



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

December 28, 2020

### **SPECIALIST'S FACTUAL REPORT**

# **METEOROLOGY**

**CEN20LA379**

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## **A. ACCIDENT**

Location: Chester, Arkansas  
Date: September 4, 2020  
Time: 2055 central daylight time  
0155 coordinated universal time (UTC) on September 5, 2020  
Airplane: Cirrus SR22; Registration: N733CD

## **B. METEOROLOGIST**

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## **C. SUMMARY**

On September 4, 2020, about 2055 central daylight time, a Cirrus SR22 airplane, N733CD, was destroyed when it was involved in an accident near Chester, Arkansas. The private pilot and three passengers sustained fatal injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

## **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 (WPC) and the National Center for Environmental Information (NCEI). All times are central daylight time (CDT) based upon the 24 hour clock, local time is +5 hours to UTC, and UTC=Z. 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 35.6860598° N and longitude 94.2525844° W, at an elevation of approximately 1,450 ft.

## **E. FACTUAL INFORMATION**

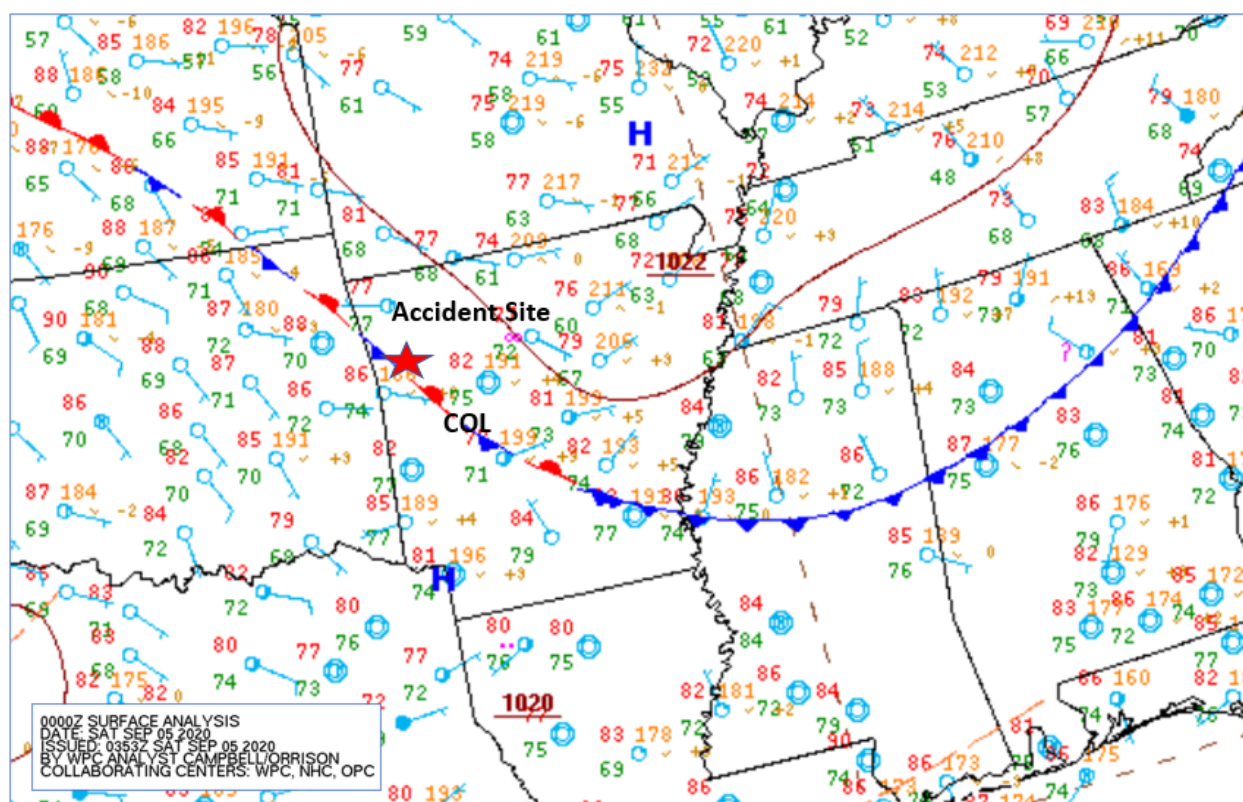
### **1.0 Synoptic Situation**

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 00-45H change 2.

## 1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1900 CDT (0000Z September 5, 2020) is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a developing stationary front<sup>1</sup> that extended from Kansas southeastward through northeast Oklahoma and into Arkansas in the immediate vicinity of the accident site. The front changed into a cold front over southern Arkansas and continued eastward across Mississippi, Alabama, and then east-northeastward into Georgia and western North Carolina. High pressure systems were located on either side of the front over Missouri at 1022-hectopascals<sup>2</sup> (hPa) and over northeast Texas at 1020-hPa. A col<sup>3</sup> or neutral point in the pressure field was identified between the two high pressure systems and where the stationary and cold fronts changed identity. The accident was in the immediate vicinity of the stationary front and on the cool air side of the front, and to the northwest of the col.



**Figure 1 - NWS Surface Analysis Chart for 1900 CDT with approximate accident site noted**

<sup>1</sup> Frontogenesis - is a meteorological process of tightening of horizontal temperature gradients to produce fronts.

<sup>2</sup> Hectopascals is the new standard unit for reporting sea-level pressure and has the same units as the former unit of millibars (mb). Standard sea-level pressure is 1013.25-hPa at 59° Fahrenheit or 15° Celsius(C).

<sup>3</sup> Col – also called a saddle point, or neutral point, is the point of intersection of a trough and a ridge in the pressure pattern of a weather map. It is the point of relatively lowest pressure between two highs and the point of relatively highest pressure between two lows.

The station models in the immediate vicinity of the accident site depicted light winds, relatively clear skies, temperature near 86° F, and dew point temperature near 74° F. The chart did not depict any significant weather being reported at that time along the stationary front.

## 1.2 Convective Outlook

The NWS Storm Prediction Center (SPC) is tasked with providing timely and accurate forecasts and watches for severe thunderstorms and tornadoes over the contiguous United States. One of their primary products highlighting the expected areas of organized thunderstorms is the Convective Outlook (AC). The intent of the chart is to identify to users where the NWS SPC expects organized thunderstorms and severe thunderstorms<sup>4</sup> to form. The SPC Convective Outlook issued at approximately 1500 CDT (2000Z) is included as figure 2 with the approximate accident site marked by the red star. The outlook valid for the period expected a general risk of air mass type thunderstorms across the eastern Oklahoma and Arkansas. The highest category indicated on the chart was a marginal risk of thunderstorms over the mid-Atlantic region.

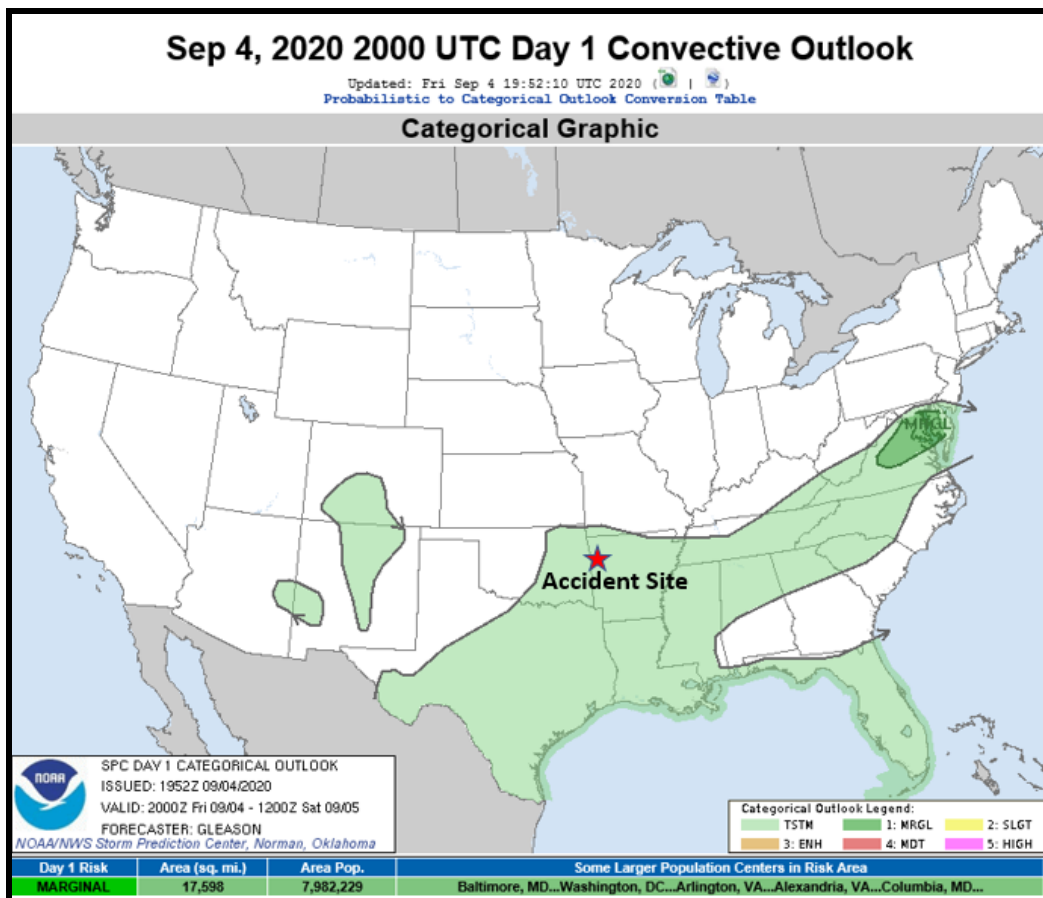


Figure 2 - Convective Outlook issued at 1500 CDT and valid during the period

<sup>4</sup> A severe thunderstorm is one that produces a tornado, large hail over 1.0 inch in diameter, or outflow winds greater than 50 knots. While all thunderstorms imply the likelihood of severe turbulence, a severe thunderstorm implies a high likelihood of severe to extreme turbulence, wind shear, and a high probability of encountering hail.

The text narrative of the Convective Outlook bulletin issued with the graphic was as follows.

*SPC AC 041952  
Day 1 Convective Outlook  
NWS Storm Prediction Center Norman OK  
0252 PM CDT Fri Sep 04 2020*

*Valid 042000Z - 051200Z*

*...THERE IS A MARGINAL RISK OF SEVERE THUNDERSTORMS ACROSS PARTS OF THE MID-ATLANTIC...*

*...SUMMARY...*

*Isolated damaging winds may occur this afternoon across parts of the Mid-Atlantic.*

*...20Z Update...*

*A southwestward expansion was made to the Marginal Risk into parts of central VA for strong to locally damaging wind gusts based on observational trends and latest short-term model guidance. Prior forecast reasoning remains unchanged.*

*..Gleason.. 09/04/2020*

*.PREV DISCUSSION... /ISSUED 1124 AM CDT Fri Sep 04 2020/*

*...Synopsis...*

*A closed mid-upper high will persist over UT, with a downstream trough over the Great Lakes/New England. In association with embedded speed maxima aloft, a surface cold front will move southeastward across the Mid-Atlantic this afternoon/evening and continue slowly southward into the Southeast states. Farther west, a weak midlevel trough will persist over south central and east TX, with scattered thunderstorms expected along the diffuse front with 2"+ PW and moderate buoyancy. Otherwise, a few thunderstorms are expected across the FL Peninsula with local sea breeze circulations, as well as isolated terrain-focused storms across parts of the southern Rockies. Some low-topped convection will be possible this afternoon across northern WI and vicinity, but meager buoyancy and marginally cold equilibrium level temperatures suggest that lightning will be sparse, at best.*

*...Mid-Atlantic this afternoon...*

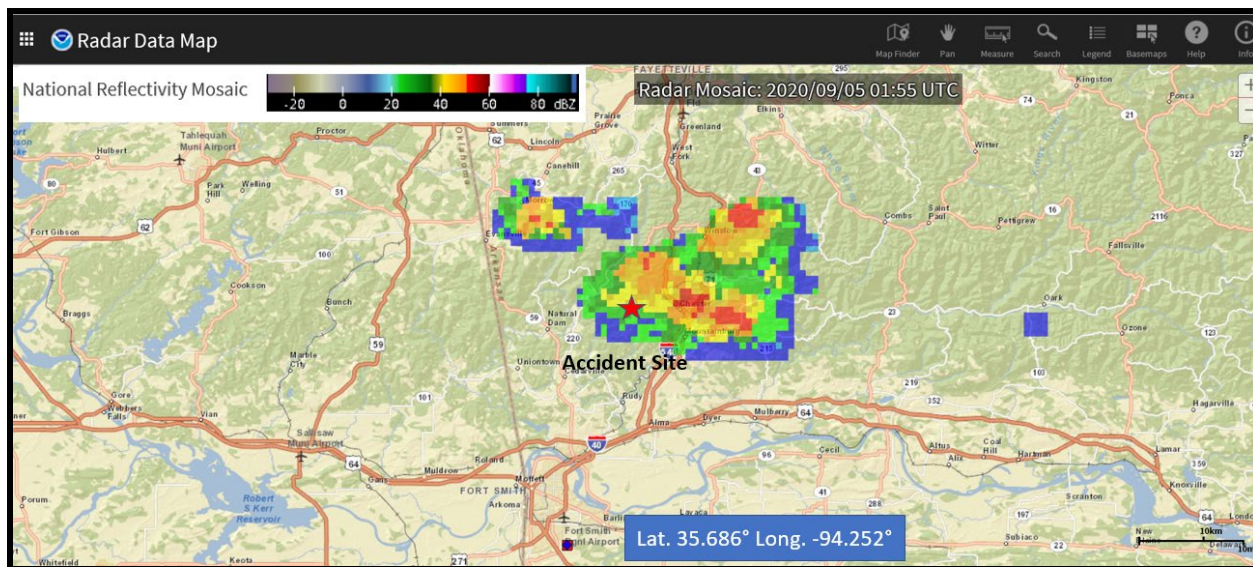
*Strong surface heating is ongoing ahead of a cold front and east of the higher terrain across VA/MD, where boundary-layer cumulus formation is noted as of late morning. Regional 12z soundings revealed poor midlevel lapse rates over this area (which are likely to continue through the day), so surface heating and boundary-layer dewpoints of 68-70 F will be the primary drivers of destabilization and at least widely scattered thunderstorm development along and just ahead of the cold front this afternoon. MLCAPE will reach 500-1000 J/kg, and effective bulk shear of 35-40 kt is expected along the southern fringe of the stronger midlevel westerlies, which could be sufficient for a few organized/low-end supercell structures. Isolated wind damage may occur with the stronger cells.*

*NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 0100Z*

### **1.3 National Composite Reflectivity Mosaic**

The south-central section of the NCEI National Composite Radar Mosaic for 2055 CDT (0155Z) is included as figure 3 with the approximate accident site marked by a red star. The

image depicted several intense radar echoes with reflectivities near 50 dBZ north of Fort Smith and near Chester, Arkansas, with the accident site located under the southwest section of one of the intense echoes in light to moderate intensity echoes. Based on the echoes in the vicinity of the accident site, the closest NWS weather surveillance radar will be further documented in section 5.0 of this report.



**Figure 3 - National Composite Reflectivity Mosaic for 2055 CDT**

## 2.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for the area. The cloud heights are reported above ground level (agl), and the magnetic variation over the region was estimated as 2° E based on the sectional chart for the area.

### 2.1 Fayetteville, Arkansas

The closest official weather reporting site to the accident site was from Drake Field Airport (KFYV), Fayetteville, Arkansas, located approximately 19 miles north of the accident site at an elevation of 1,252 ft. The airport also had an Automated Surface Observation System (ASOS) whose reports were augmented by tower personnel between the hours between 0600-2200 CDT. At the time of the accident the following conditions were being reported.

*KFYV Weather Observation at 2053 CDT, wind calm, visibility 10 miles or more, scattered clouds at 6,000 ft agl, temperature 23° C, dew point 22° C, altimeter 30.21 inches of mercury ("Hg). Remarks: automated station with a precipitation discriminator, temperature 22.8° C, dew point temperatures 21.7° C.*

The general flight categories<sup>5</sup> and raw METAR observation reported surrounding the time of the accident from 1753 through 2253 CDT were as follows, with the observations decoded above and the time of the accident in bold type.

*VFR METAR KFYV 042253Z 00000KT 10SM SCT046 SCT060 29/23 A3013 RMK AO2 LTG DSNT N AND NW SLP189 T02890228=*

*VFR SPECI KFYV 042323Z 00000KT 10SM VCTS FEW046 BKN065 27/22 A3015 RMK AO2 LTG DSNT W-N T02720222=*

*VFR SPECI KFYV 042351Z 29012G17KT 10SM TS FEW028 BKN045 BKN055 26/22 A3016 RMK AO2 LTG DSNT W TSB48=*

*VFR METAR KFYV 042353Z 29011KT 10SM TS FEW028 BKN045 OVC100 26/22 A3017 RMK AO2 LTG DSNT W TSB48 SLP202 T02610217 10328 20261 53005=*

*VFR SPECI KFYV 050018Z VRB03KT 10SM -RA FEW029 BKN047 BKN075 24/22 A3016 RMK AO2 RAB06 TSE14 P0000 T02440217=*

*VFR SPECI KFYV 050025Z 00000KT 10SM VCTS -RA FEW047 SCT075 BKN095 24/22 A3016 RMK AO2 LTG DSNT SW RAB06 TSE14 P0000 T02440217=*

*VFR SPECI KFYV 050040Z 29004KT 10SM FEW043 24/22 A3017 RMK AO2 LTG DSNT SW RAB06E28 TSE14 P0000 T02390222=*

*VFR METAR KFYV 050053Z 16003KT 10SM CLR 24/22 A3019 RMK AO2 LTG DSNT SW RAB06E28 TSE14 SLP210 P0000 T02390222=*

***VFR METAR KFYV 050153Z 00000KT 10SM SCT060 23/22 A3021 RMK AO2 SLP217 T02280217=***

***Accident 0155Z***

*VFR METAR KFYV 050253Z AUTO 19004KT 10SM SCT060 23/22 A3023 RMK AO2 LTG DSNT W SLP224 60000 T02280222 53022=*

*VFR METAR KFYV 050353Z AUTO 20003KT 10SM FEW045 SCT055 23/22 A3025 RMK AO2 LTG DSNT SW AND W SLP228 T02330217=*

Thunderstorms were reported in the vicinity and at the station between 1823 through 2340 CDT with lightning reported in the distance through 1953 CDT, with less than 0.01 inch of

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<sup>5</sup> 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.

precipitation reported during the period. As indicated in the plain text observation above, no thunderstorms were reported in the hour surrounding the time of the accident.

## 2.2 Fort Smith, Arkansas

The next closest weather reporting site was from Fort Smith Regional Airport (KFSM), located approximately 21 miles south of the accident site at an elevation of 469 feet. The airport also had an ASOS and was augmented by tower personnel during the hours between 0530-2300 CDT. The following conditions were being reported at the time of the accident.

*KFSM Weather Observation at 2053 CDT, wind calm, visibility 10 miles or more, skies clear below 12,000 ft, temperature 26° C, dew point 21° C, altimeter 30.16 "Hg. Remarks: automated station with a precipitation discriminator, sea-level pressure 1020.7-hPa, temperature 26.1° C, dew point temperatures 21.1° C.*

The general flight categories and raw METAR observation reported surrounding the time of the accident from 1553 through 2253 CDT were as follows:

*VFR METAR KFSM 042053Z 0000KT 10SM CLR 33/22 A3009 RMK AO2 LTG DSNT NE SLP185 T03280222 57016=*

*VFR METAR KFSM 042153Z 1000KT 10SM CLR 32/22 A3011 RMK AO2 LTG DSNT SE SLP188 T03220217=*

*VFR METAR KFSM 042253Z 1800KT 10SM CLR 31/24 A3009 RMK AO2 SLP183 T03110239=*

*VFR METAR KFSM 042353Z 1100KT 10SM CLR 30/23 A3010 RMK AO2 SLP186 T03000233 10333 20300 53002=*

*VFR METAR KFSM 050053Z 1100KT 10SM CLR 28/22 A3013 RMK AO2 LTG DSNT N SLP197 T02780222=*

*VFR METAR KFSM 050153Z 0000KT 10SM CLR 26/21 A3016 RMK AO2 SLP207 T02610211=*

*Accident 0155Z*

*VFR METAR KFSM 050253Z 0900KT 10SM CLR 25/21 A3020 RMK AO2 SLP220 T02500211 53032=*

*VFR METAR KFSM 050353Z AUTO 0700KT 10SM CLR 24/22 A3020 RMK AO2 SLP222 T02440217=*

In the observation the hour prior to the accident, KFSM reported lightning in the distant north. No rain or thunderstorms were reported at the airport on September 4, 2020.

## 2.3 Fayetteville/Springdale/Rogers, Arkansas

Northwest Arkansas Regional Airport (KXNA), servicing the Fayetteville/Springdale/Rogers area, Arkansas, was located approximately 35 miles north of the accident site at an elevation of 1,288 ft. The airport also had an ASOS and observations were augmented between 0530 and 2300 CDT. The following conditions were reported surrounding the period from 1653 through 2253 CDT were as follows.

*VFR METAR KXNA 042153Z 08005KT 10SM FEW120 30/20 A3016 RMK AO2 LTG DSNT NW SLP196 T03000200=*

*MVFR SPECI KXNA 042222Z 02012G16KT 4SM R16/5000VP6000FT TSRA SCT043 SCT060 BKN120 28/21 A3016 RMK AO2 LTG DSNT W RAB20 TSB16 P0005 T02780206=*

*IFR SPECI KXNA 042226Z 36011G16KT 1 3/4SM R16/4000VP6000FT +TSRA SCT046 BKN065 BKN120 26/21 A3016 RMK AO2 LTG DSNT W RAB20 TSB16 P0010 T02560211=*

*IFR METAR KXNA 042253Z 28013KT 2SM R16/5500VP6000FT +TSRA BKN044 BKN075 OVC100 23/19 A3016 RMK AO2 LTG DSNT SW AND W RAB20 TSB16 SLP203 P0043 T02280194=*

*MVFR SPECI KXNA 042301Z 27007KT 3SM +TSRA SCT042 BKN075 OVC100 22/19 A3016 RMK AO2 LTG DSNT SW P0004 T02220189=*

*VFR SPECI KXNA 042325Z 24008KT 10SM VCTS -RA FEW075 BKN095 OVC110 23/21 A3016 RMK AO2 LTG DSNT N AND S AND SW TSE19 P0008 T02280206=*

*VFR SPECI KXNA 042351Z 22005KT 10SM FEW042 FEW070 SCT090 23/21 A3016 RMK AO2 LTG DSNT S AND SW RAE40 TSE19 P0008=*

*VFR METAR KXNA 042353Z 21005KT 10SM FEW042 FEW070 24/21 A3016 RMK AO2 LTG DSNT S AND SW RAE40 TSE19 SLP201 P0008 60051 T02390206 50001=*

*VFR METAR KXNA 050053Z 00000KT 10SM CLR 23/21 A3018 RMK AO2 SLP207 T02330206=*

*VFR METAR KXNA 050153Z 00000KT 10SM CLR 23/21 A3021 RMK AO2 SLP217 T02330206=*

#### ***Accident 0155Z***

*VFR METAR KXNA 050253Z 00000KT 10SM FEW050 23/21 A3024 RMK AO2 LTG DSNT SW SLP225 T02330206 53025=*

*VFR METAR KXNA 050353Z AUTO 16004KT 10SM CLR 23/21 A3025 RMK AO2 LTG DSNT SW SLP229 T02280206=*

A review of the observations indicated that thunderstorms and heavy rain were reported at or in the vicinity of the station between 1715 through 1840 CDT, with 0.51 inches of rain reported during the period.

## **2.4 METAR Display**

The NWS Aviation Weather Center's (AWC) display of METARs for 2055 CDT from their website<sup>6</sup> is included as figure 4 with the weather radar<sup>7</sup> overlaid and the approximate accident site marked by the red star. The temperatures and dew point temperatures are in °F and the ceiling heights are in 100's ft agl. The image depicted general VFR conditions across the region with an area of echoes in the vicinity of the accident site between KFYV and KFSM.

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<sup>6</sup> <https://aviationweather.gov/>

<sup>7</sup> The NWS AWC uses the Multi-Radar Multi-Sensor (MRMS) radar mosaic from the NWS National Severe Storm laboratory, which are created every 10-minutes.

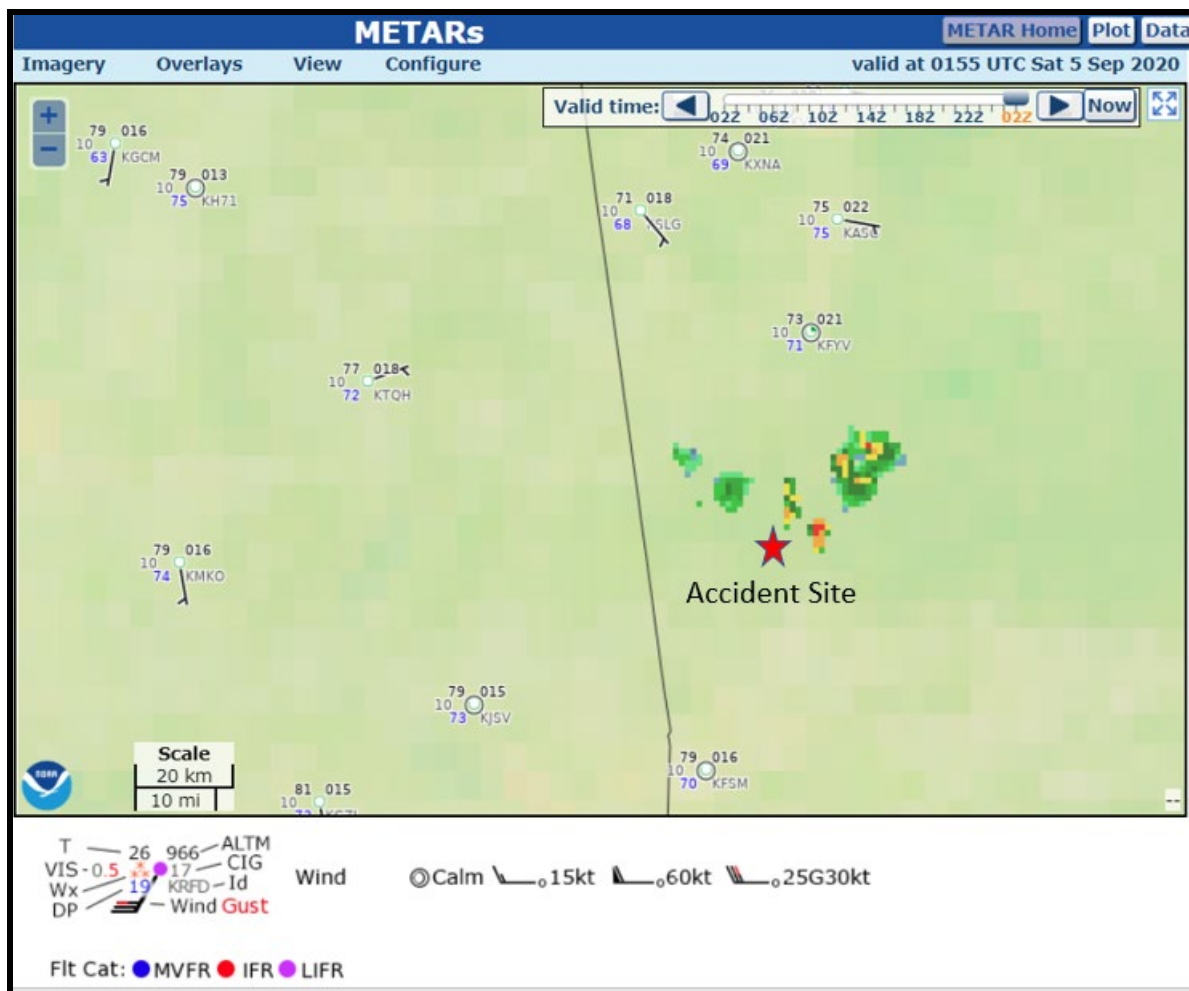


Figure 4 - Aviation Weather Center's METAR Display for 2055 CDT

### 3.0 Pilot Reports

A search of pilot reports or PIREPs indicated that there were no reports during the period 2 hours prior and after the accident over Arkansas.

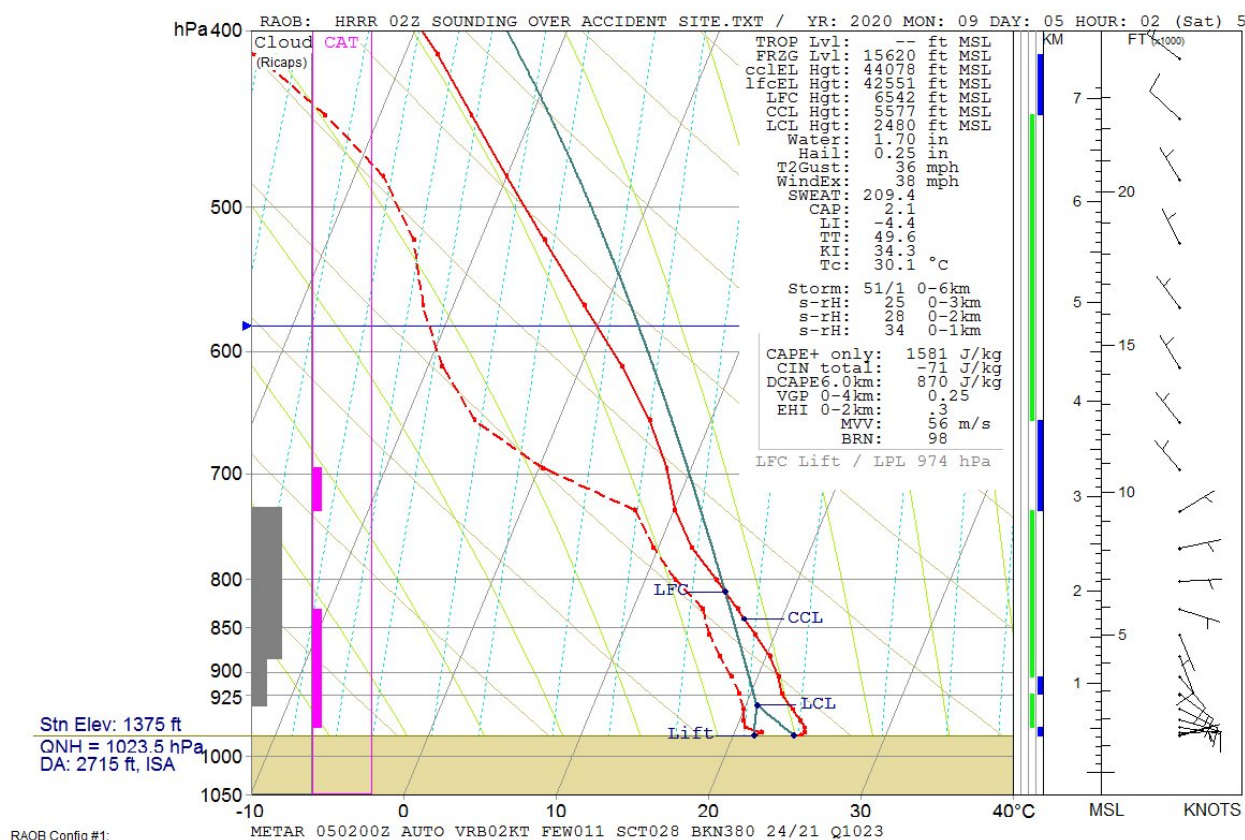
### 4.0 Upper Air Sounding

To determine the vertical structure and state of the atmosphere over the accident site coordinates a High-Resolution Rapid Refresh (HRRR)<sup>8</sup> numerical model data was retrieved from the NOAA Air Resources Laboratory and plotted on a standard Skew T log P diagram<sup>9</sup> using the

<sup>8</sup> 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.

<sup>9</sup> 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.

complete Rawinsonde Observation RAOB program software<sup>10</sup>. Figure 5 is the HRRR numerical model sounding for 2100 CDT over the approximate accident site from the surface to 400-hPa or 24,000 ft.



**Figure 5 - HRRR numerical model sounding for 2100 CDT over the accident site**

The HRRR numerical model sounding estimated the elevation at 1,375 ft over the accident coordinates, with an expected near surface temperature of 24° C, dew point of 21° C, with a relative humidity of 83%, and a density altitude of 2,715 ft. The lifted condensation level (LCL)<sup>11</sup> was identified at 1,105 ft agl or 2,408 feet msl, the convective condensation level (CCL)<sup>12</sup> at 5,577 ft msl, and a level of free convection (LFC)<sup>13</sup> at 6,542 feet msl. The equilibrium level (EL)<sup>14</sup> or expected top of convective clouds was at 42,500 ft, the tropopause

<sup>10</sup> RAOB – (The Universal RAWinsonde OBServation program) is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

<sup>11</sup> Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

<sup>12</sup> 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.

<sup>13</sup> 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.

<sup>14</sup> Equilibrium Level (EL) - On a sounding, the level above the level of free convection (LFC) at which the temperature of a rising air parcel again equals the temperature of the environment. The height of the EL is the

height was not identified in the sounding. The HRRR sounding supported clouds between the LCL and 10,000 ft, and was classified as unstable with a Lifted Index<sup>15</sup> of -4, a K-Index<sup>16</sup> of 34.3, and a Convective Available Potential Energy (CAPE)<sup>17</sup> of 1,581 Joules/kilograms (J/kg), which supported a moderate risk of air mass type thunderstorms. The maximum vertical velocity (MVV) of potential updrafts was estimated at 56 meters/second (m/s) or 109 knots, and the T2 Gust of any potential outflow winds was 31 knots. The precipitable water content was 1.70 inches. The freezing level was identified at 15,600 ft well above the accident airplanes cruising altitude.

The HRRR wind profile indicated calm surface winds with light easterly winds at 10 to 15 knots veering to the south through 5,000 ft, then backing to the east between 5,000 through 10,000 ft at 5 knots. Above 10,000 ft the winds shifted to the north-northwest with speeds of 10 knots or less. The mean 0- to 6-kilometer storm motion was from 050° at 1 knot.

## 5.0 Satellite Data

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data were obtained from an archive at the Space Science Engineering Center (SSEC) 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 band 13 imagery at a wavelength of 10.3 microns (μm) and a resolution of 2 km were obtained surrounding the time of the accident. The infrared imagery provided standard satellite imagery with radiative cloud top temperatures.

The GOES-16 infrared satellite image for 2056 CDT is included as figure 6 with the accident site marked and the frontal positions from 1900 CDT overlaid. An area of enhanced clouds associated with an area of cumulonimbus clouds extended in the immediate vicinity of the accident site with tops near 38,000 ft based on the HRRR sounding. Another area of enhanced cloud tops associated with convection was located approximately 70 miles southeast of the accident site with tops near 42,000 ft. The radiative cloud top temperature or brightness

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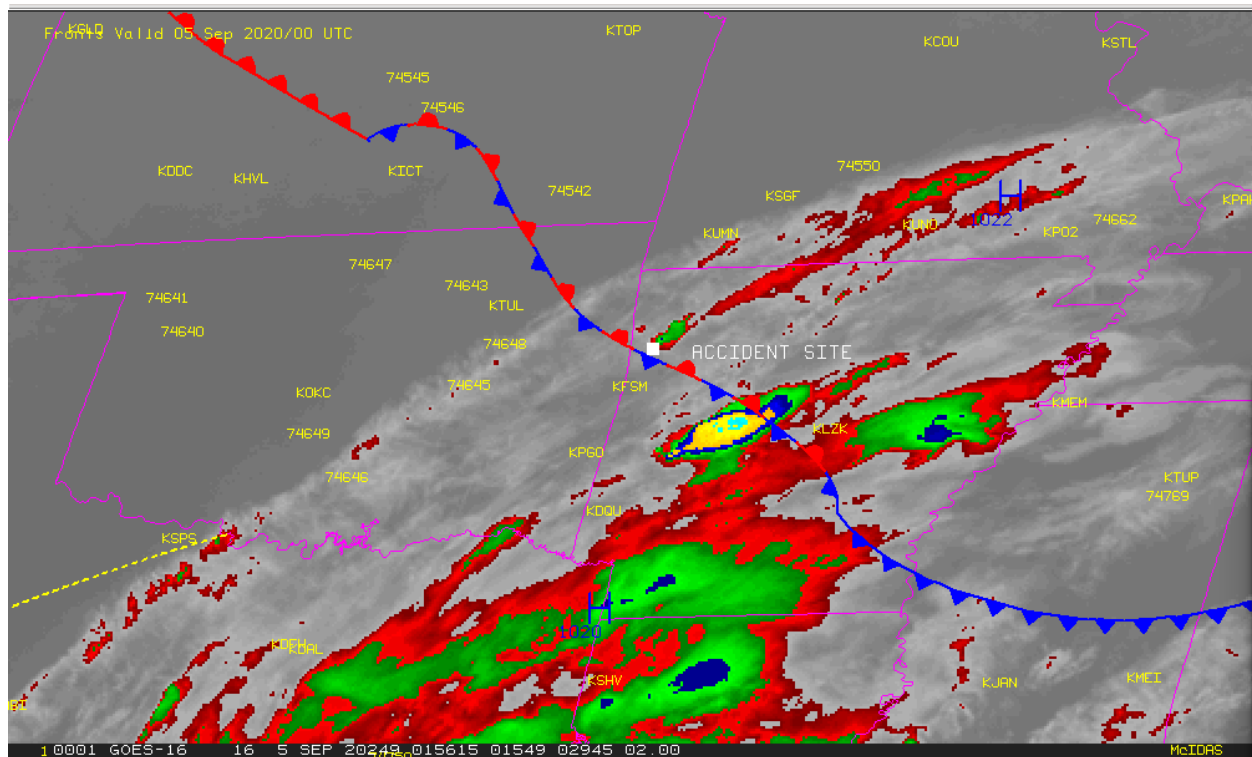
height at which thunderstorm updrafts no longer accelerate upward. Thus, to a close approximation, it represents the height of expected (or ongoing) thunderstorm tops. However, strong updrafts will continue to rise past the EL before stopping, resulting in storm tops that are higher than the EL. This process sometimes can be seen visually as an overshooting tops or anvil dome. The EL typically is higher than the tropopause and is a more accurate reference for storm tops.

<sup>15</sup> 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.

<sup>16</sup> K-Index - The measure of thunderstorm potential based on the vertical temperature lapse rate, the moisture content of the lower atmosphere and the vertical extent of the moist layer. The higher the K-Index value the greater the probability of air mass type thunderstorm development across the region.

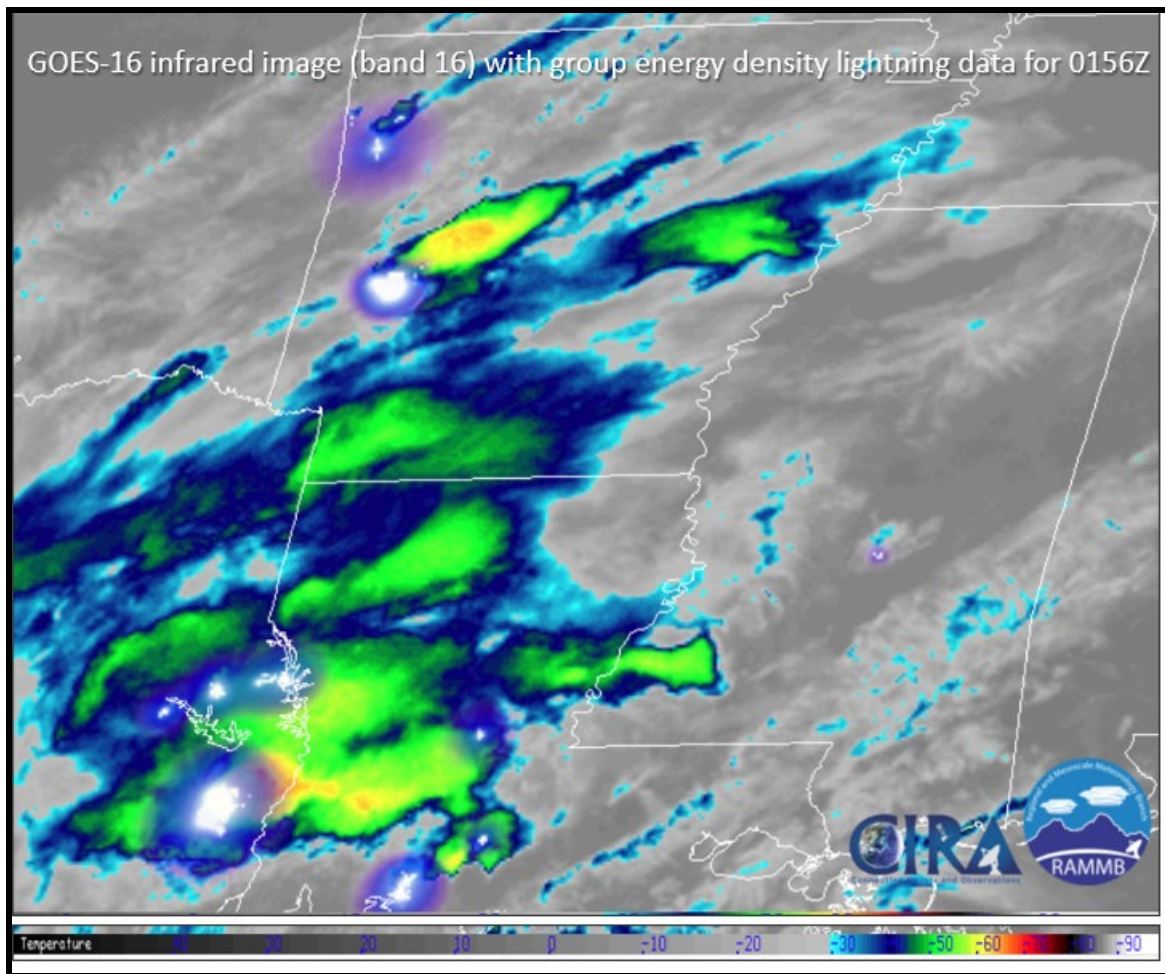
<sup>17</sup> Convective Available Potential Energy (CAPE) – is a measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather.

temperature over the accident site was 267 Kelvin or -6° C, which corresponded to tops near 18,260 ft based on the HRRR sounding, with higher cloud tops located immediately east of the accident site.



**Figure 6 - GOES-16 infrared image for 2056 CDT with fronts overlaid**

Figure 7 is another view of the GOES-16 infrared image with the Geostationary Lightning Mapper Group Density display overlaid for 2056 CDT obtained from CIRA/NOAA. The Geostationary Lightning Mapper (GLM) maps the extent of the cloud illuminated by individual lightning flashes, and the flash rates are most closely tied to updraft and storm evolution, and GLM event locations best depict the spatial extent. The image depicts significant lightning flashes from the cumulonimbus cloud to the south-southeast of KFSM and to the north in the vicinity of the accident site. Additional lightning data will be documented in section 6.6 of this report.



**Figure 7 - GOES-16 infrared image with lightning density at 2056 CDT**

## **6.0 Weather Radar Information**

The closest Weather Surveillance Radar-1988, Doppler (WSR-88D)<sup>18</sup> to the accident site was from the NWS Fort Smith (KSRX)<sup>19</sup>, Arkansas, located 24 miles south of the accident site. The level II and III archive data were obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

### **6.1 Volume Scan Strategy**

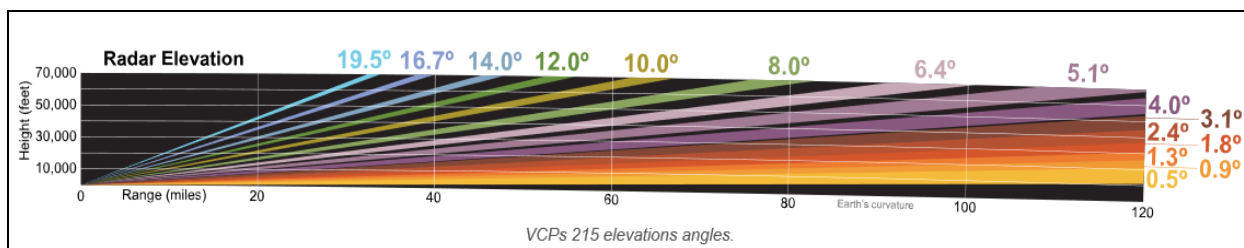
The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP).

<sup>18</sup> 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.

<sup>19</sup> Slatington Mountain (KSRX) is the location of the WSR-88D radar antenna that serves the NWS Fort Smith, Arkansas Weather Forecast office area of responsibility.

Products that require data from multiple elevation scans are not available until the end of the volume scan, which can range from 4 to 10 minutes depending on the scan being utilized.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has multiple scanning strategies, which are used when significant weather echoes are present or severe weather is occurring or is anticipated. During the period of the accident the KSRX WSR-88D was operating in the precipitation mode, general surveillance volume coverage pattern 215 (VCP-215), where the radar makes 15 different elevation scans every 6-minutes. This scanning strategy provides good low-level coverage and the most upper-level vertical sampling of the atmosphere and is depicted in figure 8.



**Figure 8 – Depiction of the WSR-88D VCP-215 scanning strategy**

## 6.2 Beam Height Calculation

Assuming standard refraction<sup>20</sup> of the 0.95° radar beam of the KSRX WSR-88D and considering the antenna height of 737 feet and a distance of 24 miles from the radar to the accident site, the following table shows the approximate beam height and width information of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

| ANTENNA ELEVATION | BEAM CENTER | BEAM BASE | BEAM TOP  |
|-------------------|-------------|-----------|-----------|
| 0.4°              | 2,140 ft    | 930 ft    | 3,350 ft  |
| 0.8°              | 3,150 ft    | 1,950 ft  | 4,360 ft  |
| 1.23°             | 4,250 ft    | 3,040 ft  | 5,460 ft  |
| 1.71°             | 5,470 ft    | 4,260 ft  | 6,680 ft  |
| 2.33°             | 7,050 ft    | 5,840 ft  | 8,260 ft  |
| 3.03°             | 8,830 ft    | 7,620 ft  | 10,030 ft |

Based on the radar height calculations, the 3.03° elevation scan depicts the conditions encompassing the altitude between 7,620 ft and 10,030 ft over the accident site and best depicts the conditions at the accident airplane's observed cruising altitude near 9,875 ft and altitude of approximately 8,800 ft at 2055 CDT.

<sup>20</sup> Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

### 6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors<sup>21</sup>, it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ<sup>22</sup>) and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates. Note echoes of 15 dBZ and greater are typically associated with precipitation reaching the surface.

**NWS VIP/DBZ CONVERSION TABLE**

| NWS VIP                | WSR-88D LEVEL | PREC MODE DBZ | RAINFALL    |
|------------------------|---------------|---------------|-------------|
| 0                      | 0             | < 5           |             |
|                        | 1             | 5 to 9        |             |
|                        | 2             | 10 to 14      |             |
| 1<br>Very Light        | 3             | 15 to 19      | .01 in/hr   |
|                        | 4             | 20 to 24      | .02 in/hr   |
|                        | 5             | 25 to 29      | .04 in/hr   |
| 2<br>Light to Moderate | 6             | 30 to 34      | .09 in/hr   |
|                        | 7             | 35 to 39      | .21 in/hr   |
| 3<br>Strong            | 8             | 40 to 44      | .48 in/hr   |
| 4<br>Very Strong       | 9             | 45 to 49      | 1.10 in/hr  |
| 5<br>Intense           | 10            | 50 to 54      | 2.49 in/hr  |
| 6<br>Extreme           | 11            | 55 to 59      | >5.67 in/hr |
|                        | 12            | 60 to 64      |             |
|                        | 13            | 65 to 69      |             |
|                        | 14            | 70 to 74      |             |
|                        | 15            | > 75          |             |

Air traffic control (ATC) weather display systems also use radar weather processors with the ability to determine precipitation intensity, with controllers instructed<sup>23</sup> to describe the intensity to pilots based on the following table. One exception is that the Air Route Traffic Control Centers weather and radar processor system does not display light intensity echoes below 30 dBZ. This table is also referenced for pilots in Advisory Circular AC 00-24C - "Thunderstorm".

|              |                    |
|--------------|--------------------|
| Reflectivity | Weather Radar Echo |
|--------------|--------------------|

<sup>21</sup> Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glaze ice.

<sup>22</sup> dBZ -  $10 \log Z_e$

<sup>23</sup> FAA Joint Order 7110.65W - Air Traffic Control, section 2-6-4 "Weather and Chaff Services".

| (dBZ) Ranges | Intensity Terminology |
|--------------|-----------------------|
| < 30 dBZ     | Light                 |
| 30 – 40 dBZ  | Moderate              |
| >40 – 50 dBZ | Heavy                 |
| >50 dBZ      | Extreme               |

#### 6.4 Composite reflectivity Imagery

Composite reflectivity images utilize all elevation scans during each volume scan to create the image. It is composed of the greatest echo intensity (reflectivity) from any elevation angle seen from the radar. It is used to reveal the highest reflectivity value in the column. Composite reflectivity image is one of the last radar image views created, as it requires all elevation scans to have been completed before the image can be produced. The short range composite reflectivity product (NCR) provides a resolution of 1 km x 1 km (0.54 nm x 0.54 nm) to 124 miles radius.

Figure 9 is the KSRX WSR-88D composite reflectivity image at 2055 CDT with the flight track overlaid. The image depicts light intensity echoes of 15 to 20 dBZ along the flight path, when the pilot enters echoes above 20 dBZ and reverses course. The accident airplane then turns north-northwestward remaining in echoes of 20-30 dBZ and then makes a descending right turn near the edge of higher reflectivity, without entering the moderate to intense echoes.

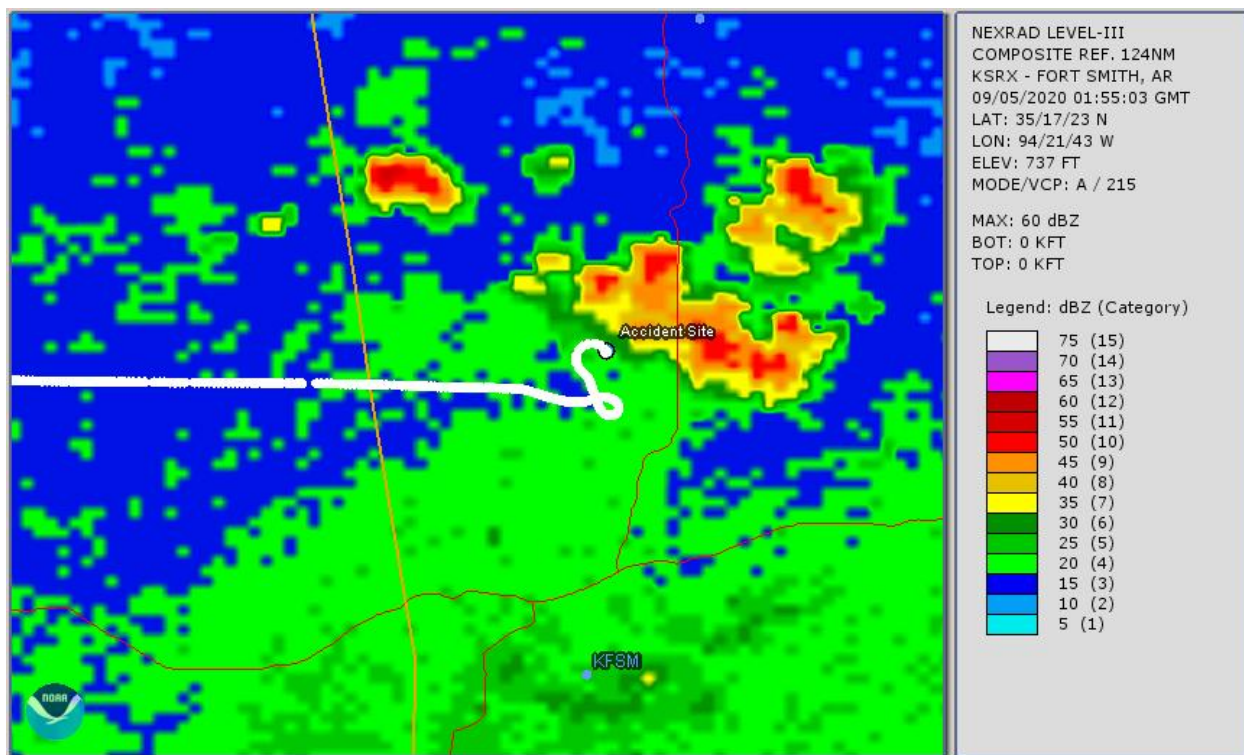


Figure 9 - KSRX WSR-88D composite reflectivity image at 2055 CDT with flight track

## 6.5 Base Reflectivity Imagery

The NWS WSR-88D base reflectivity images are the individual elevation scan images for the VCP being operated and provide a resolution of  $0.5^\circ$  azimuthal by 0.25 km (0.13 nm) range resolution. Figure 10 is the KSRX WSR-88D  $3.03^\circ$  base reflectivity image depicting the conditions at the accident airplanes altitude at 2055 CDT, with echoes less than 15.0 dBZ removed from this image only. The accident site is located along the edge of the larger cluster of echoes with maximum reflectivity near 58 dBZ northwest through east of the flight track.

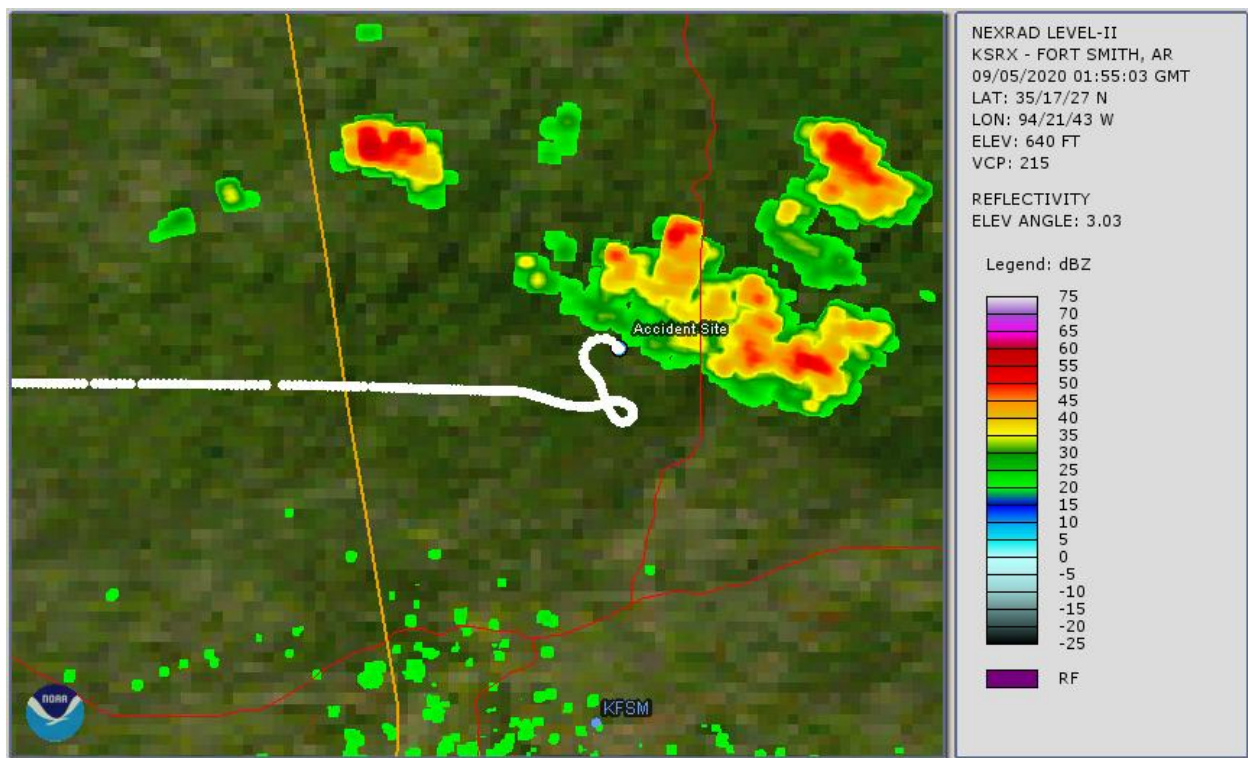


Figure 10 - KSRX WSR-88D  $3.03^\circ$  base reflectivity image at 2055 CDT

A review of the lower elevation scans are provided as figures 11 through 16 and indicated very light intensity echoes of 20 dBZ from the lowest  $0.4^\circ$  through the  $1.7^\circ$  elevation scans or below approximately 7,000 ft, and echoes of 15 dBZ or less through the  $3.03^\circ$  elevation scan or through 8,800 ft or the accident airplane's altitude.

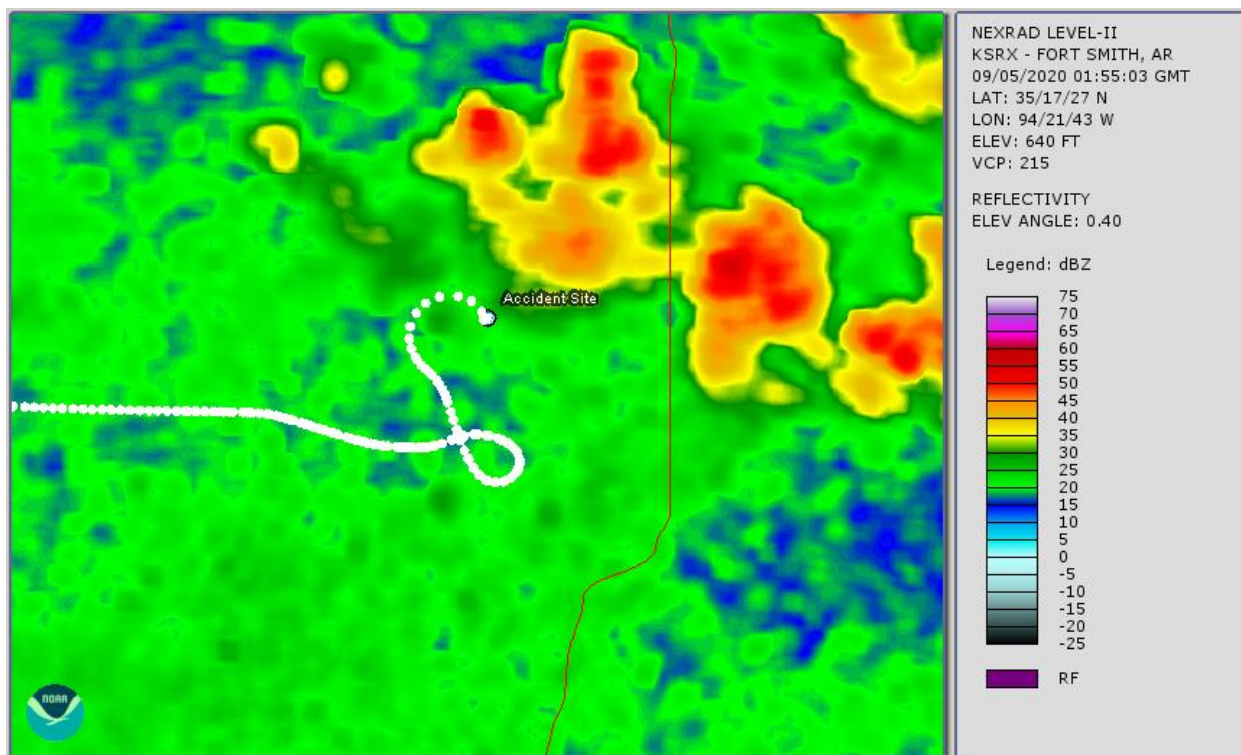


Figure 3 - KSRX WSR-88D 0.40° base reflectivity image at 2055 CDT

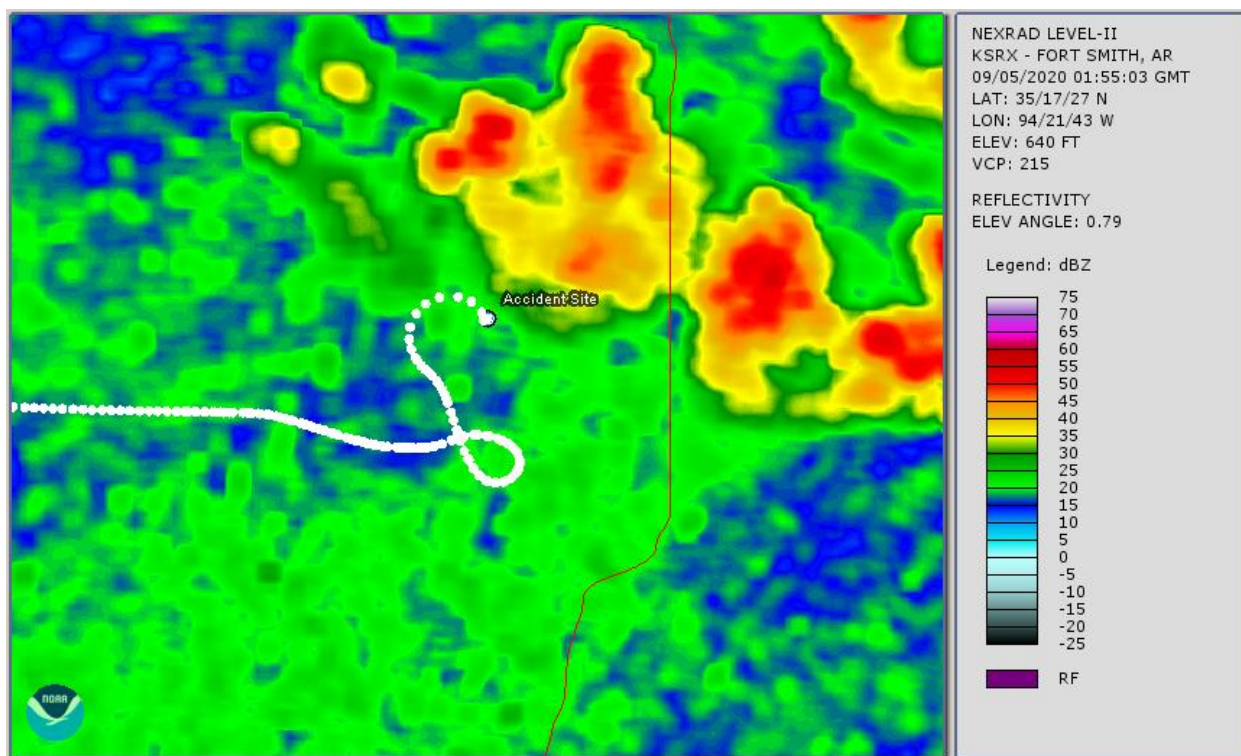


Figure 4 - KSRX WSR-88D 0.79° base reflectivity image at 2055 CDT

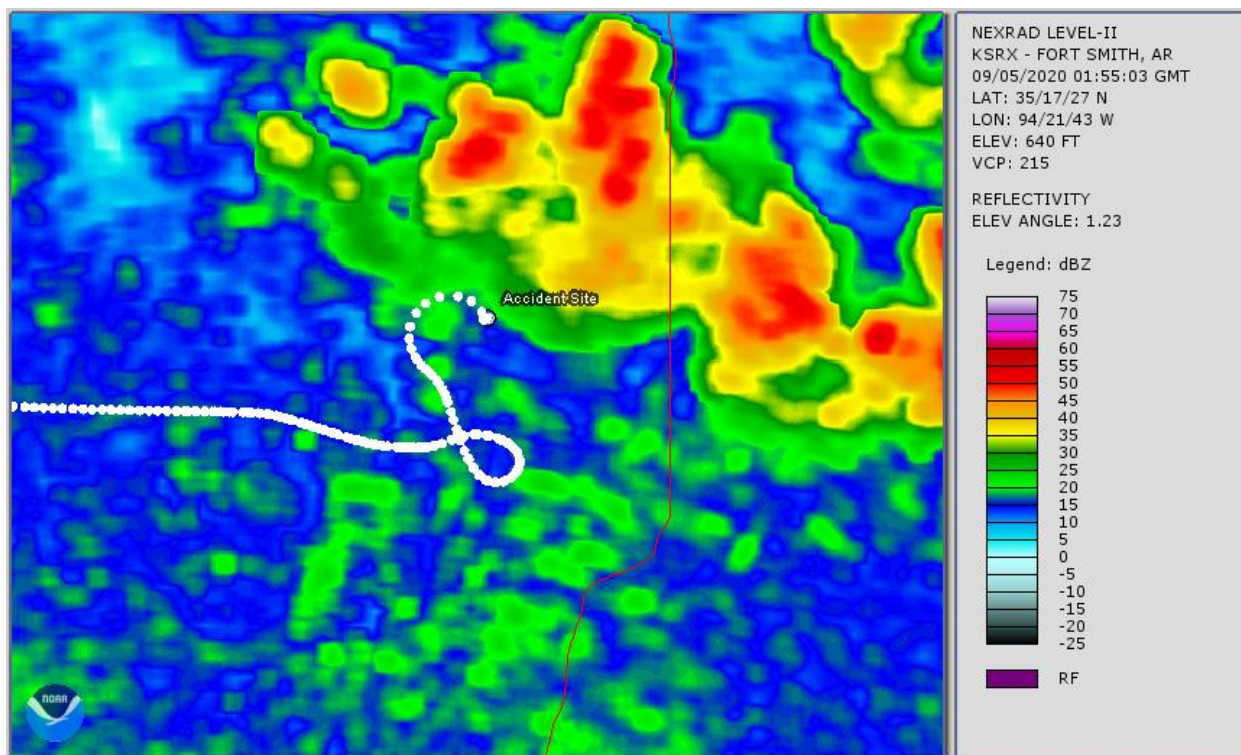


Figure 5 - KSRX WSR-88D 1.23° base reflectivity image at 2055 CDT

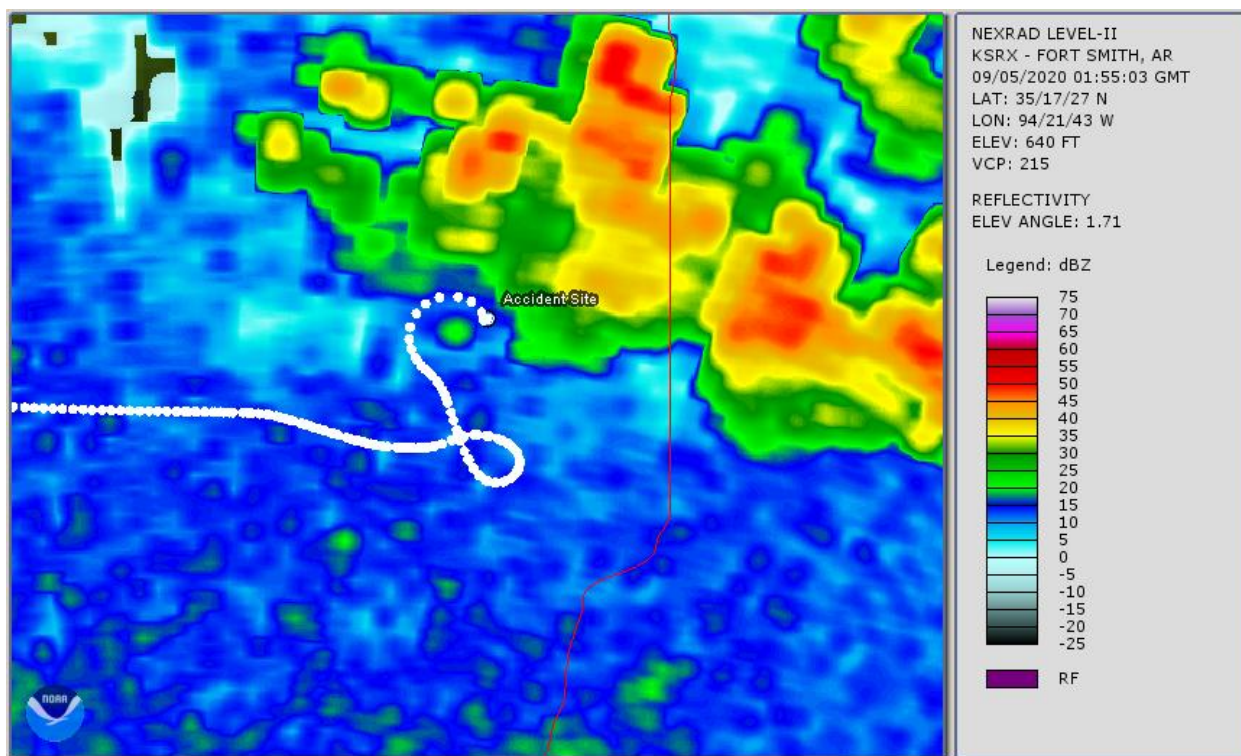


Figure 6 - KSRX WSR-88D 1.71° base reflectivity image at 2055 CDT

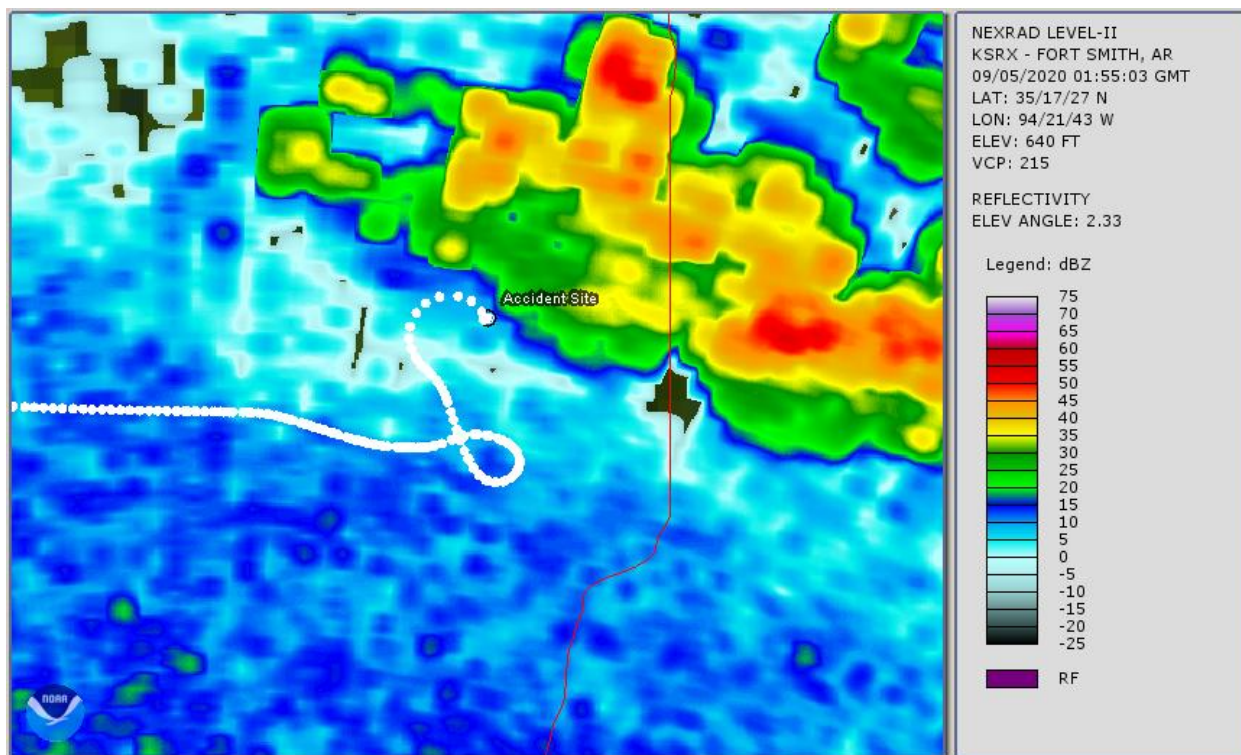


Figure 7 - KSRX WSR-88D 2.33° base reflectivity image at 2055 CDT

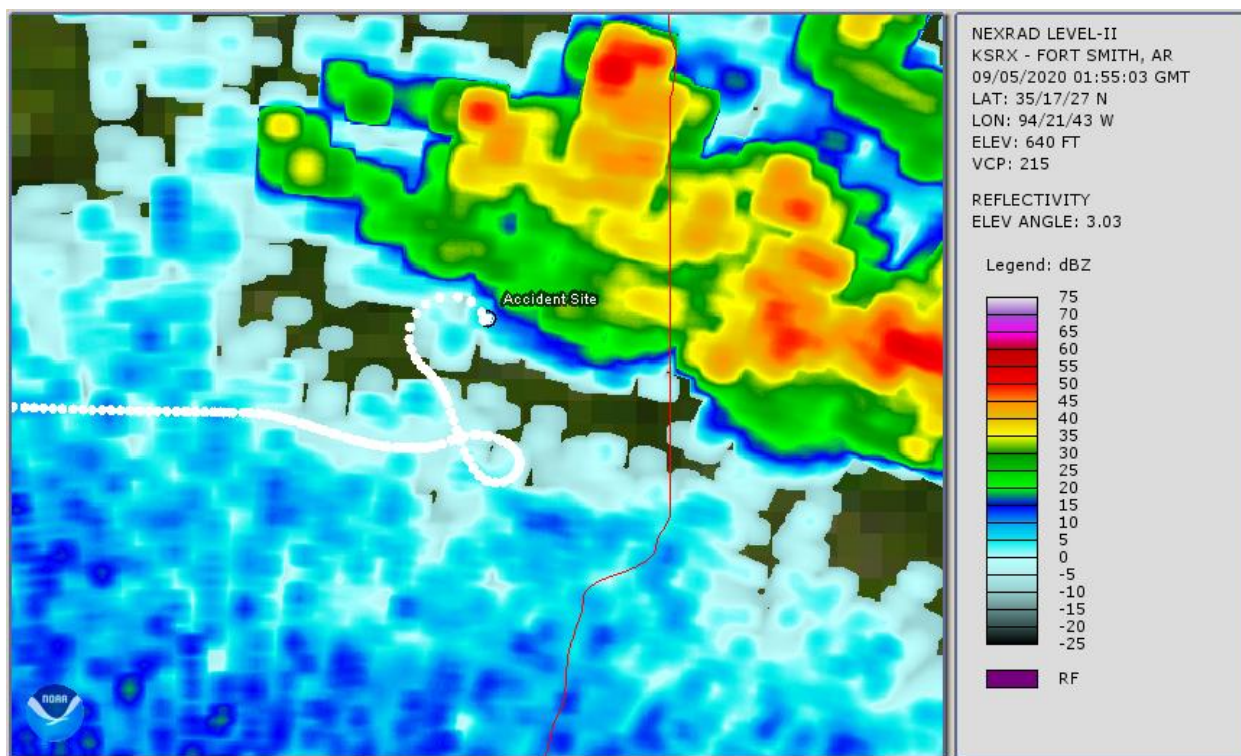


Figure 8 - KSRX WSR-88D 3.03° base reflectivity image at 2055 CDT

## 6.6 Echo Top Imagery

The WSR-88D Enhanced Echo Top product (EET) provides the highest sample with a minimum reflectivity of 18 dBZ, with a resolution of 1 km x 1°. Figure 17 is the KSRX WSR-88D enhanced echo tops product for 2055 CDT and shows the accident airplane turning right into echoes with maximum tops between 15,000 and 20,000 ft. The maximum echo tops approximately 5 miles east reached 36,400 ft.

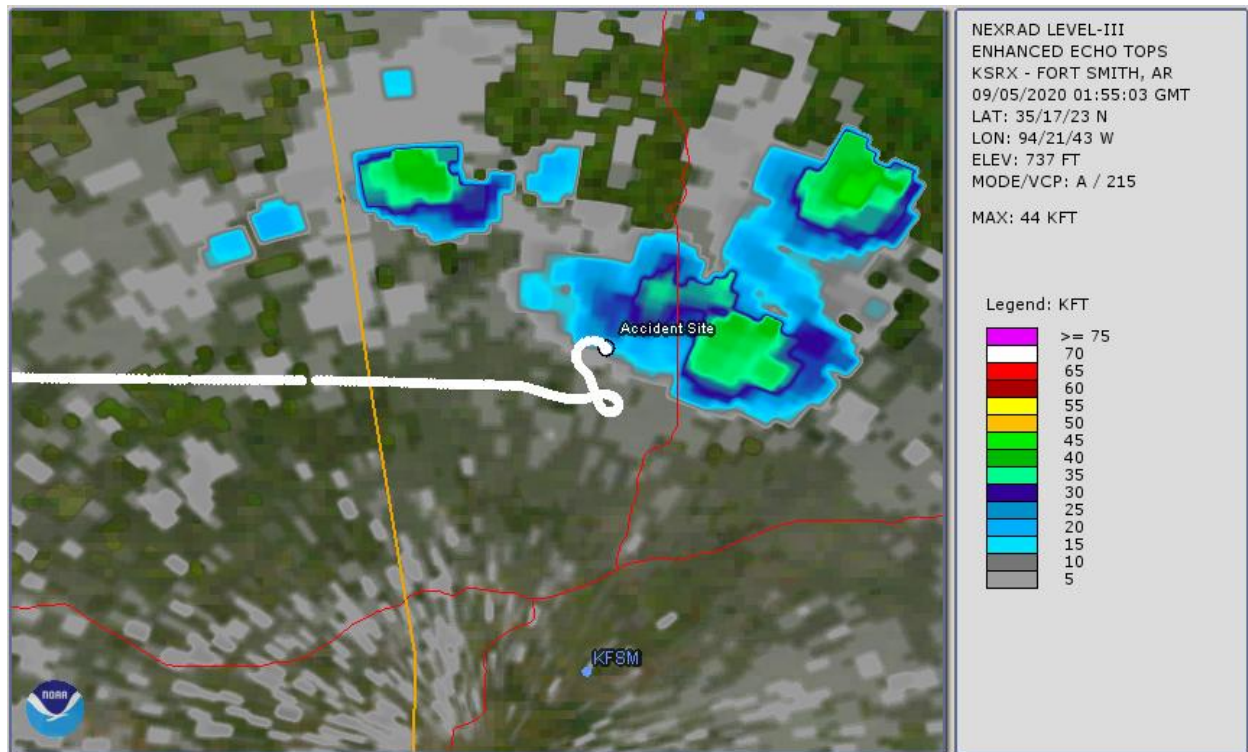


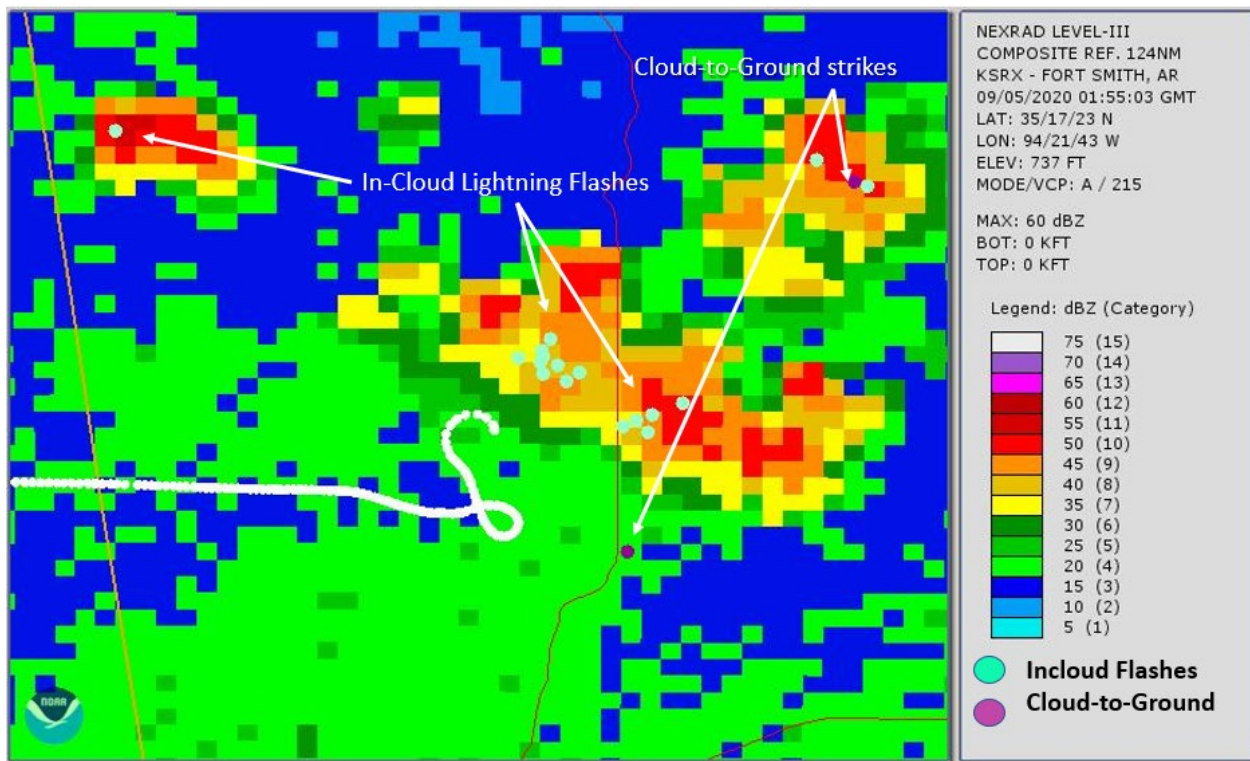
Figure 9 - KSRX WSR-88D Echo Tops Product for 2055 CDT

## 6.7 Lightning Data

Lightning data was obtained from the Earth Networks Total Lightning network and is displayed as figure 18 over the KSRX WSR-88D composite reflectivity image. Between 2035 through 2100 CDT there were 19 total lightning flashes<sup>24</sup> recorded in an approximately 10-mile radius of the accident site, with 2 cloud-to-ground lightning strikes and 17 in-cloud flashes. Of the in-cloud lightning flashes 14 were positively charged<sup>25</sup> and 3 negatively, with both cloud-to-ground flashes negatively charged. The closest in-cloud lightning flashes were detected approximately 2 miles northeast of the accident site, with no lightning flashes detected along the flight path.

<sup>24</sup> Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes.

<sup>25</sup> Positively charged lightning flashes typically originates in the cirrus anvil or the upper regions near the top of the thunderstorm, where a high positive charge resides.



**Figure 10 - Lightning flashes over the WSR-88D Composite Reflectivity Image at 2055 CDT**

A pilot flying a helicopter emergency medical flight in N760AF<sup>26</sup> from a hospital in Little Rock (KLIT) to near Springdale near the time of the accident provided a statement. He indicated that the storm he observed had almost constant lightning such that the storm could be seen easily from Little Rock. He estimated that the tops were near 40,000 ft or higher and it looked like a hot air balloon being lit from the inside by a very bright lamp. The lightning was so intense and constant that one of his crew members in the back of the airplane took a cell phone video of the storm (included in docket). The pilot indicated that it was the most intense lightning in any storm that he had ever seen in his 25 year aviation career.

## 6.8 Consolidated Storm Prediction for Aviation Data

The Federal Aviation Administration (FAA) Consolidated Storm Prediction for Aviation (CoSPA) imagery for 2055 CDT is included as figure 19. The CoSPA images provided that are available for displayed at the Air Route Traffic Control Center's (ARTCC) supervisor's position. The images below provide the general vertical integrated liquid (VIL) water levels 1-6 displayed similar to reflectivity levels, the GOES-16 satellite image for the period, with cloud-to-ground lightning, with echo tops and cell movement. The area of echoes in the vicinity of the accident site showed tops near 38,000 ft, with cloud-to-ground lightning activity, and with a movement vector indicated to the east at 5 knots. Another intense area of echoes was south of the area with significant lightning also indicated.

<sup>26</sup> Please see witness interview in the docket. N760AF took off at 2008 CDT and landed near Springdale at 2104 CDT, and passed to the east of the thunderstorms and the accident site.

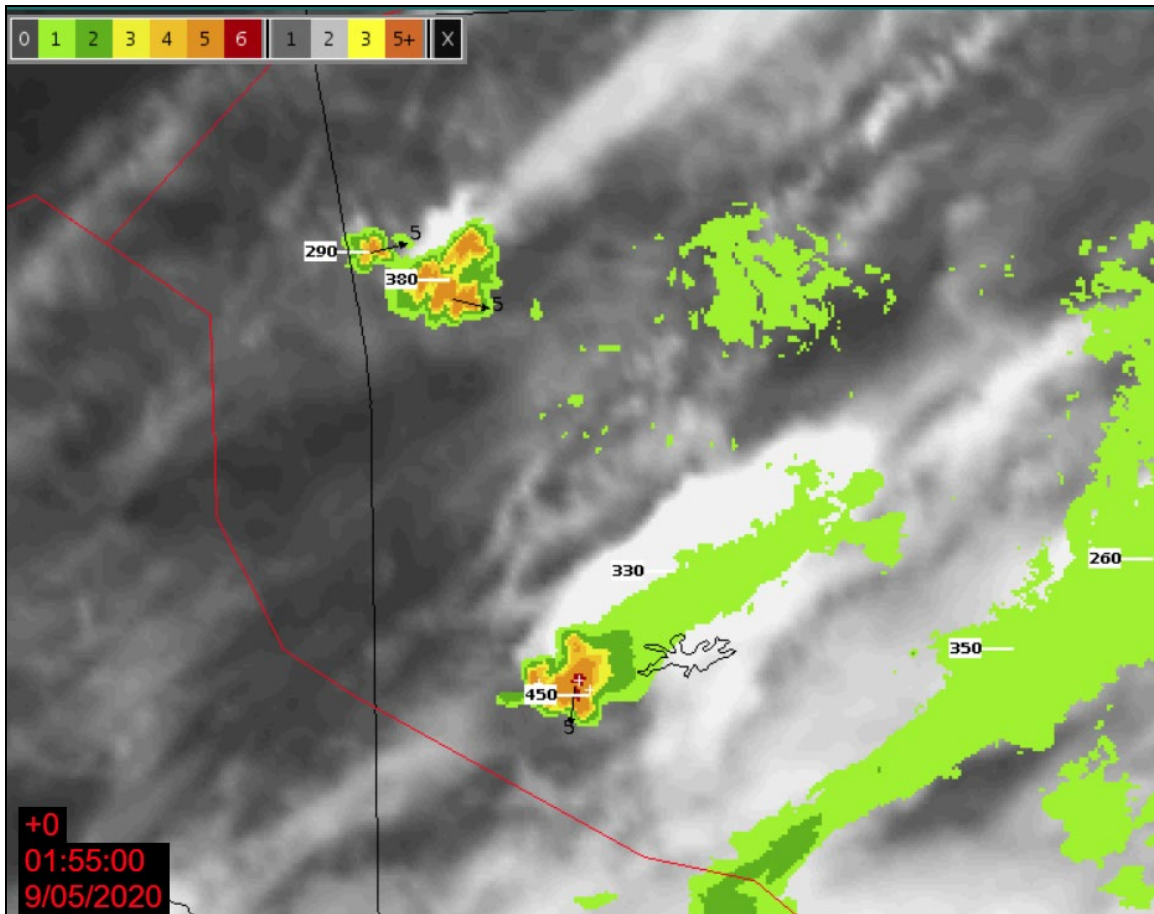


Figure 11 - CoSPA Radar image for 2055 CDT

## 7.0 NWS Forecasts and Advisories

The following NWS aviation forecasts and advisories were issued relevant to the accident flight.

### 7.1 Terminal Aerodrome Forecasts

The NWS Tulsa Weather Forecast Office (WFO) was responsible for the Chester, Arkansas area and issued the two closest Terminal Aerodrome Forecast (TAF) issued for KFSM and KXNA airports during the period. While a TAF is only valid for a 5 mile radius of the airport's center point, the TAFs along a typical route are often reviewed for the weather conditions along the general route of flight. The following TAFs were issued from the time prior to departure through the time of the accident for KFSM and KXNA, with the elements in bold type valid at the time of the accident.

#### Fort Smith (KFSM)

*TAF KFSM 041727Z 0418/0518 VRB04KT P6SM SCT030 SCT040  
FM041900 04006KT P6SM SCT040 BKN120*

*FM050500 09003KT P6SM SCT250  
TEMPO 0509/0512 5SM BR  
FM051500 08003KT P6SM SCT025=*

***AMD TAF KFSM 042105Z 0421/0518 00000KT P6SM VCTS SCT040CB BKN120  
TEMPO 0422/0424 VRB10G20KT  
FM050200 09003KT P6SM SCT250  
TEMPO 0509/0512 5SM BR  
FM051500 08003KT P6SM SCT025=***

***TAF KFSM 042320Z 0500/0524 VRB05KT P6SM VCTS SCT040CB BKN120  
FM050200 09003KT P6SM SCT250  
TEMPO 0509/0512 2SM BR SCT003  
FM051500 08003KT P6SM SCT025***

The initial forecast for KFSM issued at 1227 CDT for KFSM expected a wind from the 040° at 6 knots, visibility 6 miles or more, with scattered clouds at 4,000 ft agl, and ceiling broken at 12,000 ft. The forecast was amended at 1605 CDT and expected thunderstorms in the vicinity with scattered clouds at 4,000 ft in cumulonimbus clouds and ceiling broken at 12,000 ft, with a temporary period between 1700 and 1900 CDT of winds variable at 10 knots gusting to 20 knots. The next scheduled TAF was issued at 1820 CDT, which expected wind variable at 5 knots, visibility 6 miles or more, with thunderstorms in the vicinity, scattered clouds at 4,000 ft in cumulonimbus clouds, ceiling broken at 12,000 ft.

#### Fayetteville (KXNA)

***AMD TAF KXNA 042019Z 0420/0518 VRB05KT P6SM VCTS SCT040CB BKN120  
FM050200 VRB03KT P6SM SCT250  
TEMPO 0509/0512 1SM BR  
FM051500 VRB03KT P6SM SCT025=***

***AMD TAF KXNA 042241Z 0423/0518 VRB05KT P6SM VCTS SCT040CB BKN120  
TEMPO 0423/0502 VRB11G20KT 1 1/2SM TSRA BKN040CB  
FM050200 VRB03KT P6SM SCT250  
TEMPO 0509/0512 1SM BR  
FM051500 VRB03KT P6SM SCT025=***

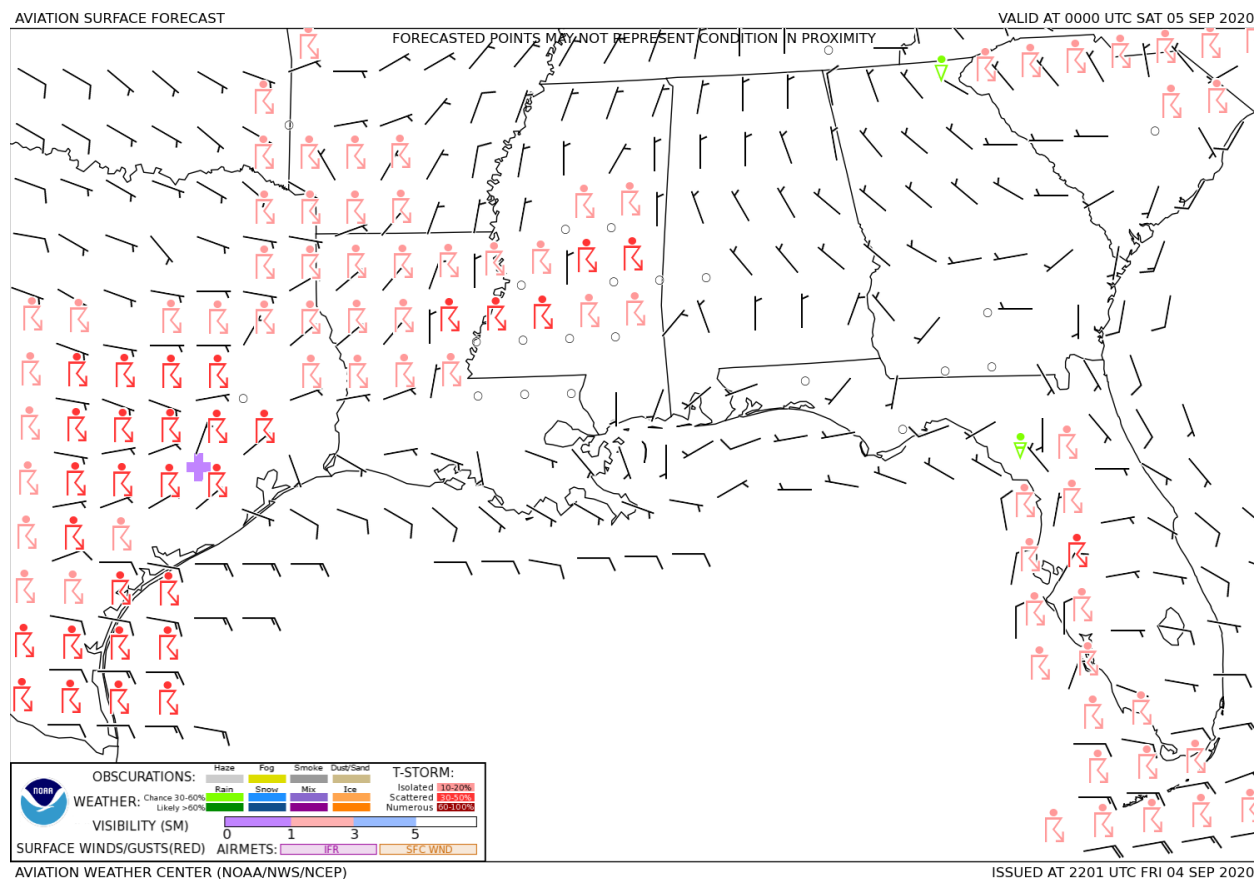
***TAF KXNA 042320Z 0500/0524 VRB05KT P6SM VCTS SCT050CB BKN120  
FM050200 VRB03KT P6SM SCT250  
FM050800 VRB02KT 3SM BR SCT002  
TEMPO 0509/0513 1SM BR VV002  
FM051300 22005KT P6SM SCT025=***

The amended forecast for KXNA issued at 1519 CDT expected a variable wind at 5 knots, visibility 6 miles or more, thunderstorms in the vicinity, with scattered clouds at 4,000 ft agl in cumulonimbus clouds, ceiling broken at 12,000 ft. Another amended was issued at 1741 CDT which included a temporary period between 1800 and 2100 CDT of wind variable at 11 knots gusting to 20 knots, visibility 1 ½ miles in thunderstorms and moderate rain, ceiling broken at 4,000 ft in cumulonimbus clouds. The next scheduled TAF was issued at 1820 CDT, which continued to expect thunderstorms in the vicinity of the airport.

## 7.2 Graphic Forecast for Aviation

The NWS Graphic Forecast for Aviation (GFA) product provides a graphical depiction of observations and forecasts of weather phenomena critical for aviation safety. The data include surface wind, weather, color coded general flight categories of visibility, and cloud cover, with the Graphic-Airmen's Meteorological Information (G-AIRMET) for IFR conditions, mountain obscuration, and icing conditions overlaid. The GFA is available at the NWS AWC website and through other weather briefing providers.

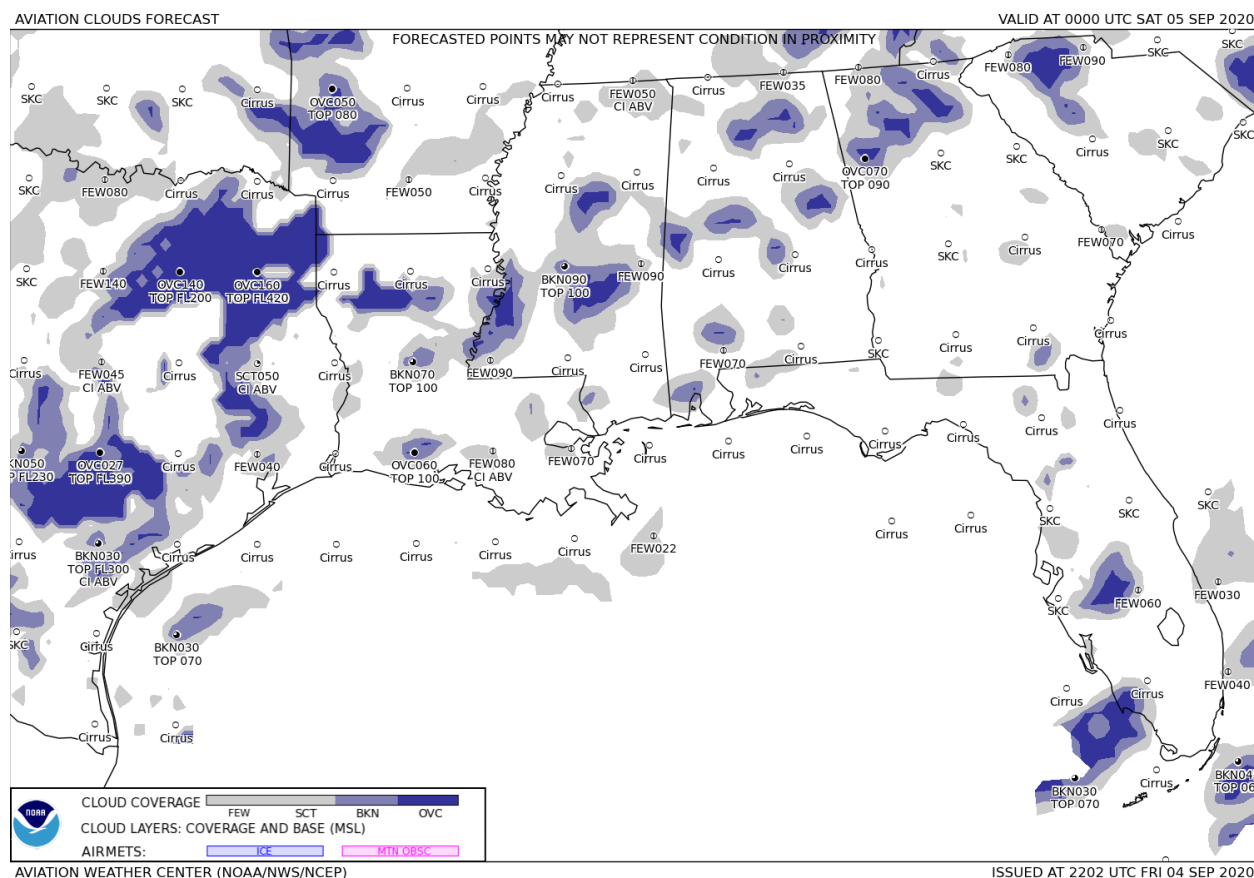
Figure 20 is the GFA Surface Forecast<sup>27</sup> issued at 1701 CDT and valid for the period between 1900 and 2200 CDT for the southeastern section of the county. The chart depicted light east to east-northeast winds of 5 knots or less, visibility better than 6 miles, with a chance of thunderstorms over the area. No G-AIRMETs for IFR conditions or high surface winds were expected over the region during the period.



**Figure 12 - Graphic Forecast for Aviation Surface Forecast valid for 1900 CDT**

<sup>27</sup> The GFA Surface Forecast depicted the expected surface wind, visibility, flight category, precipitation and weather from data output from the NWS Localized Aviation Model Output Statistics Product (LAMP), with any G-AIRMETs for IFR conditions expected for the period.

Figure 21 is the GFA Cloud Forecast<sup>28</sup> issued at 1702 CDT and valid for 1900 CDT. The GFA Cloud Forecast depicted a small area of broken to overcast clouds over extreme western Arkansas in the vicinity of the accident site.



**Figure 13 – Graphic Forecast for Aviation Cloud Forecast valid for 1900 CDT**

### 7.3 Winds Aloft Forecast

The NWS Winds and Temperature Aloft Forecast taken from the FBUS bulletin for the general route of flight current during the period was as follows.

#### *WINDS ALOFT FORECASTS*

*DATA BASED ON 041800Z*

*VALID 050000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000*

| FT         | 3000 | 6000    | 9000    | 12000   | 18000   | 24000   | 30000  | 34000  | 39000  |
|------------|------|---------|---------|---------|---------|---------|--------|--------|--------|
| <b>FSM</b> | 1012 | 9900+17 | 9900+11 | 9900+06 | 3408-07 | 3012-18 | 252235 | 244744 | 246455 |
| <b>TUL</b> | 1308 | 9900+17 | 3606+12 | 9900+07 | 3512-07 | 2915-19 | 272137 | 253446 | 244254 |
| <b>LIT</b> | 0210 | 0509+17 | 0306+12 | 3008+07 | 0105-07 | 3206-19 | 252433 | 243743 | 245455 |

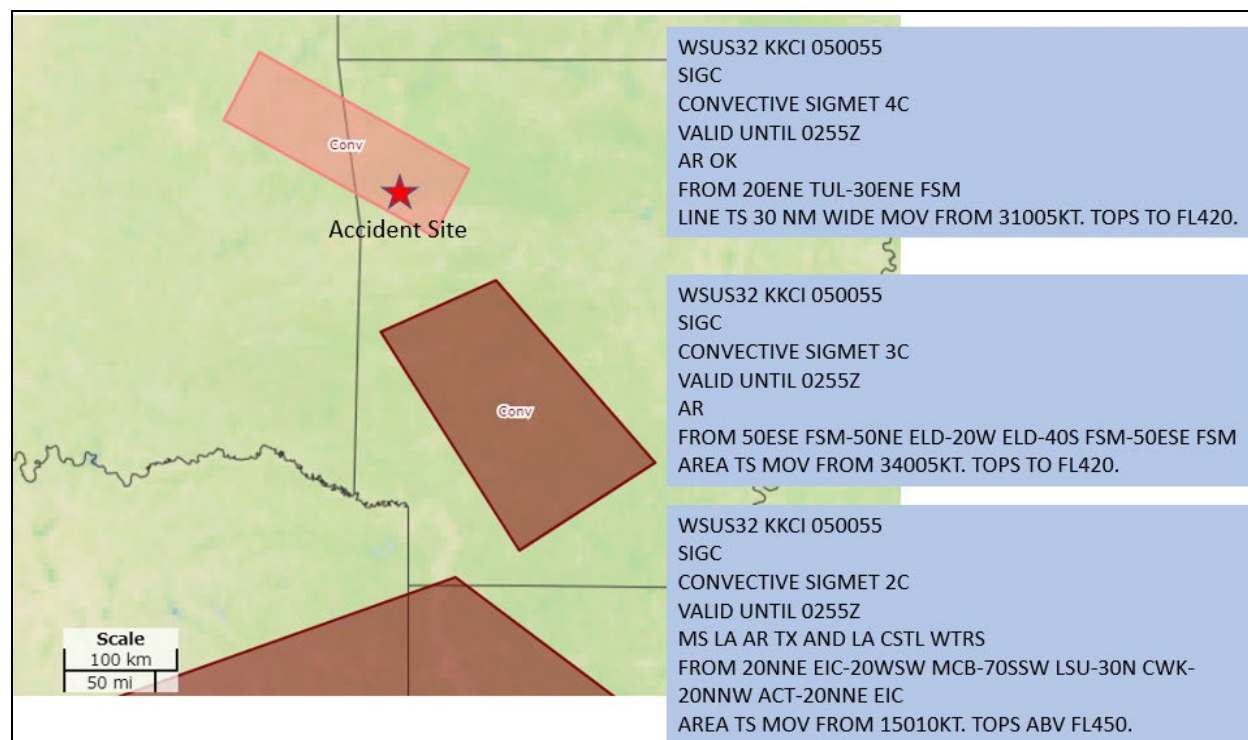
<sup>28</sup> The GFA Cloud forecast is obtained from primary data are derived from the NWS Rapid Refresh (RAP) continental-scale NOAA hourly-updated assimilation modeling system run operational at NCEP to produce cloud layers, bases, and tops. Cloud heights from the model are in ft msl.

The forecast for FSM expected at 3,000 ft a wind from 100° at 12 knots, at 6,000 ft winds light and variable with a temperature of 17° C, and at 9,000 ft wind light and variable with a temperature of 11° C.

#### 7.4 In-Flight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of the development or presence 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, AIRMET, and the Center Weather Advisory (CWA).

During the period the NWS AWC issued a series of Convective SIGMETs, the first was issued at 1955 CDT, which is depicted in figure 22. Convective SIGMET 4C was valid for 2-hours or until superseded by the next hourly issuance advisory. The advisory was issued for a line of thunderstorms 30 miles wide over Oklahoma and Arkansas and included the accident site. The line was expected to move to the southeast, or from 310° at 5 knots, with tops to 42,000 ft. Other Convective SIGMETs (3C and 2C) were issued for areas of thunderstorms over southern Arkansas and eastern Texas and Louisiana.



**Figure 14 - Convective SIGMETs issued at 1955 CDT**

At 2055 CDT (figure 23) the NWS issued Convective SIGMET 10C over southern Arkansas but did not update the previous advisory over the accident site for the line of thunderstorms and

let that area expire. There were no other CWA's, or AIRMETs current for any IFR conditions, turbulence, or icing conditions outside of convective activity.

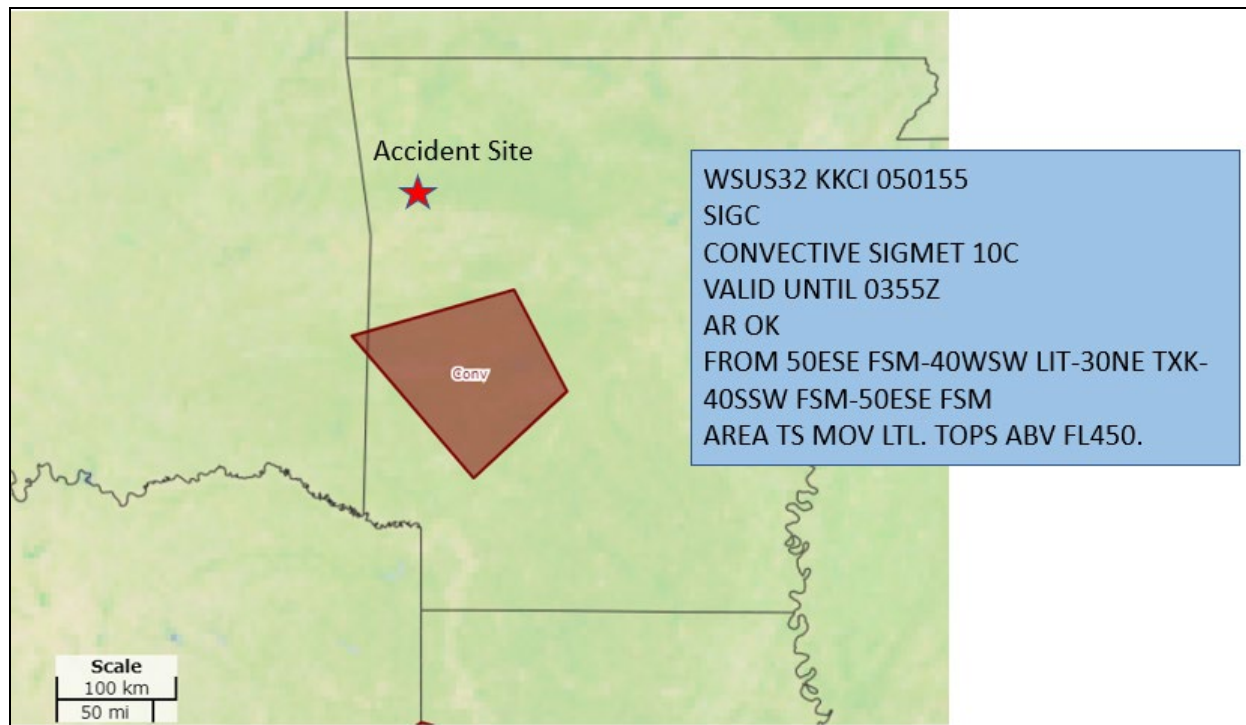


Figure 15 - Convective SIGMET issued at 2055 CDT or at the time of the accident

## 8.0 Astronomical Data

The United States Naval Observatory Multiyear Interactive Computer Almanac (MICA) software was used to provide the following astronomical data over the approximate accident site in Chester, Arkansas, on September 4, 2020. The time of the accident has been added in bold italic print for reference.

### SUN

|                             |                        |
|-----------------------------|------------------------|
| Beginning of civil twilight | 0626 CDT               |
| Sunrise                     | 0652 CDT               |
| Sun transit                 | 1315 CDT               |
| Sunset                      | 1939 CDT               |
| End of civil twilight       | 2005 CDT               |
| <b><i>Accident</i></b>      | <b><i>2055 CDT</i></b> |

### MOON

|                  |                            |
|------------------|----------------------------|
| Moonrise         | 2117 CDT                   |
| Moon culmination | 0250 CDT September 5, 2020 |
| Moonset          | 0857 CDT                   |

At the time of the accident the Sun had set and was approximately  $-15^{\circ}$  below the horizon at an azimuth of  $290^{\circ}$ . The Moon had not risen and was  $-5^{\circ}$  below the horizon at an azimuth of  $85^{\circ}$  in a waxing gibbous phase with approximately 94% of the Moon's disk illuminated when visible above the horizon.

## 9.0 Weather Briefing Information

A search of the FAA contract Flight Service Station (AFSS) provider Leidos indicated that they had no contact from the pilot for any weather briefing services, or in-flight contacts. ForeFlight indicated that the pilot of N733CD had requested a standard weather briefing at 0026 CDT on September 4, 2020 or approximately 17 hours prior to the accident aircraft's estimated time of departure (ETD). The request was for the route of flight between KMKO and KLQK, with a planned altitude of 7,500 ft, a planned estimated time of departure of 1730 CDT, an estimated time enroute of 4:08, and an estimated time of arrival at 2238 EDT. The computer derived weather briefing is included as Attachment 1, with the Notice to Airmen (NOTAMs) and special notices excluded as no major outages or restrictions for the route were noted. Foreflight further indicated that the pilot did not request or open any other weather imagery in the Foreflight app prior to the flight. There were no records of any requests for any updates during the period leading up to the time of the accident.

## 10.0 Weather Briefing References

The FAA Advisory Circular AC 00-45H change 2, section 1.3.1 discusses weather briefings and defines the different kinds of briefings pilots should obtain and defined the type of product or information that should be included. The following types of weather briefings are defined.

### 1.3.1.1 Standard Briefing

*A standard briefing includes provides a complete weather picture and is the most detailed of all briefings. This type of briefing should be obtained prior to the departure of any flight and should be used during the flight planning. A standard briefing provides the following information (if applicable to the route of flight) in sequential order:*

- **Adverse Conditions.** *This includes information about adverse conditions that may influence a decision to cancel or alter the route of flight. Adverse conditions include significant weather (e.g., thunderstorms, aircraft icing, turbulence, windshear, mountain obscuration, and areas of current and forecasted IFR conditions) and other important items, such as airport/runway closings, air traffic delays, and temporary flight restrictions (TFR).*
- **VFR flight NOT RECOMMENDED (VNR.)** *If the weather for the route of flight is below VFR minimums, or if it is doubtful the flight can be made under VFR conditions due to the forecasted weather, the briefer may state that VFR is not recommended. The pilot can then decide whether or not to continue the flight under VFR, but this advisory should be weighed carefully. This advisory is not provided via the Internet.*

- **Synopsis.** The synopsis is an overview of the larger weather picture. Fronts and major weather systems along or near the route of flight and weather that may affect the flight are provided.
- **Current Conditions.** This portion of the briefing contains the current surface weather observations, PIREPs, and satellite and radar data along the route of flight. If the departure time is more than 2 hours away, current conditions will not be included in the briefing.
- **En Route Forecast.** The en route forecast is a summary of the weather forecast for the proposed route of flight.
- **Destination Forecast.** The destination forecast is a summary of the expected weather for the destination airport at the estimated time of arrival (ETA).
- **Winds and Temperature Aloft.** Winds and temperatures aloft is a forecast of the winds at specific altitudes along the route of flight. However, the temperature information is provided only on request.
- **NOTAMs.** This portion supplies NOTAM information that has not been published in the NOTAM publication, but is pertinent to the route of flight. Published NOTAM information is provided during the briefing only on request.
- **Prohibited Areas and Special Flight Rules Areas (SFRA).** Information on Prohibited Areas P-40 and P-56, and the SFRA for Washington, D.C. are given when appropriate to the route of flight.
- **ATC Delays.** This is an advisory of any known ATC delays that may affect the flight.
- **Other Information.** Any additional information requested is also provided at this time.

#### **1.3.1.2 Abbreviated Briefing.**

An abbreviated briefing is a shortened version of the standard briefing. It should be requested when a departure has been delayed or when specific weather information is needed to update a previous standard briefing. When this is the case, the weather specialist needs to know the time and source of the previous briefing so he or she does not inadvertently omit the necessary weather information.

#### **1.3.1.3 Outlook Briefing.**

An outlook briefing should be requested when a planned departure is 6 or more hours away. It provides initial forecast information that is limited in scope due to the timeframe of the planned flight. This type of briefing is a good source of flight planning information that can influence decisions regarding route of flight, altitude, and ultimately the “go, no-go” decision. A follow-up standard briefing prior to departure is advisable, since an outlook briefing generally only contains information based on weather trends and existing weather in geographical areas at or near the departure airport.

## **F. LIST OF ATTACHMENTS**

Attachment 1: Weather briefing information

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