor of controlled airspace in the area just east of KICNE is 14,500 feet, and controllers are required by FAA Order 7110.65, "Air Traffic Control," to avoid clearing aircraft on routes through uncontrolled airspace unless requested by the pilot.[6] No such request was made.

In high mountainous areas, minimum altitude information is critical for safe operations, because it affects aircraft performance computations, oxygen requirements for the pilot and passengers, and potential icing hazards. The NTSB concludes that, because IFR flight over

[5] According to FAA Order 8260.46D, an ODP and/or nonstandard takeoff minimums must be developed when obstructions penetrate the 40:1 departure obstacle clearance surface extending out from the end(s) of the runways at an affected airport. "SIDs are developed to assist in meeting environmental, capacity, and ATC requirements. An SID also provides protection from obstacles and is depicted graphically; however, it will not contain the '(OBSTACLE)' designation following the procedure title on the chart and may not be flown unless approved by ATC."

[6] According to the FAA Pilot/Controller Glossary, controlled airspace is defined as "…airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR [visual flight rules] flights in accordance with the airspace classification." Order 7110.65, paragraph 4-4-5 states, "…include routes through Class G [uncontrolled] airspace only when requested by the pilot. NOTE: Flight plans filed for random RNAV [area navigation] routes through Class G airspace are considered a request by the pilot."

mountainous terrain requires high minimum altitudes, an SID that contains published transitions to commonly used navigational fixes, including MIA information for each transition, would alert pilots and departure controllers of the minimum altitudes required before takeoff and allow them to adjust their route if necessary. Therefore, the NTSB recommends that the FAA establish SID procedures that provide transition routes and MIA information for aircraft cleared over commonly used navigational fixes from JAC and similarly situated airports.

Radar Tracking and Automated Software Alerts

Radar targets for aircraft operating under the control of Salt Lake Center are supplied by multiple radar sites; however, at lower altitudes or in mountainous areas, an aircraft may not be visible or visible to only one radar site. The information displayed to the Salt Lake Center controller indicated a loss of radar contact with the Mooney from 1335:44 until 1346:13 (see figure). Although the Rock Springs Air Route Surveillance Radar (ARSR) covered this area, Salt Lake Center had declared it not usable for technical issues,[7] and no other radar site could fill in the missing coverage; thus, ATC radar contact with the Mooney was lost for the segment of its flight where it was only visible to the Rock Springs radar.

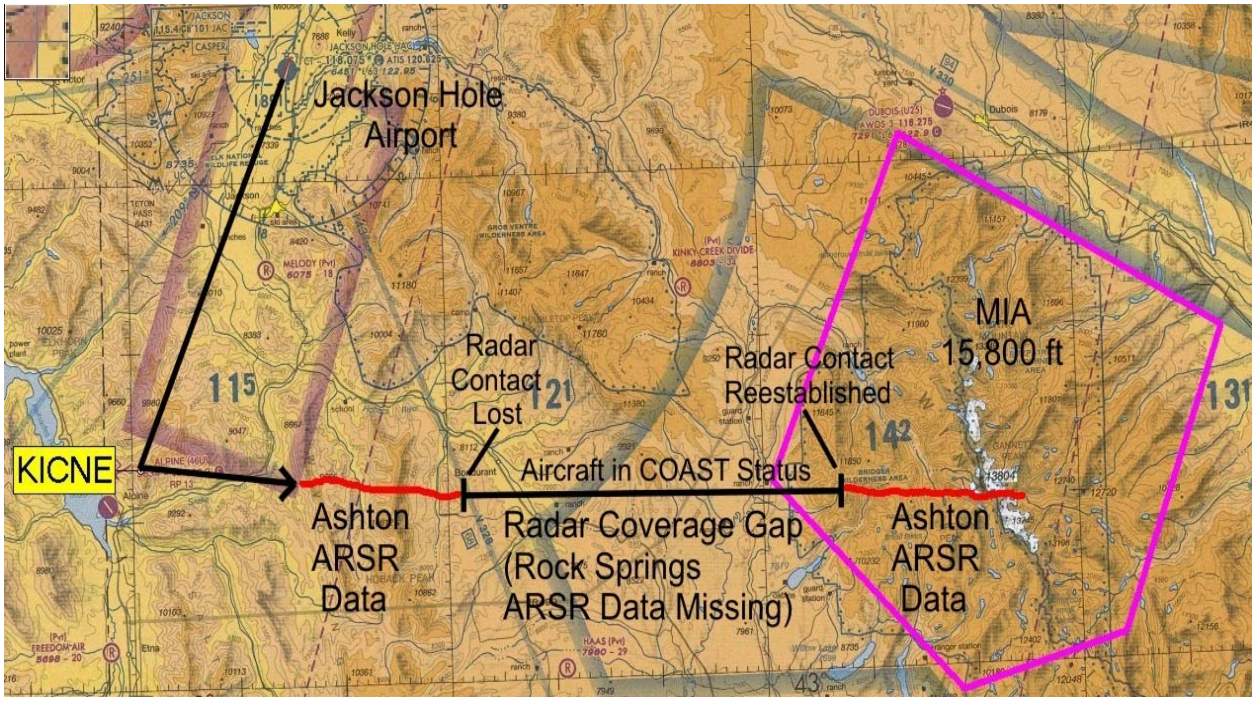


Figure. Airplane flight path with MIA polygon and radar coverage depicted. (Riverton is east of the MIA polygon.)

When an aircraft being tracked by ATC enters an area with no radar coverage, FAA's ERAM radar data processing system compensates for the loss of radar position data by maintaining a "coast track." In the absence of an actual radar target for the aircraft, ERAM places the aircraft's data block at an estimated position based on the aircraft's flight plan and the

[7] Although the Rock Springs radar data were declared unusable for ATC purposes and eliminated from Salt Lake Center controller displays, the radar site continued to provide targets that were recorded by Salt Lake Center, which were made available to NTSB investigators.

system's trajectory model of the flight path and updates the estimated position every 10 to 12 seconds. The airplane's altitude, 14,000 feet, was entered by the Salt Lake Center controller.

One of the safety functions built into the ERAM software is E-MSAW, which compares the observed position and altitude of radar-tracked IFR aircraft to the established MIA. If an aircraft appears on radar below the MIA, the system issues a visible E-MSAW alert to the controller. When an alert occurs, the controller is required to evaluate its validity and, if valid, to issue a safety alert to advise the pilot of the situation and to provide the MIA for the area. When the Mooney returned to normal radar tracking status, the system immediately generated an E-MSAW alert because the airplane was 1,800 feet below the MIA.

During the period that the Mooney was in coast track status and progressing along its route at 14,000 feet, the airplane entered an area where the MIA is 15,800 feet. However, E-MSAW alerts that affect aircraft in coast status are suppressed. The NTSB is concerned that this suppression function may not be appropriate and, in some circumstances, such as those demonstrated by this accident, could prevent controllers from receiving a valid and timely alert about an aircraft approaching hazardous terrain.

According to ERAM documentation, ERAM is designed to provide an E-MSAW alert to the controller about 2 minutes before an aircraft is predicted to enter an area where it will be below the MIA. The ERAM-predicted position for the coast track data block crossed the 15,800 foot MIA boundary at 1342:52; the Rock Springs radar data for the Mooney shows that it actually crossed the MIA boundary less than a minute later. Given the accuracy of the position estimates (provided by the ERAM coast tracking function) and the reported altitude (provided to the controller by the pilot of the Mooney), there appears to be little justification for the suppression of E-MSAW alerts based solely on the aircraft's coast track status. If E-MSAW alerts had not been suppressed based on the coast track, the controller would have received an alert at approximately 1340:52 (based on the ERAM-predicted position of the airplane), more than 5 minutes before the alert actually occurred at 1346:13. With the additional time, the controller could have instructed the pilot to attempt to climb earlier or to choose other options, such as a controller-directed radar vector around the high terrain. The NTSB concludes that providing controllers with an E-MSAW alert when an aircraft is in coast mode and is predicted to enter restricted airspace or another area, such as an MIA polygon, could provide additional time for the pilot to take alternative action. Therefore, the NTSB recommends that the FAA modify ERAM software such that E-MSAW alerts are provided for aircraft in coast track status that are receiving automatic position updates.

In addition, ERAM has sufficient information in its flight trajectory modeling software to perform an extended probe along an aircraft's flight track. Such probes are currently performed to warn controllers that an aircraft is predicted to enter restricted airspace or other areas that aircraft may need to completely avoid. This function could be extended to look ahead along an aircraft's flight plan or cleared route and provide a cautionary warning to controllers when an aircraft operating under IFR is predicted to enter an MIA polygon below the required MIA before an urgent E-MSAW alert occurs. In this accident, such a caution could have been issued several minutes before the E-MSAW alert, because all of the information available to ERAM indicated that the airplane was in steady state flight along its cleared route at an altitude that was not in conformance with the MIA that the airplane was approaching. Although a change in either

altitude or route was clearly necessary for safety purposes, no change was issued because the controller and pilot were both unaware of the approaching hazard. The NTSB concludes that predicting flight paths that may soon be out of conformance with required MIAs and providing nonurgent cautions to controllers handling such aircraft would allow sufficient time for pilots to climb safely or otherwise maintain the minimum altitude. Therefore, the NTSB recommends that the FAA modify ERAM software such that cautionary warnings are provided to controllers when an aircraft is predicted to enter an MIA polygon below the MIA.

Therefore, the NTSB makes the following recommendations to the Federal Aviation Administration:

> Establish Standard Instrument Departure procedures that provide transition routes and minimum instrument flight rules altitude information for aircraft cleared over commonly used navigational fixes from Jackson Hole Airport and similarly situated airports. (A-11-32)
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> Modify en route automation modernization software such that en route minimum safe altitude warning alerts are provided for aircraft in coast track status that are receiving automatic position updates. (A-11-33)
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> Modify en route automation modernization software such that cautionary warnings are provided to controllers when an aircraft is predicted to enter a minimum instrument flight rules altitude (MIA) polygon below the MIA. (A-11-34)

In response to the recommendations in this letter, please refer to Safety Recommendations A-11-32 through A-11-34. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman