NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 12, 2015

Group Chairman's Weather Study

METEOROLOGY

CEN15FA060

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A. ACCIDENT

Location: Boonville, Missouri
Date: November 30, 2014
Time: About 0900 central standard time (1500 UTC[1])
Airplane: Bellanca Viking 17-30A; registration N6629V

B. METEOROLOGY GROUP

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C. SUMMARY

On November 30, 2014, about 0900 central standard time, a Bellanca model 17-30A airplane, N6629V, was substantially damaged when it collided with terrain during landing approach to runway 36 at Jesse Viertel Memorial Airport (VER), Boonville, Missouri. The commercial pilot was fatally injured and his 3 passengers were seriously injured. The airplane was registered to and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 without a flight plan. Day visual meteorological conditions prevailed for the cross-country flight that departed Spirit of St. Louis Airport (SUS), Chesterfield, Missouri, about 0738, and was originally destined for Charles B. Wheeler Downtown Airport (MKC), Kansas City, Missouri.

According to one of the surviving passengers, while enroute at an altitude of 2,000 to 3,000 feet mean sea level, the flight encountered a line of "dense clouds" near Sedalia, Missouri. The pilot attempted to navigate beneath the clouds, at an altitude of about 1,500 feet msl, before deciding to make a course reversal and locate a nearby airport to divert to. The pilot told the passenger, who was seated in the forward-right seat, to be on the lookout for towers and obstructions because of their low proximity to the ground. The passenger reported that after flying east for a few minutes the pilot identified VER on his tablet computer. The flight approached the airport traffic pattern from the west and made a left base-to-final turn toward runway 36. The passenger reported that the pilot extended the landing gear without any difficulties. However, when the pilot reduced engine power, in attempt to reduce airspeed, the engine experienced a loss of power. The pilot was able to briefly restore engine power by advancing the throttle, but the engine quickly lost total power. The passenger reported that the pilot then began making rapid changes to the engine throttle and mixture control without any noticeable effect to engine operation. The passenger stated that the airplane eventually "stalled completely", about 250 feet above the ground, as the pilot prepared for a forced landing; however, the passenger did not recall the airplane impacting terrain.

[1] UTC – is an abbreviation for Coordinated Universal Time.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) 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 and the National Climatic Data Center (NCDC). All times are central daylight time (CST) based upon the 24 hour clock, local time +6 hours to UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS airport and station identifiers use standard International Civil Aviation Organization (ICAO) 4-letter station identifiers versus International Air Transport Association (IATA) 3-letter identifiers which deletes the initial country code designator "K" for U.S. airports.

The accident site was estimated at latitude 38.9466° N and longitude -92.6827° W.

E. FACTUAL INFORMATION

1.0 Synoptic Situation

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) 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 00-45G.

1.1 Surface Analysis Chart

A section of the NWS Surface Analysis Chart for 0900 CST (1500Z) on November 30, 2014 centered over Missouri is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a cold front stretching northeast to southwest across the state and in the immediate vicinity of the accident site. A high pressure system at 1029-hectopascals (hPa) was located over South Dakota with a ridge extending to the south-southeast of the high behind the front. The station models depicted a defined wind shift from the south to the north-northwest behind the cold front, with low clouds and visibility restricted in fog and mist behind the front with falling temperatures.

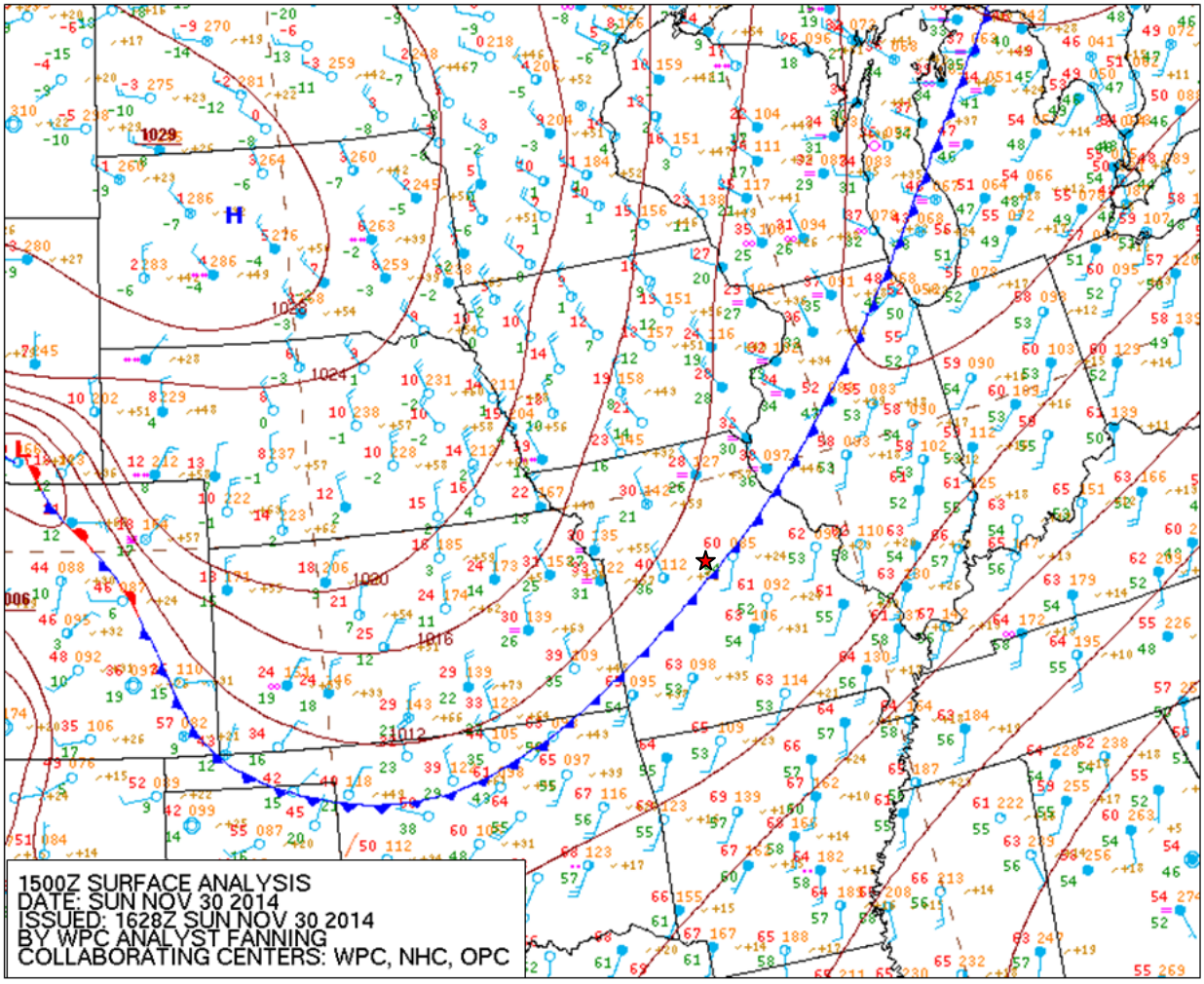

Figure 1 - NWS Surface Analysis Chart for 0900 CST

1.2 Weather Radar Mosaic

The National Center for Atmospheric Research (NCAR) - Research Application Laboratory (RAL) regional radar mosaic image indicated no significant weather echoes over the region associated with precipitation surrounding the period and was therefore not included or documented.

1.3 NWS Constant Pressure Charts

The NWS 850-hPa Constant Pressure Charts for 0600 CST (1200Z) on November 30, 2014 is included as figure 2 and depicted the general conditions at approximately 5,000 feet. The chart depicted a short wave trough extending south-southwestward over western Missouri associated with the cold front moving across the region. The isotherms or lines of equal temperature on the chart depicted a 35° C temperature decrease to the northwest behind the system. The station

models across central Missouri indicated temperatures above freezing near 10° C with dry air and wind from the west-southwest at 20 to 45 knots.

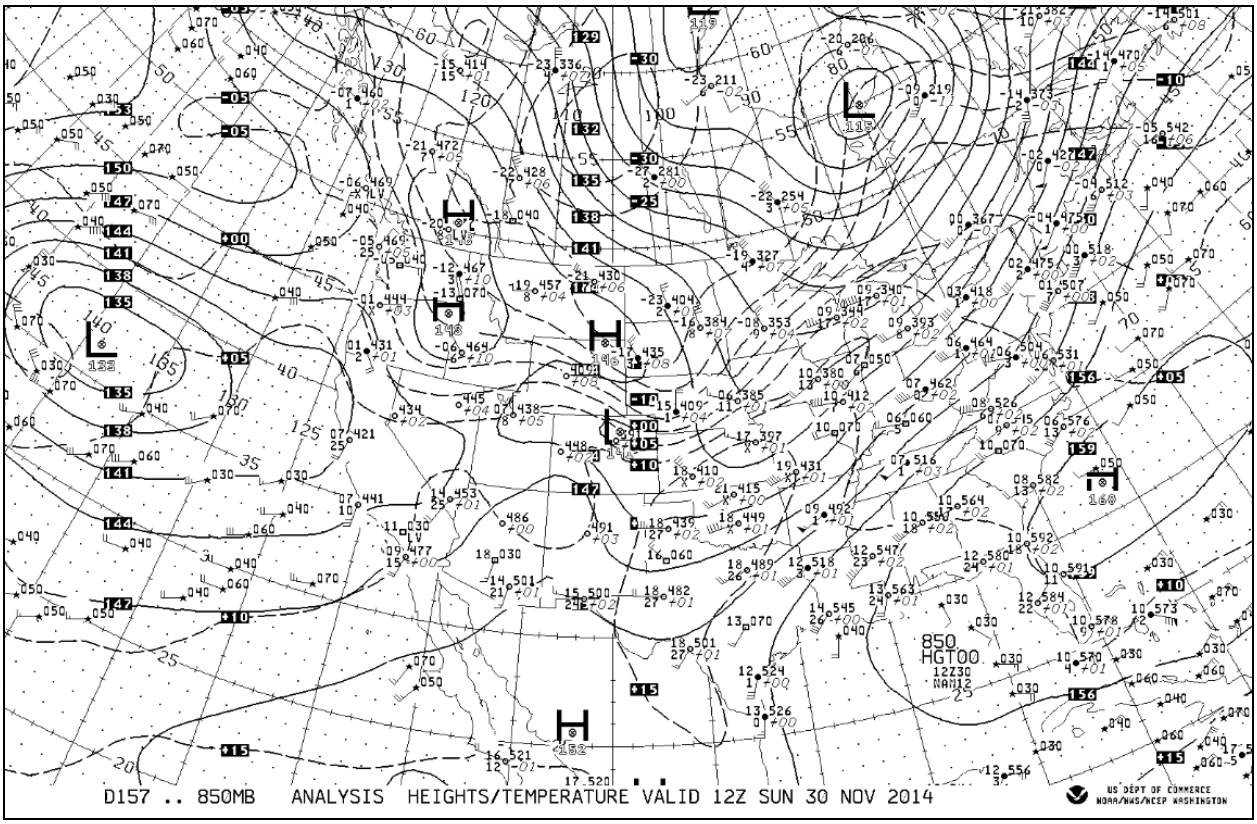

Figure 2- NWS 850-hPa Constant Pressure Chart for 0600 CST

1.4 12-hour Prognostic Chart

The NWS 12- and 24-hour Low Level Significant Weather Prognostic Chart valid for the period is included as figure 3, and depicted the forecast pressure system, fronts, and precipitation expected during the period. The 12-hour surface forecast (bottom left) depicted the cold front across central Missouri with no expected precipitation. Behind the front the isobars or lines of equal pressure indicated a strong pressure gradient associated with strong north-northwest winds on the cold air side of the front. Winter weather conditions were indicated over northern Colorado and Wyoming westward into California with snow. The chart also depicted a large area of MVFR conditions over Missouri during the period (top left). The 24-hour forecast on the right side of the chart depicted developing precipitation over Missouri with freezing rain and rain immediately south of the St. Louis area and across central Missouri. The flight conditions expected MVFR to IFR conditions over central and eastern Missouri during the evening.

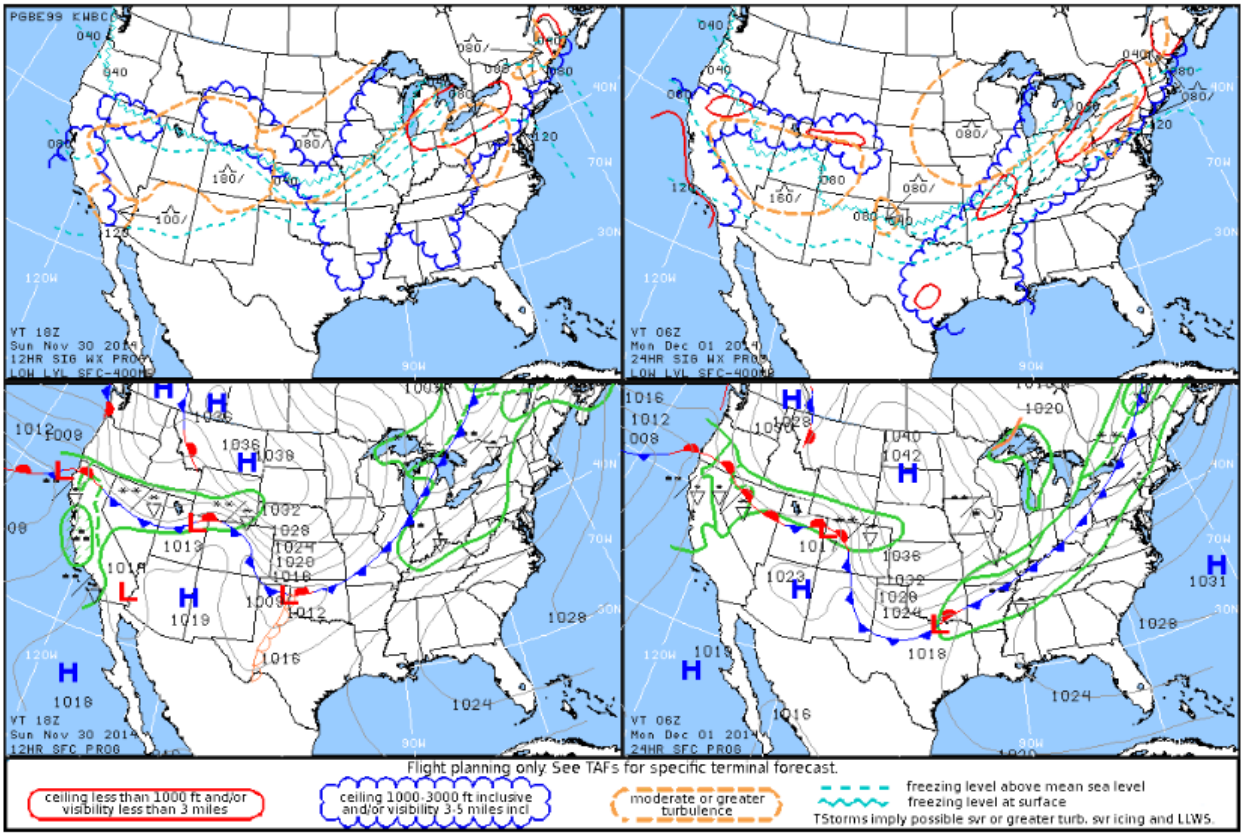

Figure 3 - NWS Low-level Significant Weather Prognostic Chart valid for the period

2.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for the departure and the closest airport to the accident site. The cloud heights are reported above ground level (agl).

2.1 Jesse Biertel Memorial Airport (KVER) Boonville, MO

The accident airplane was reported as having encountering low ceilings and visibilities attempting to turn back to the east and was attempting to land at Jesse Biertel Memorial Airport (KVER) in Boonville, Missouri, and crashed approximately ¼ mile south-southwest of the airport. The airport had a single north to south runway 18/36 at an elevation of 715 feet, and had an Automated Weather Observation System (AWOS) and disseminated observation every 20 minutes. The following weather conditions were reported at the time of the accident:

Jesse Biertel Memorial Airport (KVER) weather observation at 0855 CST (1455Z), automated, wind from 310° at 13 knots gusting to 16 knots, visibility 10 miles, ceiling broken[2] at

[2] Ceiling – is defined as the lowest layer of clouds reported as broken, overcast, or the vertical visibility into a surfaced based obscuration.

2,600 feet agl, broken at 3,400 feet, and overcast at 4,100 feet, temperature 11° Celsius (C), dew point temperature 7° C, altimeter 29.82 inches of mercury (Hg). Remarks: automated observation system, temperature 10.7° C, dew point 7.3° C.

The raw observations surrounding the period with the general flight categories[3] follow. Immediately after the accident between 0935 and 0954 CST (1535Z-1654Z) no ceiling or sky conditions were reported by the system for unknown reasons, thus the flight category could not be determined although visibility was obscured due to mist and met the MVFR flight category. The observations were as follows:

VFR *METAR KVER 301155Z AUTO 19004KT 10SM CLR 11/10 A2970 RMK AO2 T01110102 10204 21110=*

VFR *METAR KVER 301215Z AUTO 18004KT 10SM CLR 12/11 A2970 RMKAO2 T01160105=*

VFR *METAR KVER 301235Z AUTO 19004KT 10SM CLR 12/11 A2971 RMK AO2 T01160105=*

VFR *METAR KVER 301255Z AUTO 19003KT 10SM CLR 12/11 A2972 RMK AO2 T01200107=*

VFR *METAR KVER 301315Z AUTO 00000KT 10SM CLR 12/11 A2974 RMK AO2 T01210109=*

VFR *METAR KVER 301335Z AUTO 20004KT 10SM CLR 12/11 A2975 RMK AO2 T01200107=*

VFR *METAR KVER 301355Z AUTO 20003KT 10SM CLR 13/11 A2975 RMK AO2 T01260107=*

MVFR *METAR KVER 301415Z AUTO 28005KT 10SM BKN027 BKN036 13/11 A2978 RMK AO2 T01290105=*

MVFR *METAR KVER 301435Z AUTO 30009G14KT 10SM OVC024 13/11 A2979 RMK AO2 T01330106=*

MVFR *METAR KVER 301455Z AUTO 31013G16KT 10SM BKN026 BKN034 OVC041 11/07 A2982 RMK AO2 T01070073=*

Accident

MVFR *METAR KVER 301515Z AUTO 32010G15KT 10SM SCT021 BKN028 OVC043 08/05 A2984 RMK AO2 T00760045=*

UNK *METAR KVER 301535Z AUTO 31014G18KT 10SM 06/04 A2987 RMK AO2 T00640039=*

UNK *METAR KVER 301615Z AUTO 31009KT 5SM BR 03/02 A2991 RMK AO2 T00330018=*

UNK *METAR KVER 301635Z AUTO 31008KT 5SM BR 03/01 A2993 RMK AO2 T00260012=*

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[3] As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 feet 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 feet agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 feet agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 feet 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 feet agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

IFR METAR KVER 301655Z AUTO 31008KT 5SM BR OVC007 02/01 A2993 RMK AO2 T00210009=

2.2 Sedalia Memorial Airport (KDMO), Sedalia, MO

One of the passengers indicated that the flight encountered a line of dense low clouds in the vicinity of Sedalia, Missouri, before turning back to the east. At the time Sedalia Memorial Airport (KDMO) reported the following conditions:

Sedalia Memorial Airport (KDMO) weather observation at 0853 CST (1453Z), automated, wind from 330° at 14 knots, visibility 10 miles, ceiling broken at 1,700 feet agl, broken at 2,400 feet, overcast at 3,000 feet, temperature 7° C, dew point 4° C, altimeter 29.84 inches of Hg.

Within an hour ceilings of 800 feet and lower were reported, and continued to decrease to LIFR conditions. The raw observations and flight categories were as follows:

VFR METAR KDMO 301153Z AUTO 22007KT 10SM CLR 14/11 A2971 RMK AO2 SLP058 T01440106 10161 20144 53017

VFR METAR KDMO 301253Z AUTO 21008KT 10SM CLR 14/11 A2973 RMK AO2 SLP065 T01390106

VFR METAR KDMO 301353Z AUTO 24008KT 10SM CLR 15/11 A2977 RMK AO2 SLP077 T01500111

MVFR SPECI KDMO 301429Z AUTO 31012G19KT 10SM SCT015 BKN028 OVC034 09/06 A2981 RMK AO2 PRESRR T00940061

MVFR METAR KDMO 301453Z AUTO 33014KT 10SM BKN017 BKN024 OVC030 07/04 A2984 RMK AO2 SLP105 T00720039 53043

Accident

MVFR SPECI KDMO 301522Z AUTO 33018KT 10SM SCT008 OVC023 06/03 A2987 RMK AO2 T00560033

IFR SPECI KDMO 301535Z AUTO 33014KT 10SM BKN008 OVC023 06/03 A2988 RMK AO2 T00560033

IFR METAR KDMO 301553Z AUTO 33016KT 5SM BR OVC005 04/02 A2991 RMK AO2 PRESRR SLP129 T00390022

LIFR METAR KDMO 301653Z AUTO 35015KT 3SM BR OVC004 02/01 A2994 RMK AO2 SLP141 T00220006

2.3 Charles B. Wheeler Downtown Airport (KMKC), Kansas City, MO

The planned destination was the Charles B. Wheeler Downtown Airport (KMKC), Kansas City, located approximately 90 miles west of the accident site at an elevation of 757 feet. The airport had an Automated Surface Observation System (ASOS) and was augmented by human observers and reported the following conditions at the time of departure and at the time of the accident:

Charles B. Wheeler Downtown Airport (KMKC) weather observation at 0634 CST (0728Z), wind from 010° at 9 knots, visibility 7 miles, ceiling overcast at 800 feet agl, temperature 2° C,

dew point 0° C, and altimeter 29.79 inches of Hg. Remarks; automated observation system, ceiling 700 variable 1,000 feet, temperature 2.2° C, dew point 0.0° C.

Charles B. Wheeler Downtown Airport weather observation at 0854 CST (1454Z), wind from 360° at 15 knots, visibility 4 miles in haze, ceiling overcast at 800 feet agl, temperature 1° C, dew point -2° C, and altimeter 29.92 inches of Hg. Remarks; automated observation system, sea level pressure 1013.5 hPa, temperature 0.6° C, dew point -2.2° C, 3-hour pressure tendency risen 5.7 hPa.

The following are the raw observations and general flight categories surrounding the period:

VFR METAR KMKC 301154Z 35012KT 10SM CLR 02/M01 A2975 RMK AO2 SLP076 T00221006 10139 20022 53045=

MVFR SPECI KMKC 301211Z 34007KT 8SM BKN011 02/M01 A2977 RMK AO2 T00221011=

Departure 1328Z

IFR SPECI KMKC 301234Z 01009KT 7SM OVC008 02/00 A2979 RMK AO2 CIG 007V010 T00220000=

IFR METAR KMKC 301254Z 36012KT 6SM BR OVC007 03/01 A2981 RMK AO2 SLP095 T00280006=

IFR METAR KMKC 301354Z 02013G20KT 5SM BR OVC007 01/M01 A2987 RMK AO2 SLP115 T00111011=

IFR METAR KMKC 301454Z 36015KT 4SM HZ OVC008 01/M02 A2992 RMK AO2 SLP135 T00061022 53057=

Accident 1500Z

MVFR SPECI KMKC 301540Z 35011G20KT 7SM OVC010 00/M03 A2996 RMK AO2 T00001033=

MVFR METAR KMKC 301554Z 36010KT 8SM OVC010 00/M03 A2997 RMK AO2 SLP152 T00001033=

MVFR METAR KMKC 301654Z 36011KT 8SM OVC013 00/M04 A3002 RMK AO2 SLP168 T00001039=

2.4 Surrounding Conditions

The following is a depiction of the weather conditions as reported by the NWS Aviation Weather Center's Experimental Helicopter Emergency Medical System (HEMS) Weather Tool for the area across central Missouri at 0900 CST or the approximate time of the accident. The station circles are colored coded depicting the general flight categories. Where black is VFR, blue for MVFR, red for IFR, pink for LIFR, and green for not reporting. The image depicts MVFR to LIFR condition from Boonville into the Kansas City area, and eastern Kansas.

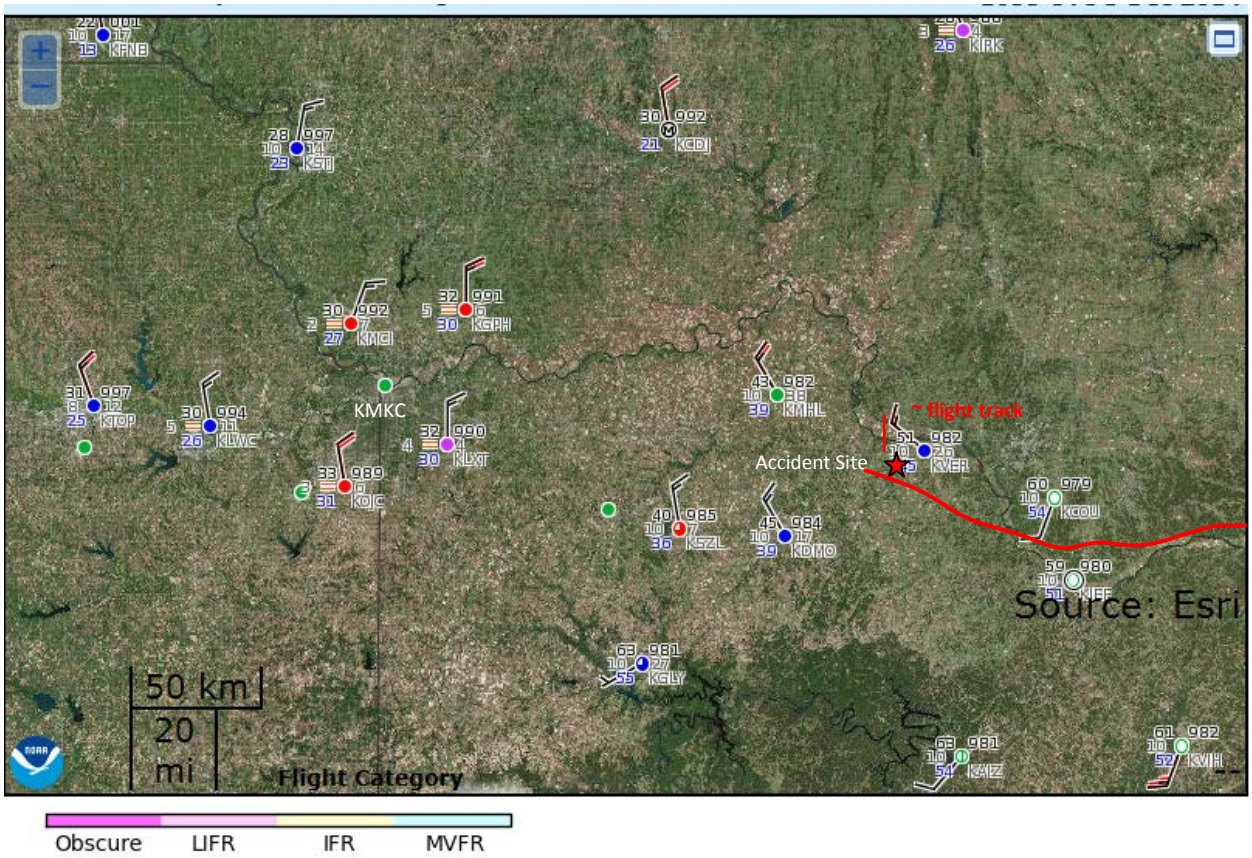

Figure 4 - Plot of observations and flight categories at 0900 CST near accident site

At the approximate time of the accident the observations across central Missouri indicated in figure 4 reported the following conditions:

	Rolla National Airport (KVIH), Rolla/Vichy, MO
VFR	*KVIH 301453Z AUTO 20015G24KT 10SM CLR 16/11 A2982*
	Jefferson City Memorial Airport (KJEF), Jefferson City, MO
VFR	*KJEF 301453Z 00000KT 10SM CLR 15/11 A2980*
	Lee C. Fine Memorial Airport (KAIZ), Kaiser/Lake Ozark, MO
VFR	*KAIZ 301455Z AUTO 22010KT 10SM FEW033 17/12 A2981*
	Columbia Regional Airport (KCOU), Columbia, MO
VFR	*KCOU 301454Z 20011KT 10SM CLR 16/12 A2979*
	Jesse Biertel Memorial Airport (KVER) Boonville, MO
MVFR	*KVER 301455Z AUTO 31013G16KT 10SM BKN026 BKN034 OVC041 11/07 A2982*
	Kirksville Regional Airport (KIRK), Kirksville, MO
LIFR	*KIRK 301455Z AUTO 34011KT 3SM BR OVC004 M02/M03 A2988*
	Sedalia Memorial Airport (KDMO), Sedalia, MO
MVFR	*KDMO 301453Z AUTO 33014KT 10SM BKN017 BKN024 OVC030 07/04 A2984*

	Marshall Memorial Municipal Airport (KMHL), Marshall, MO
VFR	*KMHL 301455Z AUTO 33014KT 10SM OVC038 06/04 A2982*
	Whiteman Air Force Base (KSZL), Knob Noster, MO
IFR	*KSZL 301458Z AUTO 35013KT 10SM BKN007 BKN025 04/02 A2985*
	Clinton Regional Airport (KGLY), Clinton, MO
MVFR	*KGLY 301455Z AUTO 24007KT 10SM BKN027 BKN034 17/13 A2981*
	Lee's Summit Municipal Airport (KLXT), Lee's Summit, MO
LIFR	*KLXT 301453Z AUTO 36016KT 4SM BR OVC004 00/M01 A2990*
	Midwest National Air Center Airport (KGPH), Mosby, MO
IFR	*KGPH 301455Z AUTO 36014G22KT 5SM BR OVC006 00/M01 A2991*
	Charles B. Wheeler Downtown Airport (KMKC), Kansas City
IFR	*KMKC 301454Z 36015KT 4SM HZ OVC008 01/M02 A2992*
	Johnson County Executive Airport(KOJC), Olathe, KS
IFR	*KOJC 301453Z 35011G19KT 3SM BR OVC006 01/M01 A2989*
	Kansas City International Airport (KMCI), Kansas City, MO
IFR	*KMCI 301453Z 02016KT 1 1/2SM BR OVC007 M01/M03 A2992*
	Rosecrans Memorial Airport (KSTJ), St. Joseph, MO
MVFR	*KSTJ 301453Z 01014KT 10SM OVC014 M02/M05 A2997*
	Lawrence Municipal Airport (KLWC), Lawrence, KS
MVFR	*KLWC 301452Z AUTO 35016KT 5SM BR OVC011 M01/M03 A2994*
	Philip Billard Municipal Airport (KTOP), Topeka, KS
MVFR	*KTOP 301453Z 34016G21KT 8SM OVC012 M01/M04 A2997*

Of the stations reporting, Jefferson City (KJEF), Columbia (KCOU), Vichy (VIH), and Kaiser/Lake Ozard (KAIZ) were identified ahead of the cold front with calm or southerly wind, and clear skies. Clinton (KGLY) located to the southwest was near the frontal boundary and reported winds from the west with a ceiling broken. All of the other stations were behind the front and reported winds from the northwest to north, low broken to overcast ceilings with several stations in the Kansas City area reported visibility restrictions in mist with temperatures near freezing.

3.0 Model Sounding

The NOAA Air Resources Laboratory (ARL) archive North American Mesoscale (NAM) model data was utilized to create a sounding over the approximate accident site at 0900 CST on November 30, 2014. The NAM 12 kilometer model data was plotted on a standard Skew-T log P diagram[4] utilizing RAOB[5] software is included as figure 5 from the surface to 500-hPa or 18,000 feet.

[4] Skew T log P diagram – is a standard meteorological plot 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.

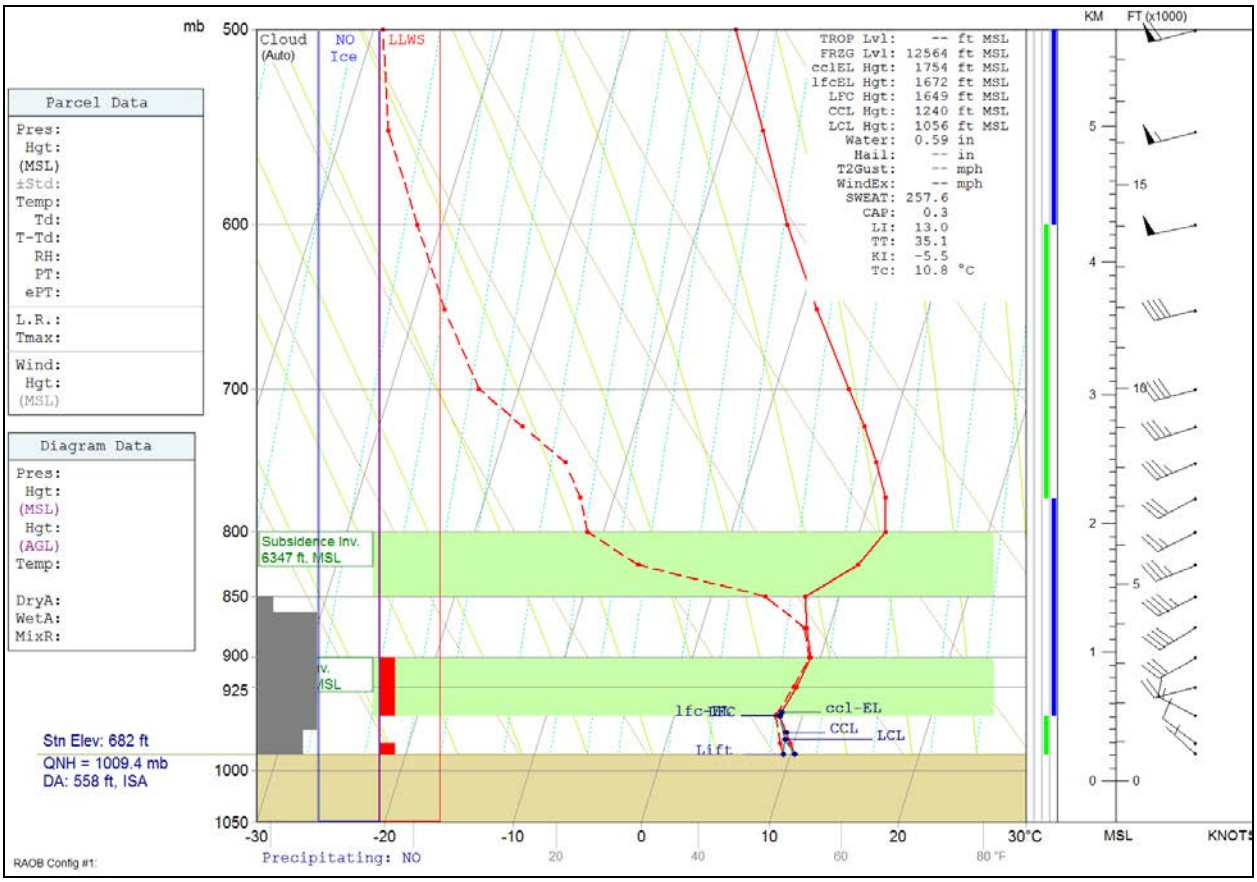

Figure 5 - NAM sounding over the accident site at 0900 CST

The sounding depicted the conditions immediately after frontal passage and indicated a surface wind from northwest, a temperature of 10.3° C, a dew point of 9.4° C, and a relative humidity of 93%. The sounding estimated the lifted condensation level (LCL)[6] at 374 feet agl, a convective condensation level (CCL)[7] at 558 feet agl, and a level of free convection (LFC)[8] at 967 feet agl. Two defined temperature inversions (depicted in green) were identified between 1,700 and 6,400 feet and the freezing level was identified at approximately 12,560 feet. The

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[5] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.

[6] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

[7] Convective Condensation Level (CCL) - The height to which a parcel of air, if heated sufficiently from below, will rise adiabatically until condensation starts. This is typically used to identify the base of cumuliform clouds, which are normally produced from surface heating and thermal convection.

[8] Level of Free Convection (LFC) -The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

sounding had a Lifted Index (LI)[9] of 13.0, and indicated a stable atmosphere with an overcast layer of low stratiform type clouds.

The wind profile indicated a surface wind from 315° at 7 knots with the wind backing to the west-southwest above 2,000 feet and increasing in speed. At 4,600 feet a low-level jet stream was identified with wind from 240° at 47 knots. The mean 0 to 18,000 feet wind was from 250° at 41 knots, and the maximum wind was from 250° at 89 knots at 39,500 feet immediately below the tropopause.

Figure 6 is the summary listing of the sounding along with the potential low-level wind shear (LLWS) and turbulence, where light (L) to moderate (M) was basically expected from 1,600 through 5,000 feet based on the vertical and horizontal wind shears and the presence of the low-level jet stream with a greater than 90% probability of occurrence. No icing was expected based on the height of the freezing level.

Height (ft-MSL)	Pres (mb)	T (C)	Td (C)	RH (%)	DD/FF (deg/kts)	CAT (AF)	LLWS	Icing - Type (S-F clouds)
682	985	10.3	9.4	94	315/7		LIGHT	
961	975	9.7	8.9	95	310/11			
1668	950	8.2	7.9	98	299/14	L-M	LIGHT	
2393	925	8.8	8.6	99	254/19	L-M	LIGHT	
3139	900	9.2	9.1	99	239/30	L-M		
3906	875	8.2	8.0	99	236/40	L-M		
4692	850	7.3	4.2	81	241/47	MDT		
5504	825	10.7	-6.5	29	247/33	L-M		
6347	800	12.0	-11.2	19	242/26	LGT		
7217	775	11.2	-12.6	17	240/29	LGT		
8111	750	9.6	-14.6	17	246/33	LGT		
9030	725	7.8	-18.8	13	251/36			
9974	700	5.7	-23.1	10	254/38			
11945	650	1.3	-27.7	9	256/42			

Figure 6 – Summary listing from sounding

4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison (UW) in Madison, Wisconsin, and processed using the Safety Board's Man-computer Interactive Data Access System (McIDAS) software. Both the infrared long wave and visible band imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 4) at a wavelength of 10.7 microns (μm) provided standard satellite image

[9] Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

with radiative cloud top temperatures with a resolution of 4 km. The visible imagery (band 1) at a wavelength of 0.65 μm provided a resolution of 1 km.

Figure 7 is the GOES-13 visible image at 2X magnification at 0845 CST with the frontal position overlaid. The accident site is marked immediately behind the front and under a layer of stratiform clouds, which extended behind the front westward through the Kansas City area.

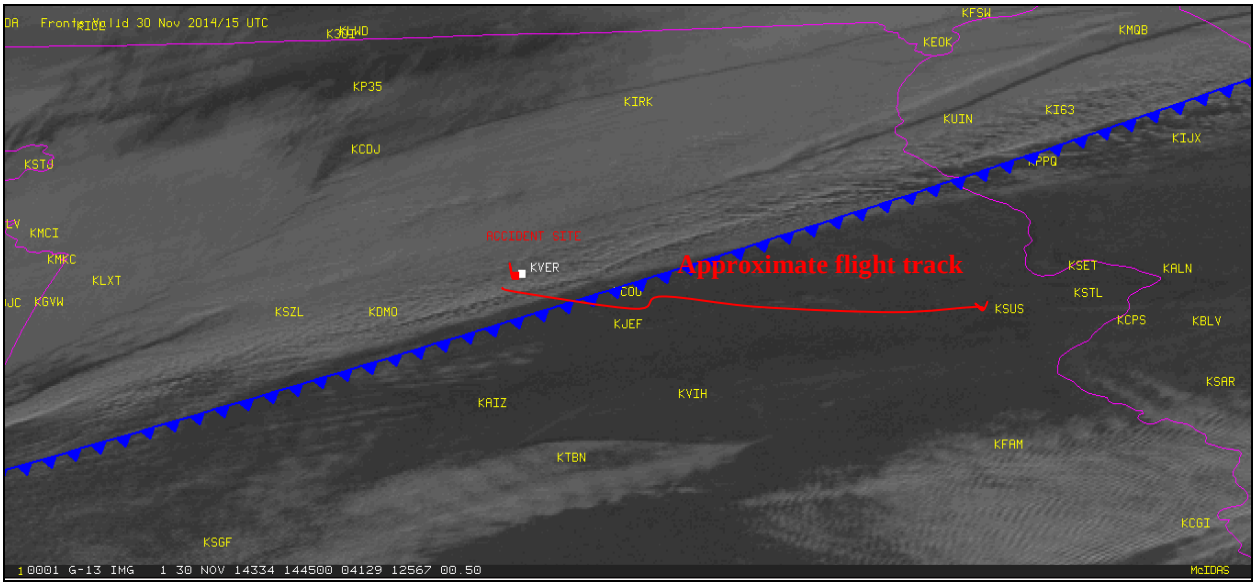


Figure 7 - GOES-13 visible image at 0845 CST with frontal position

The infrared image for the same period indicated a radiative cloud top temperature of 280° Kelvin or 6.84° C over the accident site, which based on the model sounding indicated cloud tops near 5,000 feet.

5.0 Weather Radar Information

The closest Weather Surveillance Radar-1988, Doppler (WSR-88D) to the accident site was from the NWS Kansas City (KEAX) located approximately 74 miles west of the accident site. The level II archive data was obtained from the National Climatic Data Center (NCDC) utilizing the Hierarchical Data Storage System (HDSS) and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

The WSR-88D is a S-band 10 centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width. The WSR-88D operates in several different scanning modes, identified as Mode A used during periods of precipitation and Mode B referred to the clear air mode. During the period of the accident the KEAX radar was operating in the Mode B clear air mode, where the radar makes 5 elevation scans during a ten minute period.

A review of the KEAX WSR-88D 0.5° base reflectivity images during the period identified no significant precipitation echoes during the period; however, the radar did detected a fine line of very light intensity echoes associated with the leading edge of the cold front. Figure 8 is the radar image at 0858 CST with the accident site noted. To the southwest of the accident site and southeast of Knob Noster (KSZL) and Sedalia (KDMO) is a fine line of echoes in the range of 10 to 15 dBZ[10], but due to the range and the elevation of the radar beam is not identifiable over the accident site.

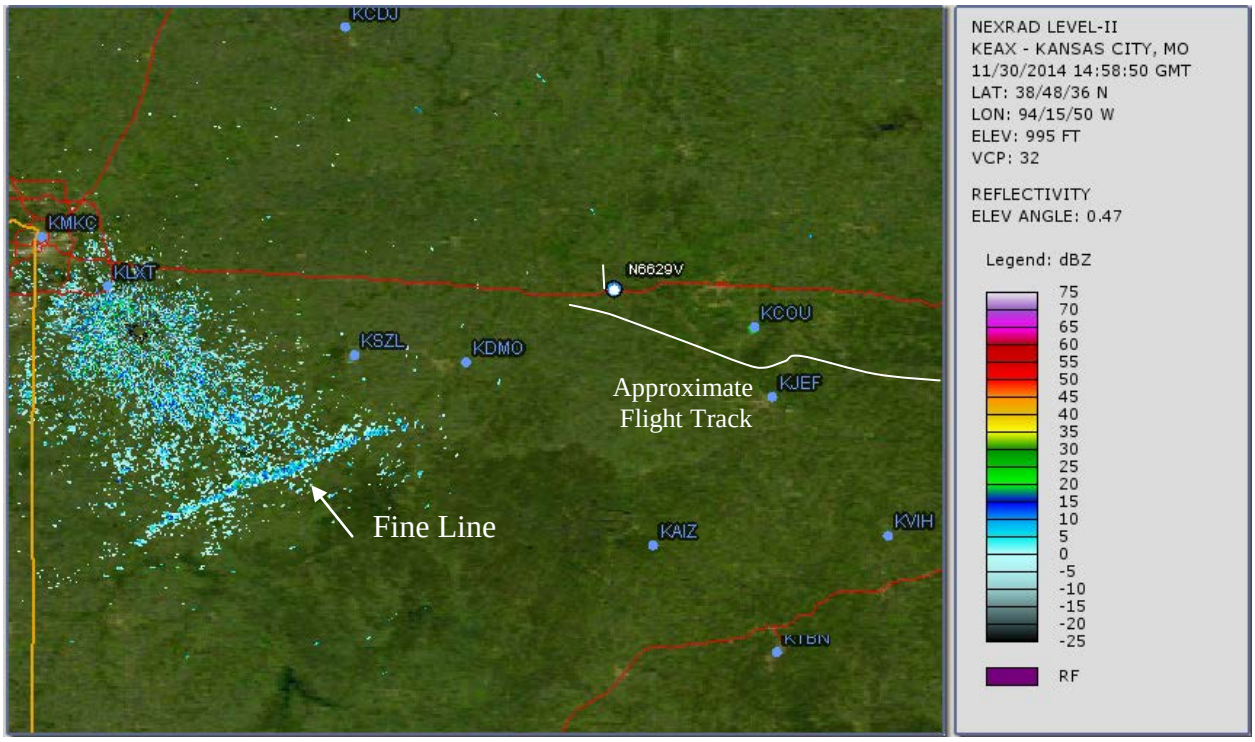


Figure 8 - KEAX WSR-88D 0.5° base reflectivity image at 0858 CST

6.0 Pilot Reports

The following pilot reports (PIREPs) were recorded over Missouri surrounding the period between 0600 and 1230 CST. The reports were as follows:

CPS UUA /OV CPS /TM 1438 /FL015 /TP AA5 /RM LLWS -10KT GPS RY2R=

Accident 1500Z

MCI UA /OV MCI360010 /TM 1607 /FLUNKN /TP DC10 /TA M03 /IC LGT RIME 025-035=

MCI UA /OV MCI360004 /TM 1646 /FLUNKN /TP B737 /SK OVC022-TOP033=

COU UA /OV COU360035 /TM 1649 /FL080 /TP C210 /SK OVCUNKN-TOP070/TB NEG=

MKC UA /OV MKC215003 /TM 1707 /FLUNKN /TP C182 /TA M02 /IC LGT MX=

[10] dBZ - 10 log Ze

MCI UA /OV MCI360005 /TM 1823 /FLUNKN /TP A319 /SK OVC032-TOP040 /TA 03 /IC TRACE RIME /RM DURC=

7.0 Terminal Aerodrome Forecast

The closest NWS Terminal Aerodrome Forecast (TAF) to the accident site was issued for Columbia Regional Airport (KCOU), Columbia, Missouri located approximately 23 miles east at an elevation of 889 feet. The TAF issued at 0539 CST expected wind from the south or 190° at 9 knots, visibility better than 6 miles, with skies clear, and wind shear at 2,000 feet with the wind from 230° at 40 knots. At 1000 CST a wind shift to the northwest or from 320° at 13 knots gusting to 22 knots, visibility unrestricted, with a ceiling broken at 1,000 feet agl. The raw forecast was as follows:

TAF KCOU 301139Z 3012/0112 19009KT P6SM SKC WS020/23040KT
FM301600 32013G22KT P6SM BKN010
FM302000 34014G24KT P6SM BKN015
FM010100 35013G22KT P6SM BKN025
FM010600 36013G22KT P6SM SCT030 BKN120=

The forecast was amended at 0826 CST and expected a wind shift to the west at 0900 CST or from 270 at 11 knots, visibility unrestricted and a ceiling broken at 3,000 feet. AT 1000 CST IFR conditions with wind from 320 at 13 knots gusting to 22 knots, visibility 5 miles in mist, with a ceiling overcast at 800 feet agl and continue through 1400 CST. The amended forecast was as follows:

TAF AMD KCOU 301426Z 3014/0112 19009KT P6SM SKC WS020/23040KT
FM301500 27011KT P6SM BKN030
FM301600 32013G22KT 5SM BR OVC008
FM302000 34014G24KT P6SM BKN015
FM010100 35013G22KT P6SM BKN025
FM010600 36013G22KT P6SM SCT030 BKN120=

The forecast for the planned destination of Charles B. Wheeler Downtown Airport (KMKC), Kansas City issued at 0523 CST expected wind from 350° at 15 knots gusting to 25 knots, visibility better than 6 miles, with a ceiling broken at 900 feet agl through 0900 CST, with temporary ceilings broken at 1,500 feet during the period. Between 0900 and 1100 CST the forecast expected wind from 350° at 14 knots gusting to 22 knots, visibility unrestricted, ceiling broken at 2,500 feet. The forecast was as follows:

TAF KMKC 301123Z 3012/0112 35015G25KT P6SM BKN009
TEMPO 3014/3015 BKN015
FM301500 35014G22KT P6SM BKN025
FM301700 36012G20KT P6SM SCT030
FM010000 36012KT P6SM SKC=

The forecast was amended at 0803 CST with minor changes, lowering the ceiling to 800 feet through 0900 CST. The updated forecast was as follows:

TAF AMD KMKC 301403Z 3014/0112 01015G25KT P6SM BKN008

TEMPO 3014/3015 BKN015
FM301500 35014G22KT P6SM BKN025
FM301700 36012G20KT P6SM SCT030
FM010000 36012KT P6SM SKC=

8.0 Area Forecast

The Area Forecast (FA) is a forecast of visual Flight Rules (VFR) clouds and weather conditions over an area as large as the size of several states. It must be used in conjunction with the AIRMET Sierra (IFR) bulletin for the same area in order to get a complete picture of the weather. The area forecast together with the AIRMET Sierra bulletin are used to determine forecast enroute weather and to interpolate conditions at airports which do not have a terminal forecast (TAF) issued. The NWS Aviation Weather Center (AWC) located in Kansas City, Missouri, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The Chicago (KCHI) regional forecast that was current at the time of the accident was issued at 0445 CST and valid through 1700 CST on November 30, 2014. The forecast was as follows:

FAUS43 KKCI 301045
FA3W
-CHIC FA 301045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 010500
CLDS/WX VALID UNTIL 302300...OTLK VALID 302300-010500
ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY
.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.
.
SYNOPSIS...LOW PRES ERN UPR MI. COLD FNT ERN UPR MI-ERN WI-SE IA-NRN MO-CNTRL KS. 21Z COLD FNT SRN LH-SRN LWR MI-CNTRL IL-SRN MO. HIGH PRES RIDGE WRN SD-WRN NE-WRN KS. 05Z COLD FNT SRN IN-WRN KY. HIGH PRES RIDGE WRN ND-CNTRL SD-CNTRL NE-CNTRL KS.
.
MO
NW...BKN020 TOP 035 SCT CI. 15Z BKN030 SCT CI. WND N G25KT. 18Z SCT040 BKN CI. OTLK...VFR.
NE...SCT CI. 16Z BKN025 TOP 040 SCT CI. AFT 19Z WND NW G25KT. OTLK...MVFR CIG.
SW...SKC. WND S 25G40KT. 15Z SCT040 SCT CI. WND SW G25KT. 22Z SCT035 SCT CI. WND NW G25KT. OTLK...MVFR CIG.
SE...SCT025. WND S G25KT. 15Z BKN025 TOP 040. OTLK...MVFR CIG.

The forecast for Missouri expected broken clouds from 2,000 to 3,000 feet with tops near 3,500 feet, with winds from the north to northwest at 25 knots. The forecast was amended by AIRMET Sierra series for IFR conditions.

9.0 In-Flight Weather Advisories

The NWS issues in-flight weather advisories designated as Severe Weather Forecast Alerts (AWW's), Convective SIGMET's (WST's), SIGMET's (WS's), Center Weather Advisories (CWA's), and AIRMET's (WA's). In-flight 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.

No SIGMETs, Weather Watches, or Center Weather Advisories were issued surrounding the period of the accident; however, a series of AIRMETs were issued for the region. The following graphic images enclose the hazard areas and are followed by the appropriate advisory.

AIRMETs

AIRMET Sierra update 2 was issued at 0245 CST and valid through 0900 CST for an area of low ceilings below 1,000 feet and visibility below 3 miles in mist. The following graphic or G-AIRMET identifies the area of the advisory.

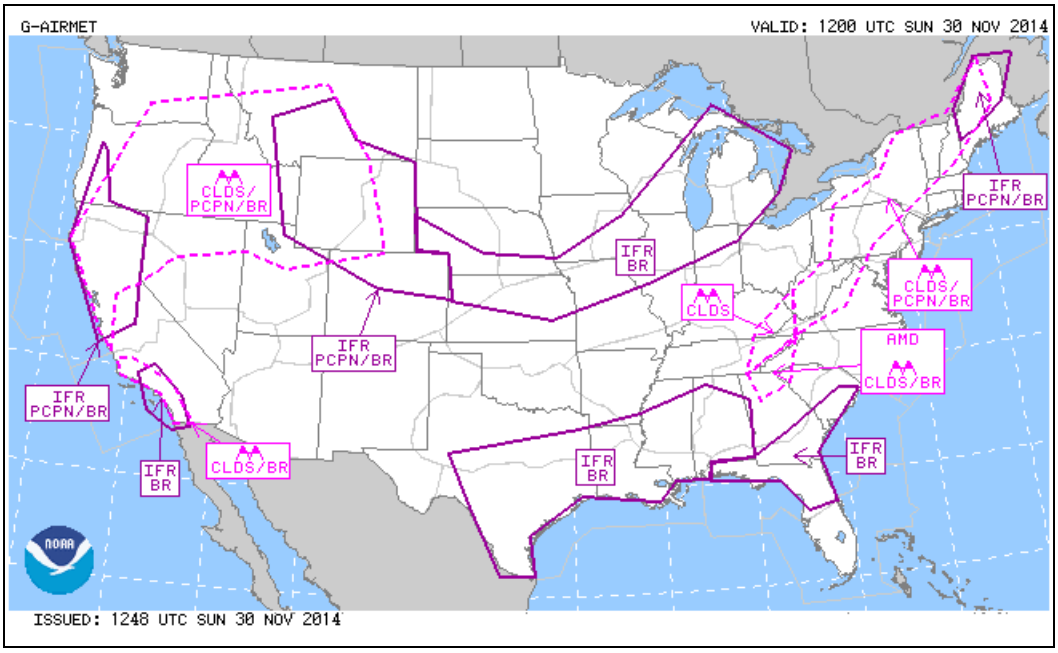


Figure 9 - AIRMET Sierra for IFR conditions

WAUS43 KKCI 300845 *2014334 0841*
WA3S
-CHIS WA 300845
AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 301500
.
AIRMET IFR...SD NE KS MN IA MO WI LM LS MI LH IL IN
FROM 30SE YQT TO YVV TO 30SE ECK TO 20WSW FWA TO 40NNE STL TO 40SW ICT TO 60SE LAA TO 40E SNY TO 50SSW BFF TO 60WNW RAP TO 50W OBH TO 40SW FOD TO 20SSE DLH TO 30SE YQT

CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 15Z THRU 21Z.

.

AIRMET MTN OBSCN...KY TN
FROM HNN TO HMV TO GQO TO LOZ TO HNN
MTNS OBSC BY CLDS. CONDS DVLPG 09-12Z. CONDS CONTG BYD 15Z THRU 21Z.

The accident site was also under AIRMET Tango for low-level wind shear as identified in the Columbia TAF. The G-AIRMET and advisories follows.

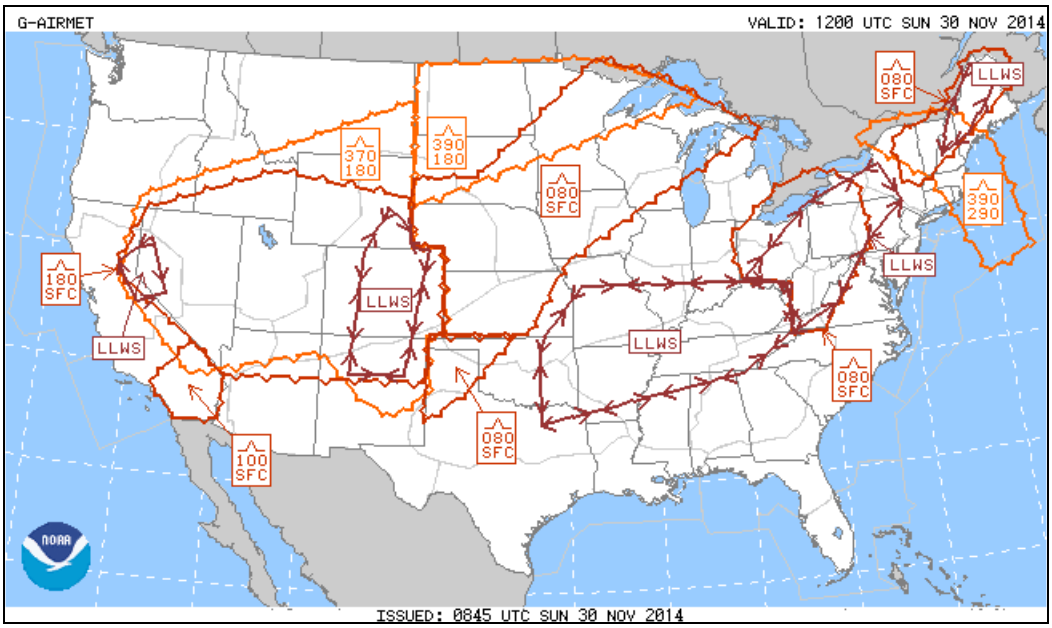


Figure 10 - NWS AIRMET Tango for Turbulence and LLWS

WAUS43 KKCI 300845 *2014334 0840*
WA3T
-CHIT WA 300845
AIRMET TANGO UPDT 1 FOR TURB AND LLWS VALID UNTIL 301500

.

AIRMET TURB...ND SD NE KS MN IA MO WI LM LS MI LH IL
FROM 40NNW INL TO YQT TO SSM TO 50NW YVV TO 20W MKG TO MCI TO 60SE ICT TO 50W LBL TO 50E SNY TO 50SSW BFF TO 60NW RAP TO 20NW PIR TO 40NNW INL
MOD TURB BLW 080. CONDS CONTG BYD 15Z THRU 21Z.

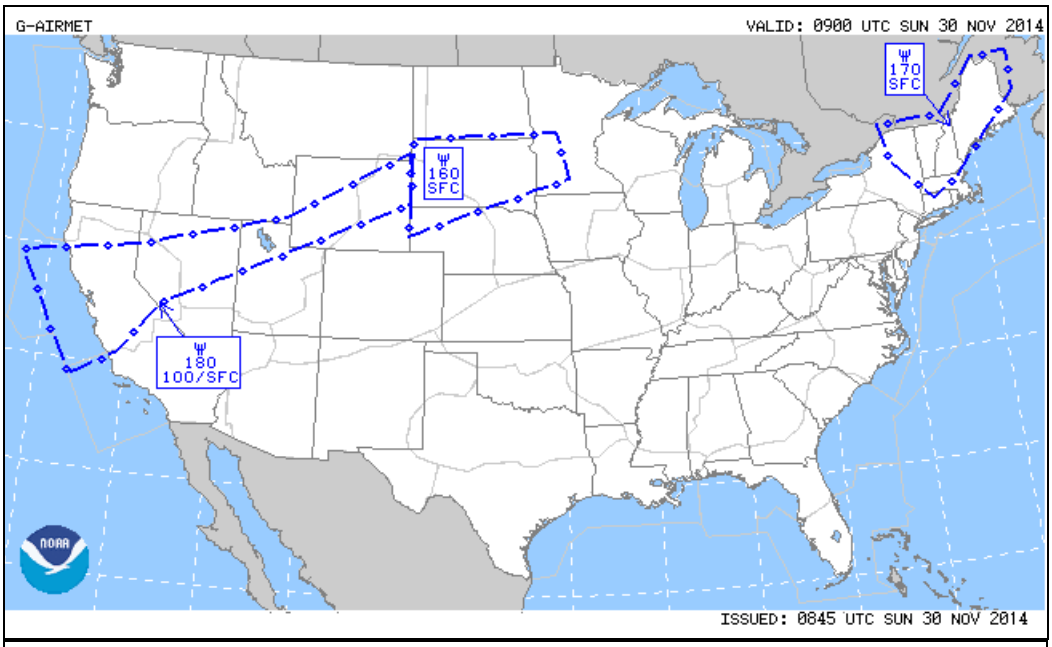
.

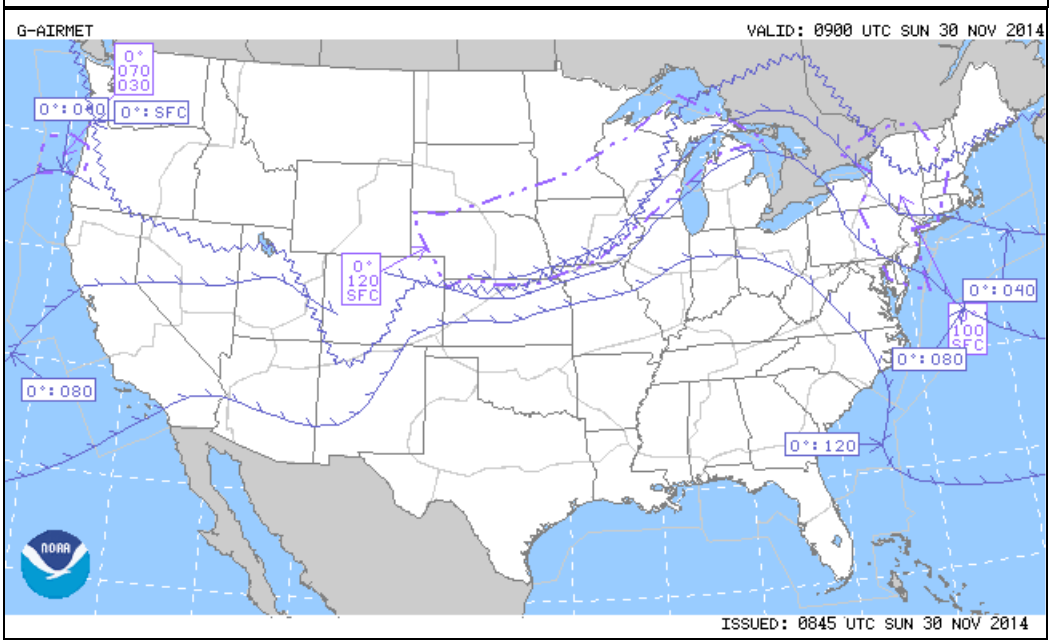
LLWS POTENTIAL...KS MO IL IN KY OK TX AR TN MS AL
BOUNDED BY 40WSW ROD-CVG-HNN-HMV-GQO-30NNW SQS-40SW TTT-END-30NE MCI-40WSW ROD
LLWS EXP. CONDS ENDG 12-15Z.

.

OTLK VALID 1500-2100Z
AREA ...TURB SD NE KS MN IA MO WI LM LS MI LH IL IN
BOUNDED BY 80WNW YQT-70WNW SSM-YVV-50SE BDF-OSW-60W LBL-50E SNY-50SSW BFF-70SW RAP-50SSE PIR-80WNW YQT
MOD TURB BLW 080. CONDS CONTG THRU 21Z.
....

While no icing advisory was current for the route the following G-AIRMET and freezing level depiction is included to show what was available during the period.





WA3Z
CHIZ WA 300845
AIRMET ZULU UPDT 1 FOR ICE AND FRZLVL VALID UNTIL 301500
.
AIRMET ICE...ND SD NE MN
FROM 50W BRD TO 40ESE RWF TO 20E FSD TO 50SSE FSD TO 30E CYS TO 70SW RAP TO 70ESE MLS TO 50W BRD
MOD ICE BLW 160. CONDS CONTG BYD 15Z THRU 21Z.
.
FRZLVL...RANGING FROM SFC-140 ACRS AREA

MULT FRZLVL BLW 130 BOUNDED BY 80ESE YQT-30WNW SSM-20WNW YVV- 30WSW BDF-50ESE ICT-50SW ICT-20SE GLD-60NNW BFF-80SE RAP- 30ENE RWF-80ESE YQT
SFC ALG 40E LAA-60WNW ICT-20W IRK-40ESE IOW-50SSE GRB-50W SSM- 30WNW SSM
040 ALG 40SE GLD-70E GCK-30NNE ICT-30WNW BDF-70SE SSM
080 ALG 40SE LAA-50SW ICT-50ESE ICT-30SE BDF-30W YVV-20SSW YVV
120 ALG OSW-20NNW TTH-40S FWA
....

10.0 Winds and Temperature Aloft Forecast

The following winds and temperature aloft forecast was current at the time prior to departure.

DATA BASED ON 301200Z
VALID 301800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	*3000*	*6000*	*9000*	*12000*	*18000*	*24000*	*30000*	*34000*	*39000*
STL	*2437*	*2642+07*	*2541+08*	*2643+01*	*2557-12*	*2666-25*	*257342*	*257951*	*258561*
COU	*2514*	*2536+09*	*2637+08*	*2643+01*	*2554-12*	*2561-25*	*257042*	*257551*	*258161*
SPI	*2430*	*2541+06*	*2544+07*	*2646+00*	*2664-13*	*2669-26*	*268242*	*268952*	*269662*
MKC	*0122*	*3219+12*	*3119+05*	*2630-01*	*2652-13*	*2564-25*	*266842*	*257352*	*258461*

11.0 Preflight Weather Briefing

The FAA Contract Automated Flight Service Station (AFSS) Lockheed Martin and the two Direct User Access Terminal Service (DUATS) providers were contacted to determine if the operator contacted them for any weather briefings prior to departure. A review of their records indicated no contact was made by the pilot or any other individual regarding N6629V for any briefing services. It is therefore unknown if the pilot reviewed any weather data prior to departure in order to satisfy Title 14 Code of Federal Regulations (CFR) Part 91.103 - Preflight Action requirements.

12.0 Astronomical Data

The United Stated Naval Observatory website provided the following astronomical data for Boonville, Cooper County, Missouri on November 30, 2014:

Sun	
Beginning of civil twilight	0640 CST
Sunrise	0710 CST
Accident	0900 CST

At the time of the accident the Sun was more than 16° above the horizon and at an azimuth of 137°.

Submitted by:

Donald Eick

NTSB Senior Meteorologist