NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

February 26, 2020

Factual Report

METEOROLOGY

ERA20FA088

Table Of Contents

A. ACCIDENT

Location: Grafton, West Virginia
Date: January 27, 2020
Time: 1255 eastern standard time
1755 Universal Coordinated Time (UTC)
Airplane: Aeropro CZ A220; Registration: N214K

B. METEOROLOGIST

Don Eick
Meteorologist Specialist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. SUMMARY

On January 27, 2020, about 1255 eastern daylight time, an Aeropro CZ A220, N214K, was destroyed when it impacted trees and terrain while enroute near Grafton, West Virginia. The private pilot was fatally injured. The airplane was operated by the pilot as a personal flight conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. There was no flight plan filed for the flight that originated from North Central West Virginia Airport (KCKB), Clarksburg, West Virginia about 1246.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are eastern standard time (EST) based upon the 24-hour clock, local time is -5 hours from UTC, and UTC=Z. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 39.392676° N and longitude 080.047981° W, at an elevation of approximately 1,425 ft.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) and the Weather Prediction Center (WPC) located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H change 2.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1300 EST centered over the accident site is included as figure 1 with the approximate accident site marked by the red star. The chart depicted a stationary front extending from the border of West Virginia southwestward across Kentucky into northwestern Tennessee. A trough of low pressure was also depicted from western Virginia southwestward into western North Carolina and South Carolina. The accident site was located immediately northeast of the stationary front and behind the trough in an area of general low pressure.

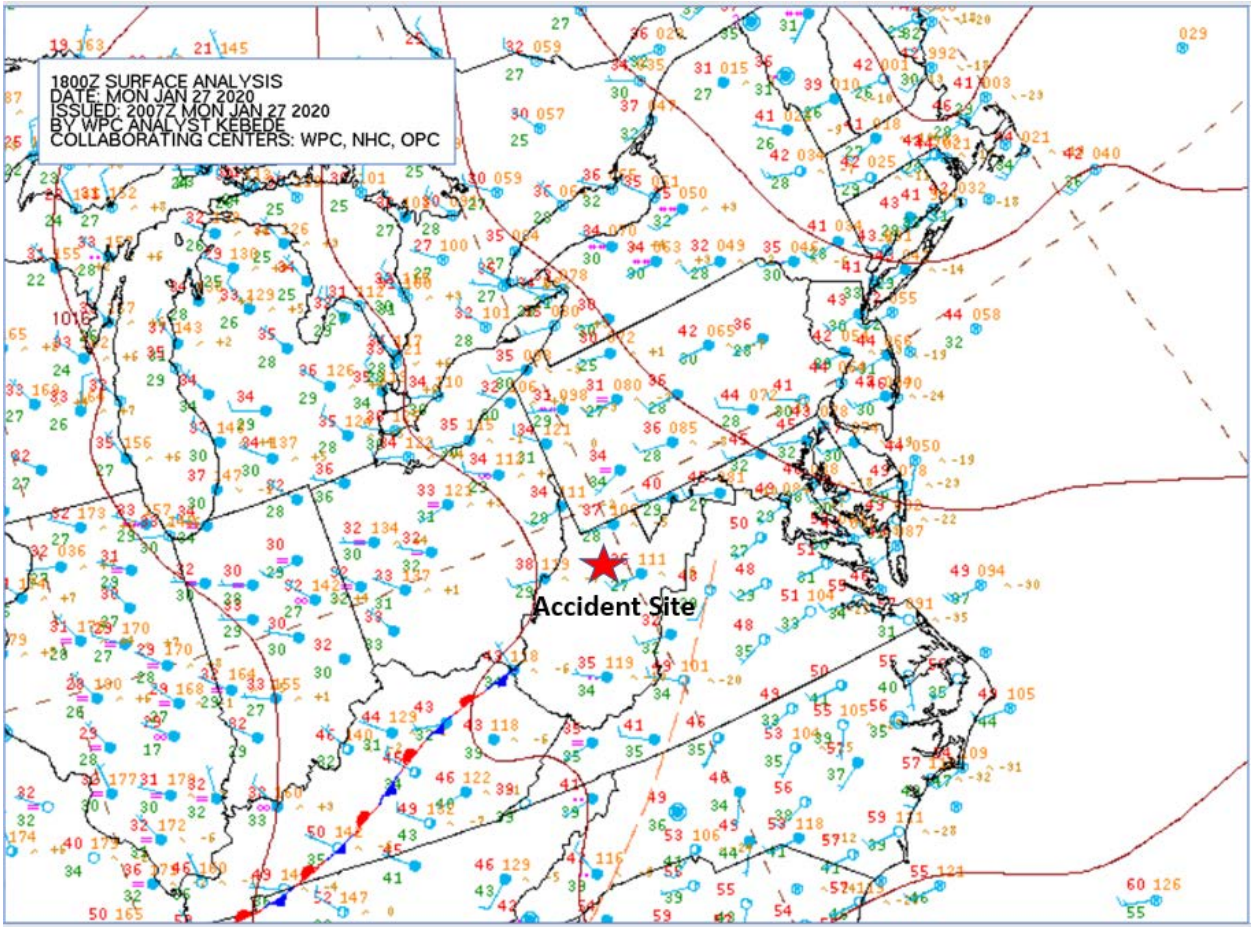

Figure 1 - NWS Surface Analysis Chart for 1300 EST

The station models surrounding the accident site indicated westerly winds of around 10 knots, overcast cloud cover, with temperatures near 36° Fahrenheit (F), with a sea level pressure near 1011.1-hectopascals (hPa)[1]. The station models across northern and central Indiana and Ohio indicated visibilities restricted in mist, with overcast clouds with temperature-dew point spreads of 4° F or less.

1.2 National Composite Radar Mosaic

A review of the NWS National Composite Mosaic Radar for 1244 EST centered over the accident site is included as figure 2. The radar mosaic depicted an east-to-west band of very light intensity echoes extending from near Parkersburg to Clarksburg, West Virginia, immediately southwest of the accident site and immediately west of the departure airport in Bridgeport. The band was moving southward with time and dissipating. No echoes were depicted over or in the immediate vicinity surrounding the accident site.

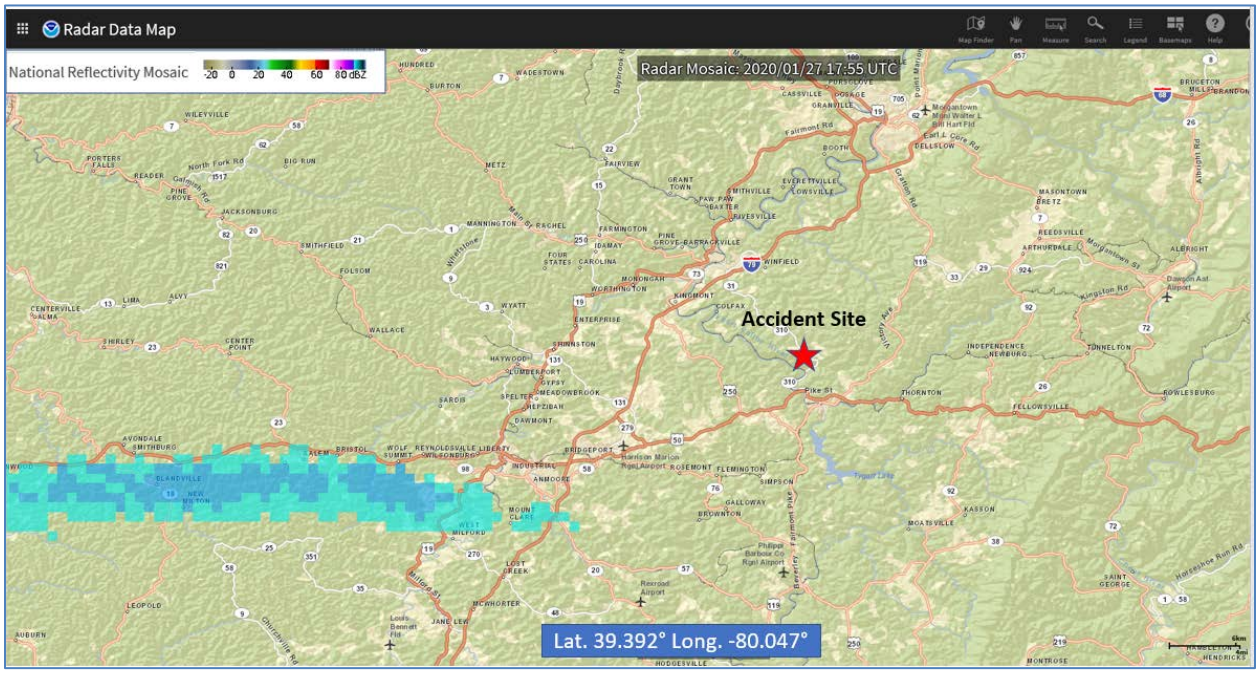

Figure 2 - National Composite Radar Mosaic for 1255 EST with the accident site noted by the red star

A review of the closest NWS weather surveillance radars (WSR-88D) for Charleston, West Virginia and Pittsburg, Pennsylvania were also reviewed and depicted no significant meteorological echoes along the flight path or over the accident site during the period.

2.0 Observations

The official observations issued surrounding the accident site were documented using standard meteorological aerodrome reports (METARs) and specials (SPECI). Cloud heights are reported

[1] Hectopascals is the new NWS reference for reporting sea level pressure and is interchangeable with the former term millibar (mb) with the same units. Standard sea-level pressure is 1013.25-hPa at 59º Fahrenheit (F) or 15º Celsius (C).

above ground level (agl) in the following section, and the magnetic variation was estimated at 9º west based on the latest sectional chart for the area.

2.1 Clarksburg, West Virginia

The accident airplane departed from North Central West Virginia Airport (KCKB), Clarksburg, West Virginia, at 1246 EST. The airport was located approximately 10 miles southwest of the accident site at an elevation of 1,224 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS), which was augmented by air traffic control personnel during normal hours of operation. The following conditions were reported at the time the accident flight departed and at the time of the accident.

> *Weather observation for KCKB at 1153 EST, wind from 280° at 9 knots, visibility 10 miles or more, ceiling broken at 1,500 ft agl, overcast at 2,500 ft, temperature 4° C, dew point temperature -2° C, altimeter 29.85 inches of mercury (Hg). Remarks: automated station with a precipitation discriminator, sea level pressure 1011.0-hPa, temperature 3.9° C, dew point temperature -1.7° C.*

> *Weather observation for KCKB at 1253 EST, wind from 260° at 6 knots, visibility 10 miles or more, ceiling broken at 1,800 ft agl, overcast at 2,300 ft, temperature 4° C, dew point temperature -2° C, altimeter 29.83 inches of Hg. Remarks: automated station with a precipitation discriminator, sea level pressure 1010.3-hPa, temperature 3.9° C, dew point temperature -1.7° C, 6-hour maximum temperature 3.9° C, 6-hour minimum temperature 2.8° C, 3-hour pressure tendency risen and fallen 0.6-hPa.*

The general flight categories[2] and raw observations from approximately 0700 through 1600 EST were as follows:

MVFR *METAR KCKB 271153Z AUTO 24007KT 10SM BKN022 BKN029 OVC044 03/M02 A2982 RMK AO2 SLP100 70001 T00281017 10028 20022 55005*

MVFR *METAR KCKB 271253Z 25007KT 10SM OVC018 03/M02 A2983 RMK AO2 SLP106 T00281017*

MVFR *SPECI KCKB 271337Z 24008KT 10SM OVC014 03/M01 A2984 RMK AO2 T00281011*

MVFR *METAR KCKB 271353Z 25006KT 10SM OVC017 03/M01 A2985 RMK AO2 SLP110 T00281011*

MVFR *METAR KCKB 271453Z 23008KT 10SM BKN017 OVC027 03/M01 A2985 RMK AO2 SLP111 T00331011*

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[2] As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories based on weather conditions reported:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

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MVFR *METAR KCKB 271553Z 25008KT 10SM BKN018 OVC025 03/M01 A2985 RMK AO2 SLP113 T00331011*

MVFR ***METAR KCKB 271653Z 28009KT 10SM BKN015 OVC025 04/M02 A2985 RMK AO2 SLP110 T00391017***

Departure 1746Z

MVFR ***METAR KCKB 271753Z 26006KT 10SM BKN018 OVC023 04/M02 A2983 RMK AO2 SLP103 T00391017 10039 20028 58006***

Accident 1755Z

MVFR *METAR KCKB 271853Z 27009KT 10SM BKN020 OVC025 04/M02 A2982 RMK AO2 SLP099 T00391022*

MVFR *METAR KCKB 271953Z 27007KT 10SM OVC022 04/M02 A2982 RMK AO2 SLP100 T00391022*

MVFR *METAR KCKB 272053Z 29007KT 10SM OVC021 04/M02 A2983 RMK AO2 SLP104 T00391022 53001*

2.2 Morgantown, West Virginia

The next closest weather reporting facility to the accident site was Morgantown Municipal Airport-Walter L. Bill Field (KMGW), located approximately 16 miles north-northeast of the accident site at an elevation of 1,244 ft. The airport also had a federally installed ASOS and was also augmented by tower personnel and reported the following conditions at the time of the accident.

> *Weather observation for KMGW at 1253 EST, wind from 280° at 7 knots, visibility 10 miles or more, ceiling overcast at 2,100 ft agl, temperature 3° C, dew point -2° C, altimeter setting 29.82 inches of Hg. Remarks: automated station with a precipitation discriminator, sea level pressure 1010.6-hPa, temperature 2.8° C, dew point -2.2° C, 6-hour maximum temperature 2.8° C, 6-hour minimum temperature 1.7° C, 3-hour pressure tendency risen and fallen 0.5-hPa.*

The general flight category and raw observations reported surrounding the period from approximately 0700 through 1700 EST were as follows.

MVFR *METAR KMGW 271153Z AUTO 20006KT 10SM OVC018 02/M01 A2981 RMK AO2 SLP104 T00171011 10017 20017 55003*

VFR *SPECI KMGW 271236Z 20005KT 10SM SCT016 OVC037 02/M02 A2982 RMK AO2 T00171017*

VFR *METAR KMGW 271253Z 21005KT 10SM OVC037 02/M02 A2982 RMK AO2 SLP108 T00171017*

MVFR *SPECI KMGW 271344Z 23005KT 10SM BKN021 OVC038 02/M01 A2984 RMK AO2 T00221011*

MVFR *METAR KMGW 271353Z 22005KT 10SM OVC021 02/M01 A2984 RMK AO2 SLP113 T00221011*

VFR *SPECI KMGW 271441Z 23005KT 10SM SCT022 OVC037 02/M01 A2984 RMK AO2 T00221011*

VFR *METAR KMGW 271453Z 22006KT 10SM FEW017 SCT022 OVC038 02/M01 A2984 RMK AO2 SLP113 T00221011 50009*

MVFR *SPECI KMGW 271501Z 23007KT 10SM BKN017 BKN022 OVC038 02/M02 A2984 RMK AO2 T00221017*

MVFR *METAR KMGW 271553Z VRB04KT 10SM BKN020 OVC026 03/M02 A2984 RMK AO2 SLP114 T00281017*

MVFR *METAR KMGW 271653Z 23008KT 10SM OVC021 03/M02 A2984 RMK AO2 SLP112 T00281022*

MVFR ***METAR KMGW 271753Z 28007KT 10SM OVC021 03/M02 A2982 RMK AO2 SLP106 T00281022 10028 20017 58005***

Accident 1755Z

MVFR *METAR KMGW 271853Z 26004KT 10SM OVC020 03/M02 A2981 RMK AO2 SLP103 T00281022*

MVFR *METAR KMGW 271953Z 32004KT 10SM OVC017 02/M02 A2982 RMK AO2 SLP106 T00221017*

MVFR *METAR KMGW 272053Z 27005KT 10SM OVC015 02/M02 A2983 RMK AO2 SLP110 T00221017 53003*

2.3 Oakland, Maryland

The next station generally along the route of flight was Garrett County Airport (K2G4), located in Oakland, Maryland, approximately 34 miles northeast of the accident site at an elevation of 2,933 ft. The airport had an Automated Weather Observation System (AWOS) and issued observations every 20-minutes. The following conditions were reported at the time of the accident.

> *Weather observation for K2G4 at 1255 EST, automated, wind from 260° at 10 knots gusting to 16 knots, wind from 242° variable 302°, visibility 10 miles or more, ceiling overcast at 600 ft agl, temperature -2° C, dew point -3° C, altimeter 29.72 inches of Hg. Remarks: automated observation system without a precipitation discriminator.*

The general flight category and raw observations from about 0700 through 1700 EST were as follows.

LIFR *METAR K2G4 271155Z AUTO 27009G16KT 5SM OVC002 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271215Z AUTO 27009G14KT 7SM OVC002 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271235Z AUTO 27010G18KT 7SM OVC002 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271255Z AUTO 27008KT 242V312 7SM OVC002 M02/M02 A2972 RMK AO1*

LIFR *METAR K2G4 271315Z AUTO 27011G18KT 4SM OVC002 M02/M02 A2972 RMK AO1*

LIFR *METAR K2G4 271335Z AUTO 28009G14KT 252V312 10SM BKN004 OVC008 M02/M02 A2973 RMK*

IFR *METAR K2G4 271355Z AUTO 27011G19KT 10SM BKN006 BKN022 M02/M03 A2972 RMK AO1*

MVFR *METAR K2G4 271415Z AUTO 26010G19KT 232V292 10SM SCT010 BKN022 M02/M03 A2973 RMK*

MVFR *METAR K2G4 271435Z AUTO 27009G16KT 10SM BKN010 OVC020 M02/M03 A2973 RMK AO1*

MVFR *METAR K2G4 271455Z AUTO 27007G16KT 232V302 10SM BKN010 BKN015 OVC020 M02/M03 A2973 RMK AO1*

MVFR *METAR K2G4 271515Z AUTO 27010G16KT 10SM BKN010 OVC020 M02/M03 A2973 RMK AO1*

IFR *METAR K2G4 271535Z AUTO 27007G14KT 10SM BKN006 BKN013 OVC020 M02/M02 A2974 RMK*

IFR *METAR K2G4 271555Z AUTO 26007G14KT 242V302 10SM OVC006 M02/M02 A2974 RMK AO1*

IFR *METAR K2G4 271615Z AUTO 27005KT 10SM OVC006 M02/M02 A2974 RMK AO1*

IFR *METAR K2G4 271635Z AUTO 27009G16KT 10SM BKN008 OVC011 M02/M03 A2973 RMK AO1*

IFR *METAR K2G4 271655Z AUTO 26008KT 10SM OVC006 M02/M02 A2973 RMK AO1*

IFR *METAR K2G4 271715Z AUTO 26008G17KT 10SM OVC006 M02/M03 A2973 RMK AO1*

IFR *METAR K2G4 271735Z AUTO 26009G18KT 232V302 10SM OVC006 M02/M03 A2972 RMK AO1*

Accident 1755Z

IFR ***METAR K2G4 271755Z AUTO 26010G16KT 242V302 10SM OVC006 M02/M03 A2972 RMK AO1***

IFR *METAR K2G4 271815Z AUTO 26008G14KT 10SM OVC006 M02/M03 A2972 RMK AO1*

IFR *METAR K2G4 271835Z AUTO 27010G14KT 4SM OVC006 M02/M02 A2972 RMK AO1*

LIFR *METAR K2G4 271855Z AUTO 27007KT 2SM OVC004 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271915Z AUTO 26006KT 2 1/2SM OVC004 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271935Z AUTO 27007KT 242V312 1 1/4SM OVC004 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 271955Z AUTO 27007KT 1 1/4SM OVC002 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 272015Z AUTO 27007KT 252V312 1 1/4SM OVC002 M02/M02 A2971 RMK AO1*

LIFR *METAR K2G4 272035Z AUTO 28006KT 1SM OVC002 M02/M02 A2972 RMK AO1*

LIFR *METAR K2G4 272055Z AUTO 28005KT 1SM OVC002 M02/M02 A2972 RMK AO1*

2.4 METAR Display

A display of the METAR observations from the NWS Aviation Weather Center's (AWC) website[3] for 1300 EST is included as figure 3 with the national radar mosaic overlaid and the approximate accident site marked by a red star. The image depicted general MVFR conditions surrounding the accident site with IFR to LIFR conditions over western Maryland panhandle and over southern Pennsylvania immediately northeast.

[3] https://aviationweather.gov/metar

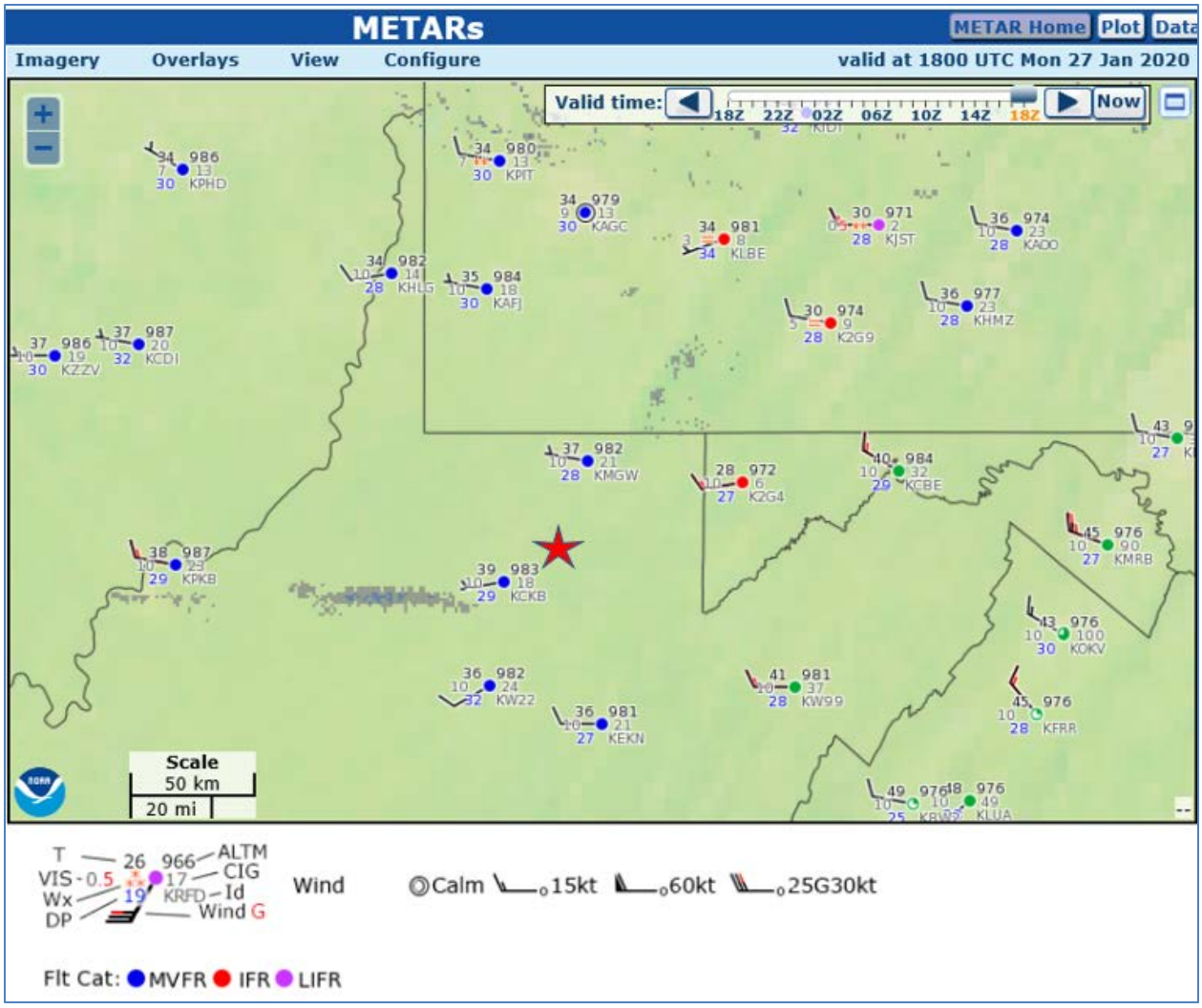

Figure 3 - NWS AWC METAR display at 1300 EST with the accident site marked by the red star

3.0 Sounding

To determine the vertical structure and state of the atmosphere over the accident site a High-Resolution Rapid Refresh (HRRR)[4] numerical model data was retrieved from the NOAA Air Resources Laboratory and plotted on a standard Skew T log P diagram[5] using the complete Rawinsonde Observation RAOB program software[6]. Figure 4 is the HRRR 1300 EST numerical

[4] The HRRR is a National Oceanic and Atmospheric Administration (NOAA) real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one-hour period.

[5] Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

[6] RAOB software – The complete RAwinsonde OBservation program is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania, for plotting and analyzing upper air data

model sounding over the accident site from the surface through 450-hPa or approximately 21,000 ft.

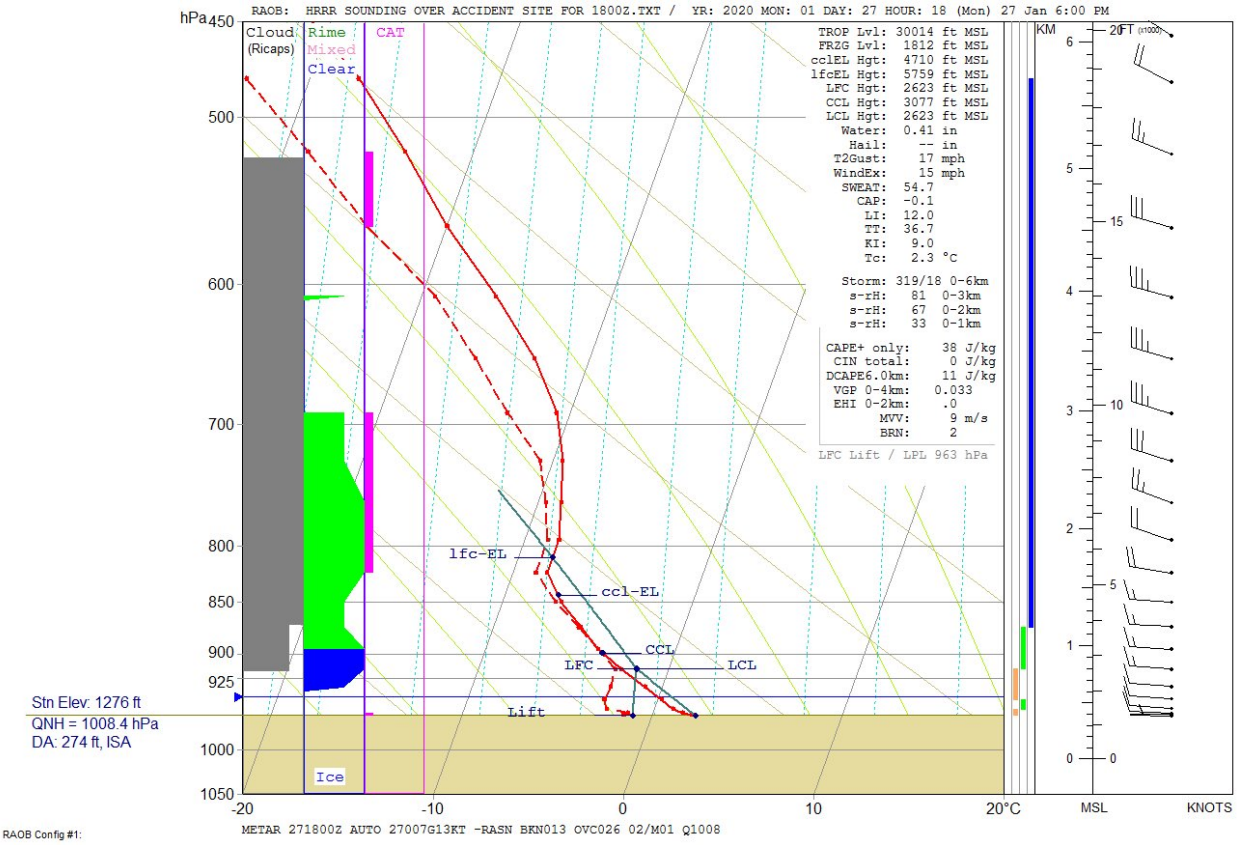

Figure 4 - HRRR numerical model sounding over the accident site at 1300 EST

The HRRR model estimated the elevation over the accident site as 1,276 ft with a near surface temperature of 2.3° C (36° F), a dew point of -1.0° C (30° F) and the relative humidity of 79%. The freezing level was at 536 ft agl (1,812 ft msl), with the entire depth of the sounding below freezing. The lifted condensation level (LCL)[7] and the level of free convection (LFC)[8] were identified at 1,347 ft agl (2,623 ft msl), and the convective condensation level (CCL) at 1,801 ft agl (3,077 ft msl). The sounding indicated a cloud layer from the LCL through 8,000 ft with a relative humidity greater than 95%. The RAOB algorithm supported structural icing in clouds with a mixture of clear to rime type icing from approximately 1,300 ft through 8,000 ft, with the potential for light to moderate intensities of icing. The precipitable water content was 0.41 inches. The atmosphere was characterized as stable with a Lifted Index[9] of 12.0, except for the lowest 3,000 ft which depicted a conditional unstable to auto-convective lapse rate.

[7] Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

[8] Level of Free Convection (LFC) - the last level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level. The LFC represents the bottom of the layer containing CAPE.

[9] Lifted Index (LI) - the difference between the lifted parcel temperature at 500 hPa and the 500 hPa temperature in the sounding. Negative values denote parcels that are warmer than the background 500 hPa temperatures and are thus buoyant or "unstable".

The HRRR wind profile indicated a surface wind from approximately 270° at 7 knots with the little variation in direction with height with slowly increasing wind speeds to 20 knots above 5,000 ft. The mean 0 to 6 kilometer or 18,000 ft wind was from approximately 290° at 24 knots. Except for a shallow layer between 4,000 and 7,000 ft of potential light turbulence, no strong vertical wind shears were noted for potential turbulence. The sounding's thermal and wind profile however, did support the potential of mountain wave development with the potential for a wave with the potential for moderate or greater turbulence near 6,000 ft.

Figure 5 is a table of the observed sounding parameters of height, pressure (Pres), temperature (T), dew point (Td), relative humidity (RH), wind direction and speed (DD/FF), and RAOB derived clear air turbulence (CAT), low-level wind shear (LLWS), icing, and potential mountain wave conditions from the surface through approximately 12,000 ft.

Height (ft-AGL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)	Wave/x---W---Turb nm	fpm	max
0	963	2.3	-1.0	79	271 / 7						
28	962	2.1	-1.5	77	271 / 6	LGT	LIGHT				
83	960	1.6	-1.3	81	272 / 9						
193	956	1.0	-2.5	77	274 / 10						
470	946	0.2	-2.8	80	274 / 11						
833	933	-0.9	-2.7	88	275 / 12			LGT Clear			
1342	915	-2.5	-2.8	98	275 / 13			MDT Clear			
1916	895	-4.1	-4.1	100	274 / 14			MDT Clear			
2530	874	-5.4	-5.5	99	274 / 16			LGT Rime			
3246	850	-6.9	-7.2	98	274 / 17			LGT Rime			
4071	823	-8.2	-8.8	95	279 / 18	LGT		MDT Rime			
4986	794	-8.2	-8.8	95	289 / 20	LGT		MDT Rime	2.13	866	MD-SV
6034	762	-8.8	-9.6	94	292 / 26	LGT		MDT Rime	2.87	506	LT-MD
7194	728	-9.5	-10.7	91	289 / 31	LGT		LGT Rime	3.64	474	LIGHT
8514	691	-10.7	-13.3	81	288 / 36			LGT Rime	4.67	336	LIGHT
10013	651	-12.9	-16.0	78	288 / 37						
11713	608	-16.1	-19.3	76	287 / 36			LGT Rime			

Figure 5 - HRRR numerical model sounding parameters from the surface through 12,000 ft

The flight track depicted the accident airplane departing and climbing northeast bound reaching approximately 5,500 ft at 1253:44 EST before turning back southwestward and rapidly descending. At 5,500 ft the sounding indicated a temperature of -8.2° C, a dew point of -8.8° C, a relative humidity of 95%, and a wind from 280° at 18 knots. At that level the sounding depicted a moderate rime icing potential and the potential for mountain wave turbulence in the clouds.

Figure 6 is a cross section sounding created using HRRR soundings over KCKB, the accident site (above), and over KMGW at 1300 EST. The extent of the clouds are provided in black, icing intensity in blue, with isotherms or lines of equal temperature in red dashed lines. In addition, the approximate flight profile of N214K has been added in bold red located in the bottom left side of the image. The cross section shows the accident airplane departing from KCKB and climbing into the overcast layer of clouds and into moderate icing conditions, with the temperature less than -5° C.

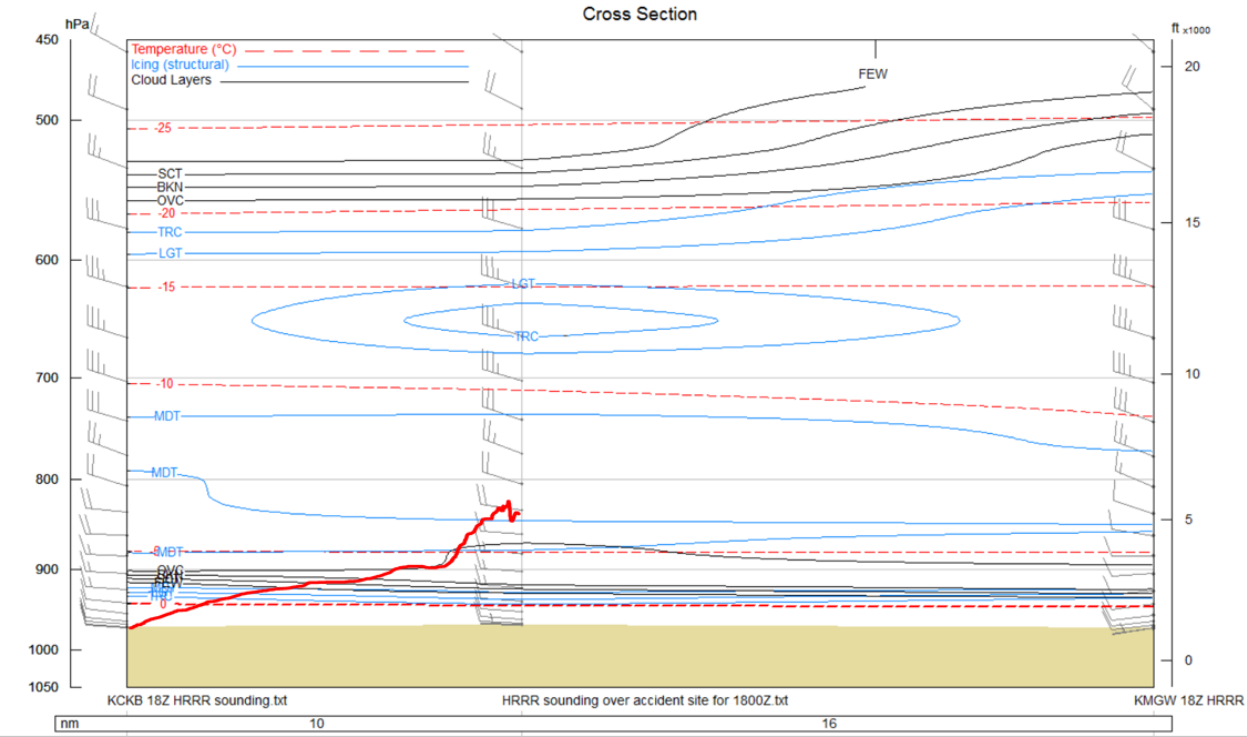

Figure 6 - Cross section from KCKB to KMGW at 1300 EST with flight profile

4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared long wave and visible imagery were obtained surrounding the time of the accident, with the images closest to the time of the accident documented below. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km. The visible (band 2) was at a wavelength of 0.64 μm images with a resolution of 0.5 km.

Figure 7 is the GOES-16 infrared image with a standard MB temperature enhancement curve applied to highlight the higher colder clouds tops at 2X magnification and with the surface fronts and troughs overlaid. A deep band of low clouds extended over the departure airport KCKB and the accident site, which had a radiative cloud top temperature of 260 Kelvin or -13.16° C, which corresponded to cloud tops near 11,500 ft.

Figure 8 is the GOES-16 visible image at 2X magnification for 1256 EST with the accident site marked in red. A thick band of nimbostratus type clouds extended over the accident site, with a series of north-northeast-to-south-southwest bands of low altocumulus clouds were depicted immediately east in parallel bands perpendicular to the wind flow, similar to transverse bands[10].

[10] Transverse bands – are bands of clouds oriented perpendicular to the flow in which they are embedded. They are often observed in satellite imagery and are often correlated with turbulence. Transverse bands at low levels often indicate the presence of a temperature inversion as well as strong directional shear in the low- to mid-level winds.

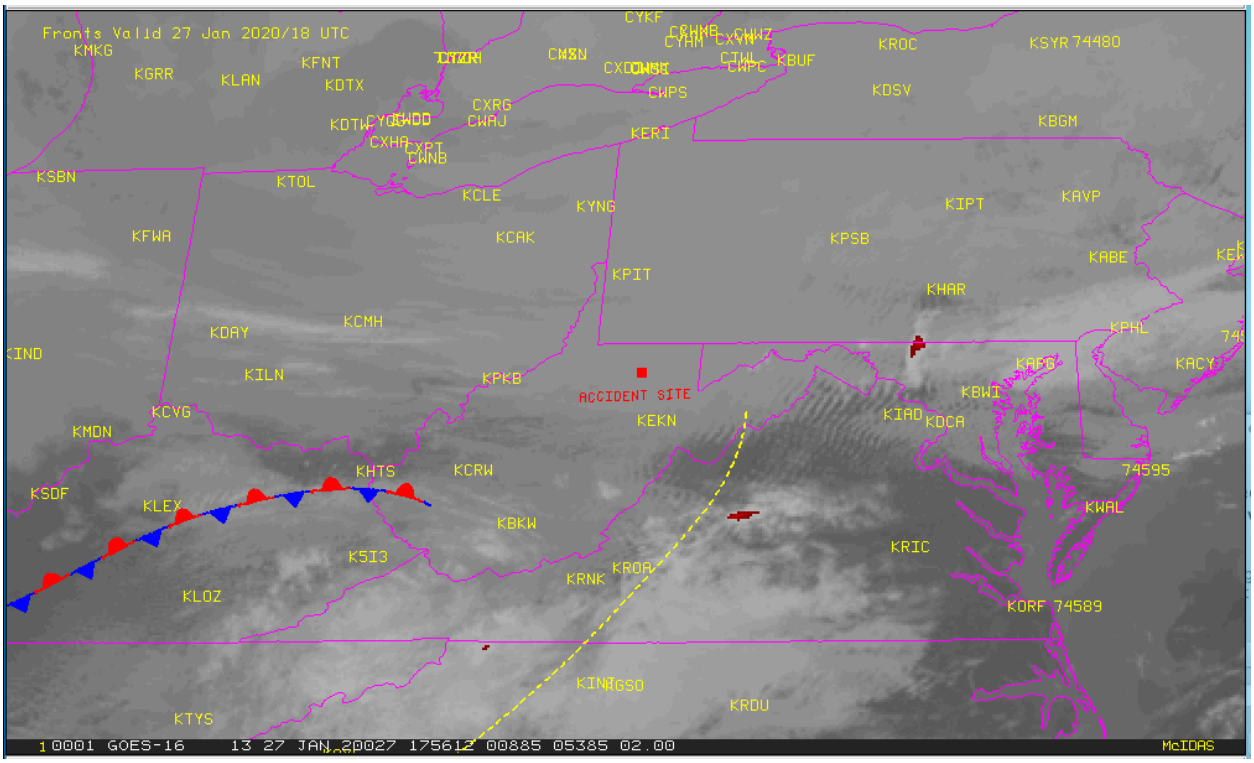

Figure 7 - GOES-16 infrared image at 2X magnification for 1256 EST with fronts overlaid

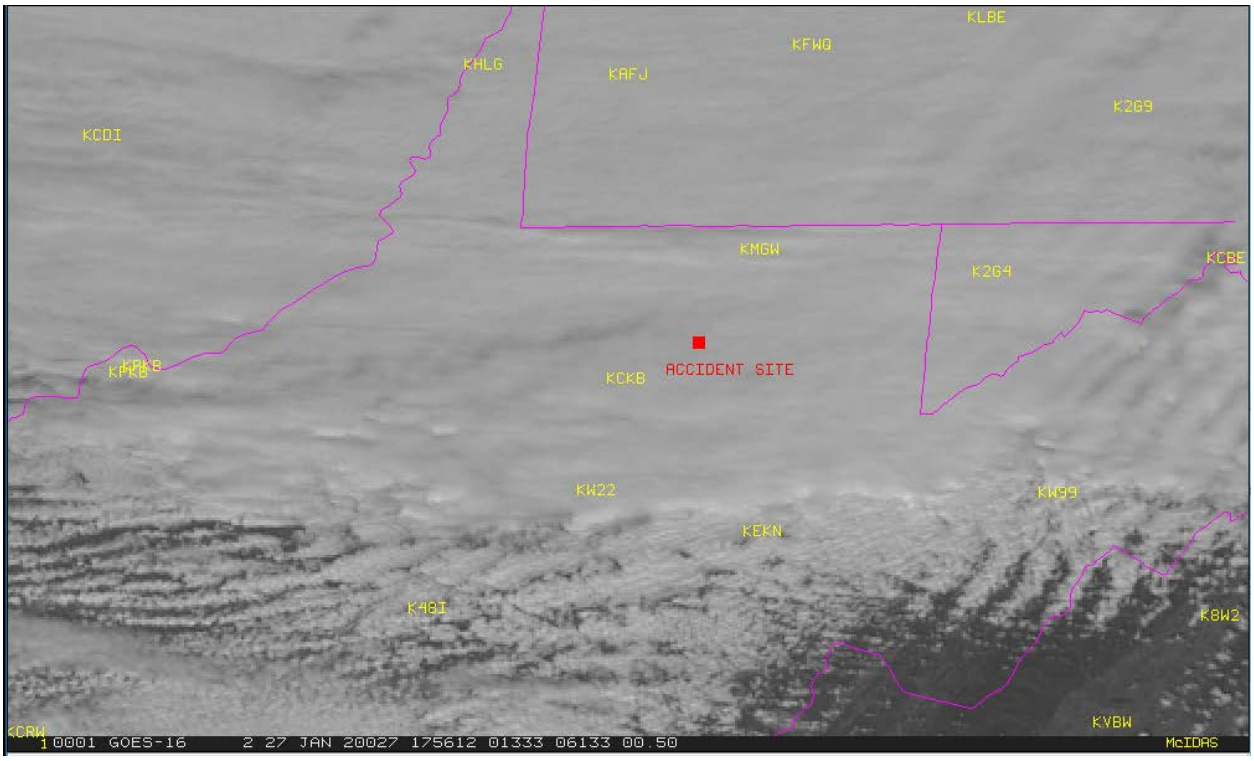

Figure 8 - GOES-16 visible image at 1256 EST at 2X magnification

5.0 Pilot Reports

The following pilot reports or PIREPs within 50 miles and below 12,000 ft between 1000 and 1400 EST were as follows. The reports are in standard format and code, with time in UTC, and are followed by a plain language decode with time converted to local EST.

CKB UA /OV W22/TM 1516/FL050/TP C560/IC LGT MX

North Central West Virginia Airport (CKB) routine pilot report; Over – Upshur County Regional Airport (W22), Buckhannon, West Virginia and approximately 18 miles south of CKB; Time – 1016 EST; Altitude – 5,000 ft; Type aircraft – Cessna Citation business jet; Icing – light mixed icing.

CKB UA /OV CKB2100010/TM 1557/FL070/TP BE20/WX TOPS070/TA -7/IC LIGHT MIXED 060-070

CKB routine pilot report; Over – 210° and 10 miles from Clarksburg (CKB) VORTAC[11]; Time – 1057 EST; Altitude – 7,000 ft; Type aircraft – Beechcraft King Air multiengine turboprop; Weather – cloud tops at 7,000 ft; Icing – light mixed icing between 6,000-7,000 ft.

CKB UA /OV 10 W CKB/TM 1650/FL050/TP BE20/IC MOD MIXED

CKB routine pilot report; Over – 10 miles west of CKB VORTAC; Time – 1150 EST; Altitude – 5,000 ft; Type aircraft – Beechcraft King Air multiengine turboprop; Icing – moderate mixed icing.

CKB UA /OV 10 NW WAY/TM 1650/FL070/TP FA20/IC MOD MIXED 070-040

CKB routine pilot report; Over – 10 miles northwest of Greene County Airport (WAY), Waynesburg, Pennsylvania, or approximately 36 miles north of CKB; Time – 1150 EST; Altitude – 7,000 ft; Type aircraft – Dassault Falcon business jet; Icing – moderate mixed icing between 7,000 ft and 4,000 ft.

CKB UA /OV VVS/TM 1810/FL050/TP BE20/SK BASES 030

CKB routine pilot report; Over – Joseph A. Hardy Connellsville Airport (VVS), Connellsville, Pennsylvania, or approximately 48 miles northeast of CKB; Time – 1310 EST; Altitude – 5,000 ft; Type aircraft – Beechcraft King Air multiengine turboprop; Sky cover – cloud bases at 3,000 ft.

Of the 5 PIREPs recorded over the area during the period all were from aircraft operating at instrument flight plan hemispheric cruising altitudes, and 4 reported light to moderate mixed icing conditions between 4,000 ft and 7,000 ft within 50 miles of the accident site.

5.1 Aircraft Icing Intensity References

For reference the following icing intensity is taken from the Airmen's Information Manual (AIM), Safety of Flight, section 7-1-21 PIREPs relating to airframe icing.

1. ***Trace.*** *Ice becomes perceptible. Rate of accumulation slightly greater than sublimation. Deicing/anti-icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).*

[11] A VORTAC is a radio-based navigational aid for aircraft pilots consisting of a co-located VHF omnidirectional range (VOR) beacon for azimuth and a tactical air navigation system (TACAN) beacon for distance information. Unless otherwise noted the VORTAC name is collocated with the airport city, but may be located off the field.

2. ***Light***. *The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti-icing equipment is used.*
3. ***Moderate.*** *The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or flight diversion is necessary.*
4. ***Severe.*** *The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.*

Note - Severe icing is aircraft dependent, as are the other categories of icing intensity. Severe icing may occur at any accumulation rate.

5.2 Icing Types References

Section 7-1-22 of the AIM provides the definitions of inflight icing terms or type of icing.

Icing Types	
Clear Ice or Glaze Ice	*Ice, sometimes clear and smooth, but usually containing some air pockets, which results in a lumpy translucent appearance. Glaze ice results from supercooled drops/droplets striking a surface but not freezing rapidly on contact. Glaze ice is denser, harder, and sometimes more transparent than rime ice. Factors, which favor glaze formation, are those that favor slow dissipation of the heat of fusion (i.e., slight supercooling and rapid accretion). With larger accretions, the ice shape typically includes "horns" protruding from unprotected leading edge surfaces. It is the ice shape, rather than the clarity or color of the ice, which is most likely to be accurately assessed from the cockpit. The terms "clear" and "glaze" have been used for essentially the same type of ice accretion, although some reserve "clear" for thinner accretions which lack horns and conform to the airfoil.*
Mixed Icing	*Simultaneous appearance or a combination of rime and glaze ice characteristics. Since the clarity, color, and shape of the ice will be a mixture of rime and glaze characteristics, accurate identification of mixed ice from the cockpit may be difficult.*
Rime Ice	*A rough, milky, opaque ice formed by the rapid freezing of supercooled drops/droplets after they strike the aircraft. The rapid freezing results in air being trapped, giving the ice its opaque appearance and making it porous and brittle. Rime ice typically accretes along the stagnation line of an airfoil and is more regular in shape and conformal to the airfoil than glaze ice. It is the ice shape, rather than the clarity or color of the ice, which is most likely to be accurately assessed from the cockpit.*
Intercycle Ice	*Ice which accumulates on a protected surface between actuation cycles of a deicing system.*
Residual Ice	*Ice which remains on a protected surface immediately after the actuation of a deicing system.*
Runback Ice	*Ice which forms from the freezing or refreezing of water leaving protected surfaces and running back to unprotected surfaces.*

6.0 NWS Forecasts

6.1 Terminal Aerodrome Forecasts

The NWS Charleston (KRLX), West Virginia, Weather Forecast Office (WFO) was responsible for the issuance of the Terminal Aerodrome Forecast (TAF) for KCKB. A TAF is a concise statement of the expected meteorological conditions at an airport during a specified period (usually 24 hours). TAFs are valid for a 5 mile radius around an airport's center point. The forecasts issued

surrounding the period relevant to the preflight planning and the time of the accident was as follows.

TAF KCKB 271731Z 2718/2818 27007KT P6SM OVC017
FM280100 31005KT P6SM OVC017
FM281600 27005KT P6SM OVC010=

The forecast issued at 1231 EST expected from 1300 through 2000 EST a wind from 270° at 7 knots, visibility 6 miles or more, ceiling overcast at 1,700 ft agl.

6.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short term weather conditions within their region with an aviation section that includes the general conditions as it relates to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF. The discussion also gives some reasoning behind the forecast. These are generated roughly every 6 hours and corresponds to the release of the latest TAFs for that office. The long term and marine sections have been excluded. The forecast discussion issued from KRLX at 1045 EST was as follows.

FXUS61 KRLX 271545
AFDRLX

AREA FORECAST DISCUSSION
National Weather Service Charleston WV
1045 AM EST Mon Jan 27 2020

.SYNOPSIS...
Low pressure passes south of the area early this morning. Multiple upper level troughs crossing this week with periods of rain and snow showers.

.NEAR TERM /THROUGH TONIGHT/...
As of 1045 AM Monday...

Decreased cloud coverage for the next several hours to account for brief periods of clearing in the western part of the CWA. These areas should become overcast again later today. Elsewhere, overcast skies are expected to continue through the period.

No other updates needed at this time.

As of 751 AM Monday...

Increased POPs for southern CWA through mid morning. Mix of wintry precip expected as a disturbance passes just south of the region. Minor snow accumulations may occur, but impacts are currently expected to be minimal. Additional update expected around mid/late morning.

As of 130 AM Monday...

A southern system brings chances of mixed precipitation on Monday morning to the southern part of the area and the mountains. There may be a chance of freezing rain in the mountains with this system, however, there is still uncertainty with whether or not freezing rain will actually occur. Precipitation should transition to upslope snow by Monday night in the higher elevations as temperatures become cold enough. Precipitation

accumulations with this system are relatively low, around an inch at the highest elevations and lower elsewhere in the mountains.

High temperatures are around normal on Monday with upper 30s to lower 40s in the lowlands and lower 30s in the mountains. Lows will be in the upper 20s and lower 30s for the lowlands and be in the lower 20s for the higher elevations.

.SHORT TERM /TUESDAY THROUGH WEDNESDAY NIGHT/...
As of 200 AM Monday...

Upslope flow will prevail into the short term period Tuesday into Wednesday. Ideal 850mb temperatures in the -8 to -10C range will arrive Tuesday morning, maintaining light snow showers up in the northeast West Virginia mountains. Forecast soundings suggest moisture depth will be wavering by Wednesday midday, shutting off snow production for the conclusion of the short term. Will also note that moisture depth at Snowshoe is projected to be shallower than up into Elkins, so a gradient of snow production could transpire as showers taper off from south to north.

00Z model suite from this evening advocate for a low pressure system navigating through the Mississippi Valley on Wednesday to brush by to the south, only bringing a slight chance for rain and showers in our extreme southern counties and perhaps a few light snow showers in southeast West Virginia.

Clouds hold steady over the entire forecast area during this time, so the chance for sunshine will be minimal. Temperature readings will be near their climatological norm for this time of year.

.AVIATION /16Z MONDAY THROUGH FRIDAY/...
As of 620 AM Monday...

Most sites will have MVFR conditions throughout the period in ceilings. However, BKW currently has IFR ceilings that will likely persist through the first few hours this morning as rain moves across the site, raising up to MVFR ceilings once this passes. A small chance of freezing drizzle may be possible in the northern mountains. Upslope snow may affect BKW and EKN Monday night, leading to MVFR visibilities at these sites. Winds will be light and from the northwest.

FORECAST CONFIDENCE AND ALTERNATE SCENARIOS THROUGH 18Z TUESDAY...

FORECAST CONFIDENCE: High.

ALTERNATE SCENARIOS: There is a small chance of freezing rain in the northern mountains this morning that may or may not occur.

EXPERIMENTAL TABLE OF FLIGHT CATEGORY OBJECTIVELY SHOWS CONSISTENCY
OF WFO FORECAST TO AVAILABLE MODEL INFORMATION:
H = HIGH: TAF CONSISTENT WITH ALL MODELS OR ALL BUT ONE MODEL.
M = MEDIUM: TAF HAS VARYING LEVEL OF CONSISTENCY WITH MODELS.
L = LOW: TAF INCONSISTENT WITH ALL MODELS OR ALL BUT ONE MODEL.

UTC 1HRLY	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*00*	*01*	*02*
EST 1HRLY	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*
CRW CONSISTENCY	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
HTS CONSISTENCY	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
BKW CONSISTENCY	*M*	*L*	*L*	*L*	*H*	*H*	*H*	*M*	*M*	*L*	*L*	*L*
EKN CONSISTENCY	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*L*	*H*
PKB CONSISTENCY	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CKB CONSISTENCY	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

AFTER 18Z TUESDAY...

Some patches of IFR are possible in the mountains Tuesday night into Wednesday with snow.

.RLX WATCHES/WARNINGS/ADVISORIES...
WV...None.
OH...None.
KY...None.
VA...None.

SYNOPSIS...MEK/CG
NEAR TERM...RH/CG/JLB
SHORT TERM...MEK
LONG TERM...MEK
AVIATION...CG

6.3 Graphic Forecast for Aviation

The NWS Graphic Forecast for Aviation (GFA) product replaced the Area Forecast and provides a graphical depiction of surface wind, weather, with color coded general flight categories, and cloud cover, with the Graphic- Airman's Meteorological Information (G-AIRMET) Sierra for IFR conditions, mountain obscuration, and icing conditions overlaid. The GFA is available at the NWS AWC website and through other weather briefing services.

Figure 9 is the east section of the GFA Surface Weather issued at 1101 EST and valid for 1300 EST with the approximate accident site marked by the red star. The image depicted expected surface winds from the west at 5 to 10 knots over the region, with potential rain and snow showers immediately east, with visibility generally unrestricted. A G-AIRMET Sierra for IFR conditions in pink extended over the route immediately east of the accident site over eastern West Virginia, Maryland, and western Pennsylvania impacting the planned route of flight.

Figure 10 is the northcentral section of the GFA Cloud Cover product issued at 1101 EST and valid for 1300 EST with the approximate accident site marked by a red star. The cloud heights are provided with reference to msl heights. The image depicted an extensive area of overcast clouds over the region with bases near 2,700 ft (about 1,200 ft agl) with tops near 10,000 ft. AG-AIRMET Sierra for mountain obscuration and a G-AIRMET Zulu for moderate icing conditions also extended over the accident site.

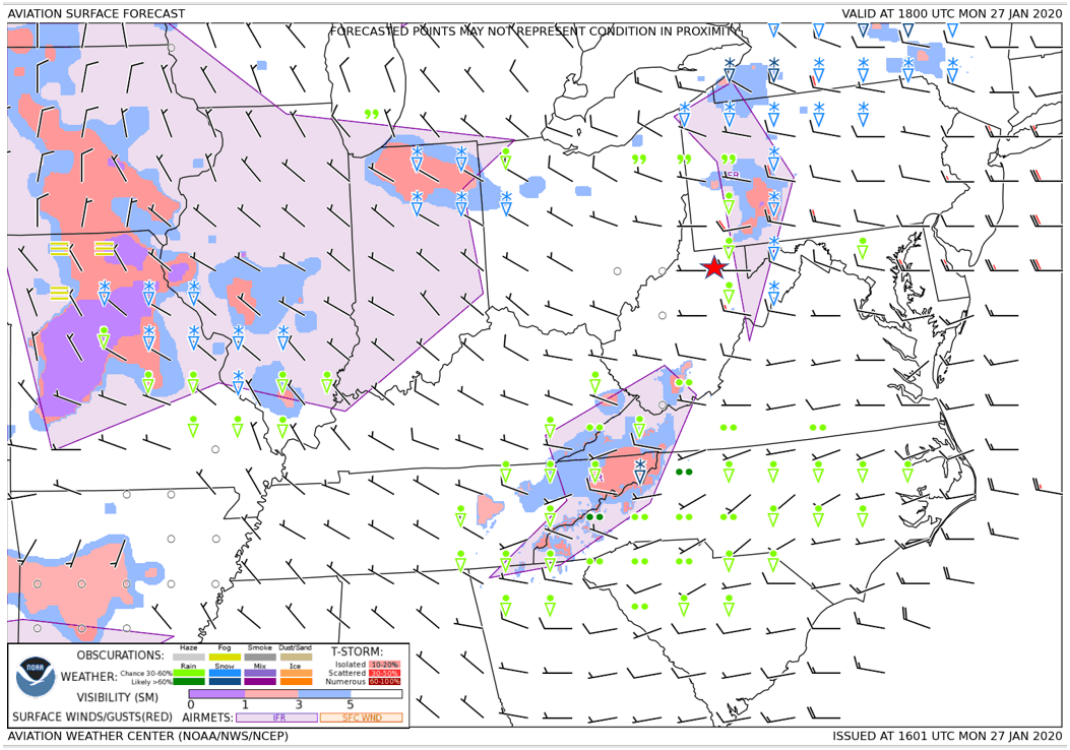

Figure 9 - Graphic Forecast for Aviation Surface Weather issued at 1101 EST and valid for 1300 EST

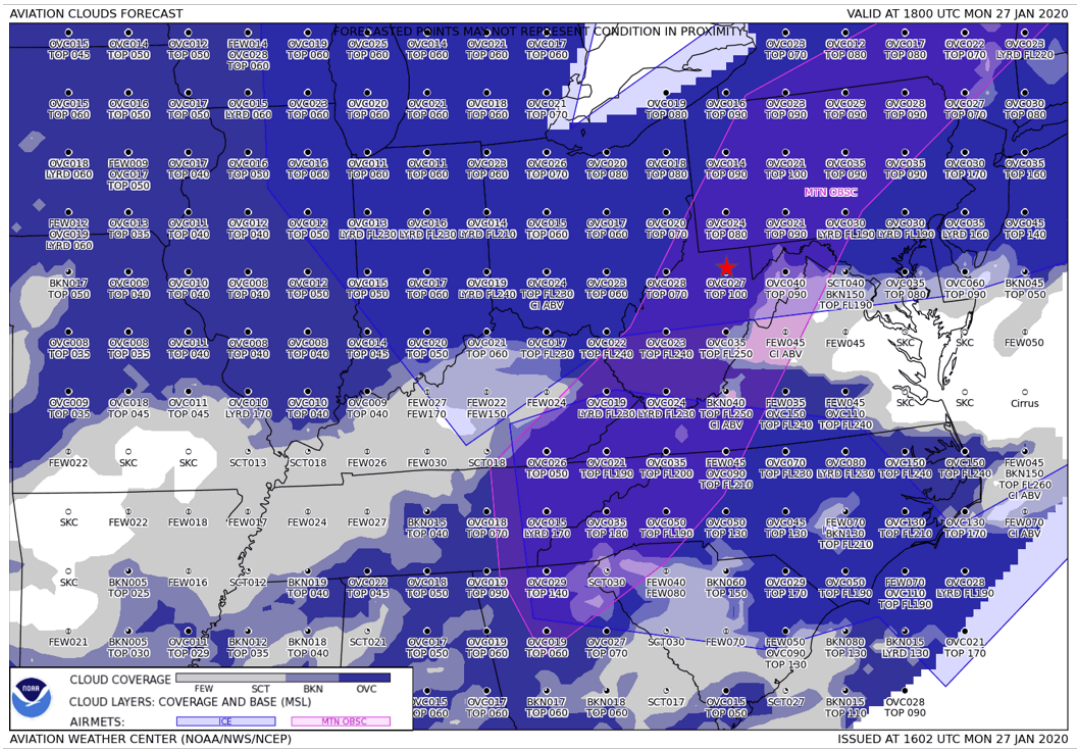

Figure 10 - Graphic Forecast for Aviation Cloud Cover issued at 1102 EST and valid for 1300 EST

6.4 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft forecast[12] valid for 1300 EST and for use between 0900 and 1600 EST was as follows for the general route of flight.

WINDS ALOFT FORECASTS
DATA BASED ON 271200Z
VALID 271800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	*3000*	*6000*	*9000*	*12000*	*18000*	*24000*	*30000*	*34000*	*39000*
EKN		*2926-08*	*2935-09*	*2934-14*	*2822-25*	*2827-38*	*273846*	*284845*	*295043*
AGC	*2917*	*3021-08*	*3124-10*	*3126-14*	*3321-25*	*3123-37*	*292948*	*283946*	*294243*
CRW	*2711*	*2925-04*	*2929-09*	*2827-15*	*2718-27*	*2820-39*	*284043*	*284843*	*295544*

The closest station was Elkins-Randolph County Airport (KEKN), Elkins, West Virginia, at an elevation of 1,987 ft located approximately 32 miles south of the accident site. The first forecast level above 1,500 ft of the surface was for 6,000 ft which expected a wind from 290° at 26 knots with a temperature of -8° C, for 9,000 ft the wind was from 290° at 35 knots with a temperature of -9° C.

7.0 NWS Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of the development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA ARTCCs. There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the AIRMET, and the Center Weather Advisory (CWA). Inflight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft. The following advisories were current during the period.

During the period the NWS did not issue any SIGMETs, Convective SIGMETs or CWA's for any severe conditions. However, the NWS had a series of G-AIRMETs current for IFR conditions, mountain obscuration, moderate turbulence between 3,000 ft and 10,000 ft, and moderate icing conditions from the surface through 10,000 ft. Figures 11-13 are the depiction of the G-AIRMETs current during the period.

[12] NWS bulletin FBUS31 KWNO

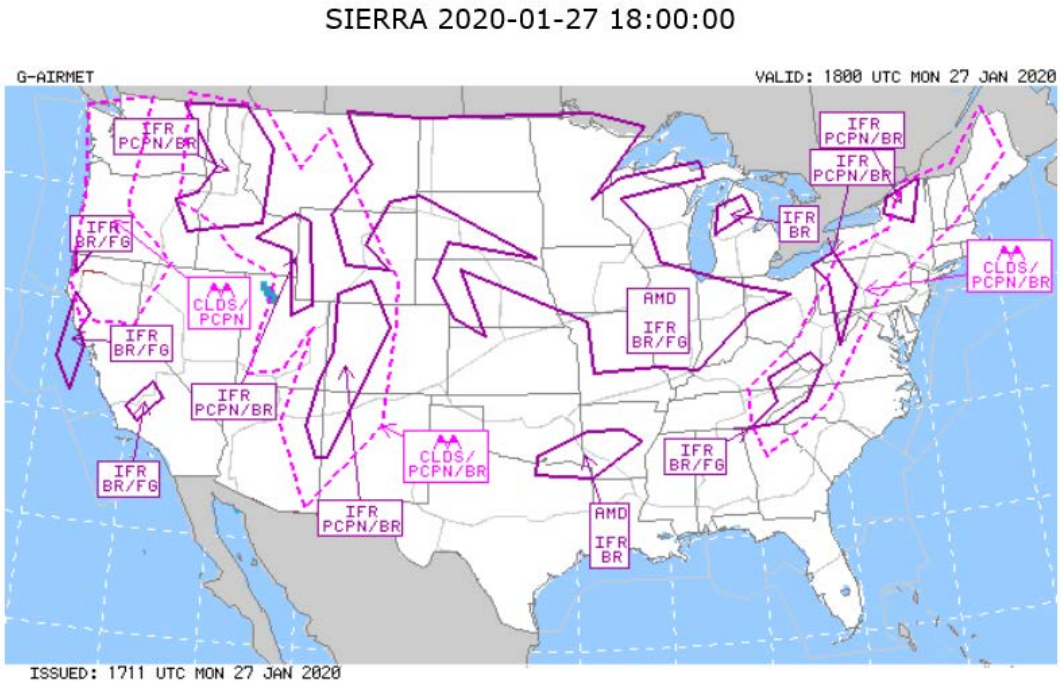

Figure 11 - G-AIRMET Sierra for IFR and mountain obscuration conditions valid for 1300 EST

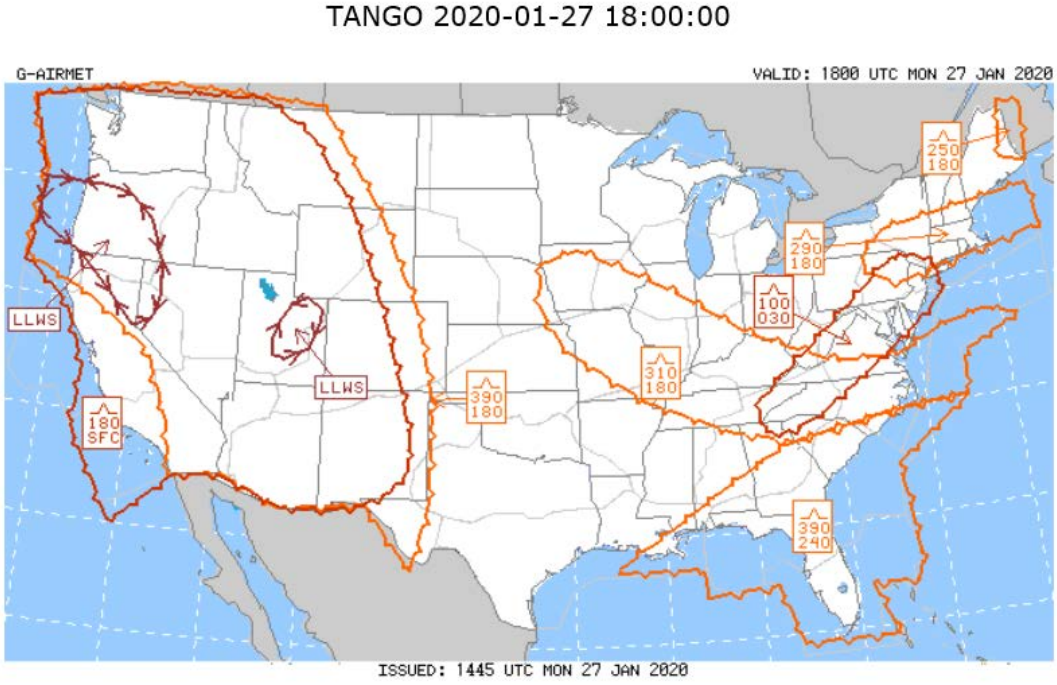

Figure 12 - G-AIRMET Tango for moderate turbulence between 3,000 ft and 10,000 ft valid for 1300 EST

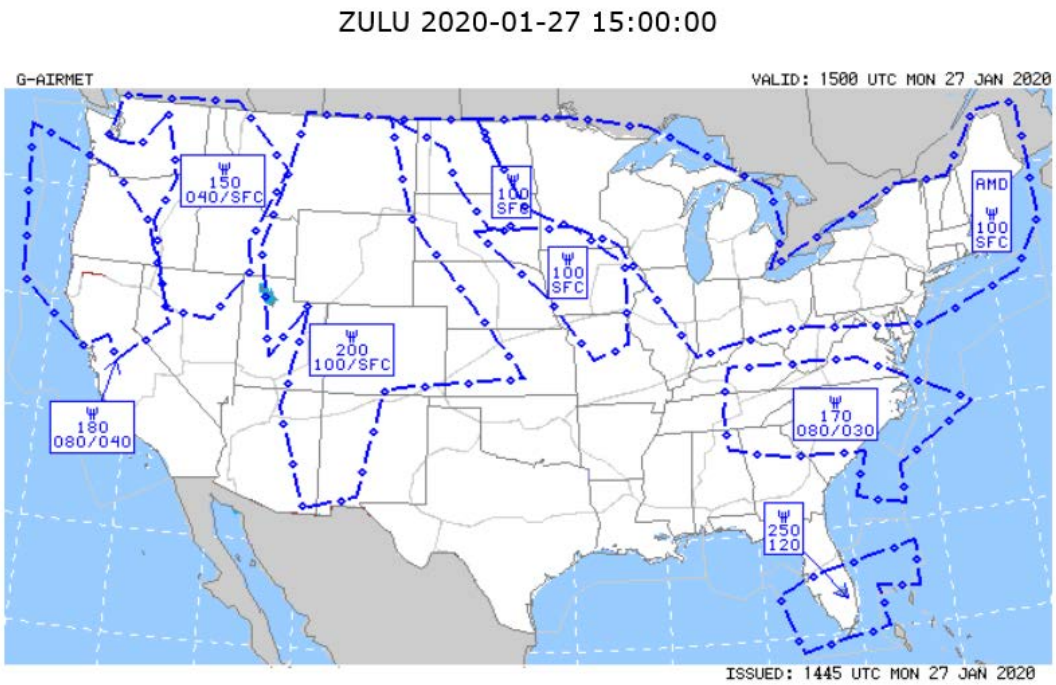

Figure 13 - G-AIRMET Zulu for moderate icing conditions from the surface through 10,000 ft

8.0 Preflight Weather Briefing

A search of the FAA Automated Flight Service Station (AFSS) contract provider Leidos indicated that they had no contact with the pilot of N214K on January 27, 2020 for any weather briefing information, flight plans, or other contact. A separate search of third-party weather vendors ForeFlight and Flt.Plan.com indicated they also had no contact or services provided to the pilot during the period. It is therefore unknown what the accident pilot knew about the weather conditions or familiarized himself with prior to the flight.

9.0 Astronomical Conditions

The astronomical conditions for Clarksburg, West Virginia, were calculated from the United States Naval Observatory's Multiyear Interactive Computer Almanac (MICA) software program for January 27, 2020. The time of the accident has been added in italic bold print for refence.

Sun	
Begin civil twilight	0704 EST
Sunrise	0732 EST
Sun transition	1234 EST
Accident	***1255 EST***
Sunset	1735 EST
End civil twilight	18044 EST

At the time of the accident the Sun was 32° above the horizon at an azimuth of 186°.

Submitted by:

_____

Don Eick
Senior Meteorologist