NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

May 29, 2018

Weather Study

METEOROLOGY

ERA18FA114

Table Of Contents

A. ACCIDENT

Location: Hydro, Oklahoma
Date: March 25, 2018
Time: 2137 central daylight time (0237 UTC[1] on March 26, 2018)
Airplane: Beech V35A; N7019N

B. METEOROLOGIST

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C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in central daylight time (CDT) for March 25, 2018 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl) unless otherwise noted.

Coordinates used for the accident location: 35.454444° north latitude, 98.562778° west longitude, at an elevation of about 1,675 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

The National Weather Service (NWS) Surface Analysis Chart for 2200 CDT is presented in figure 1. The surface analysis chart identified a warm front stretching northward from northeast Texas into central Oklahoma and then extending westward. The NWS Surface Analysis Chart depicted this front as stationary in western Oklahoma, which extended west-northwestward through the Texas and Oklahoma Panhandles into southeastern Colorado. A surface low pressure center of 1001 hectopascals (hPa) was identified in southeastern Colorado. In the accident region, along and ahead of the warm front, station models depicted sky conditions as overcast, with station models behind the warm front depicting sky conditions as clear below 12,000 feet. In the accident region surface winds were generally from the southeast to east at magnitudes of 10-15 knots. Dew point depressions ranged from 0° to 7° degrees Fahrenheit.

[1] UTC – abbreviation for Coordinated Universal Time

A WSR-88D regional radar composite reflectivity mosaic obtained from the National Centers for Environmental Information (NCEI) for 2135 CDT (figure 2) did not depict any echoes across the accident region.

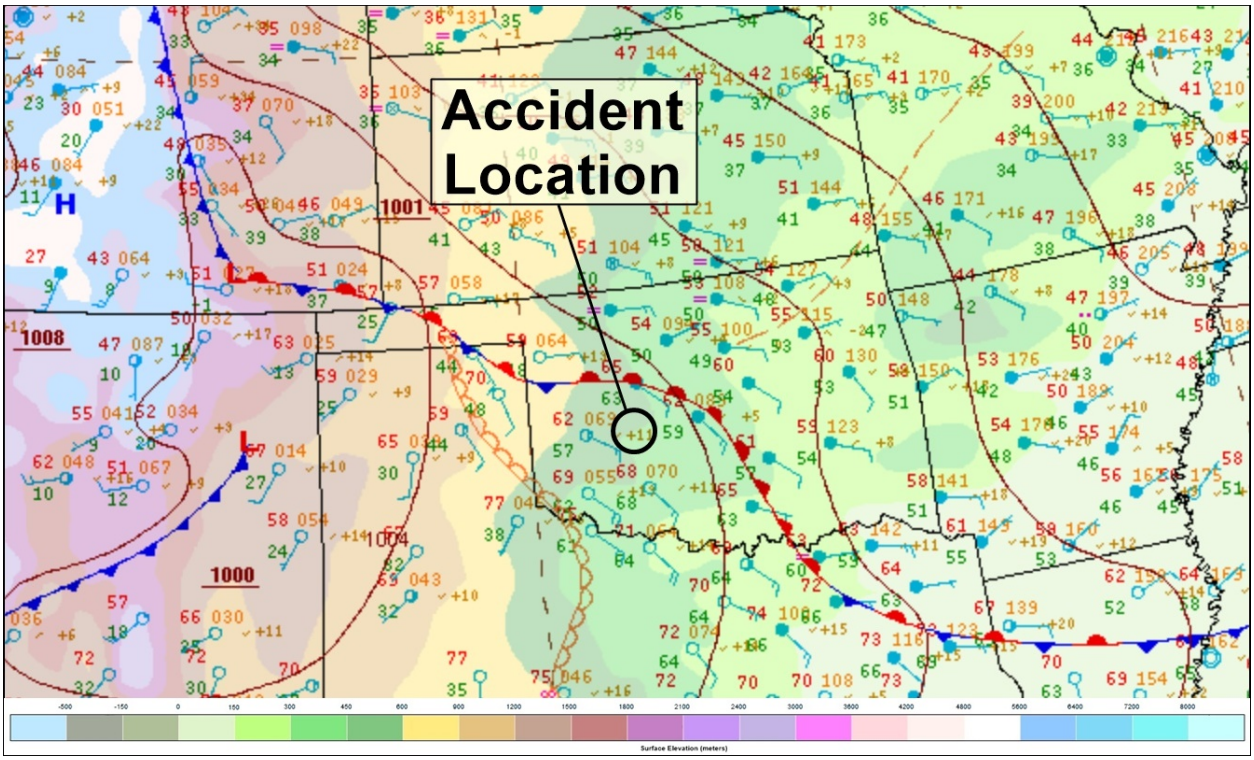

Figure 1 - NWS Surface Analysis Chart for 2200 CDT.

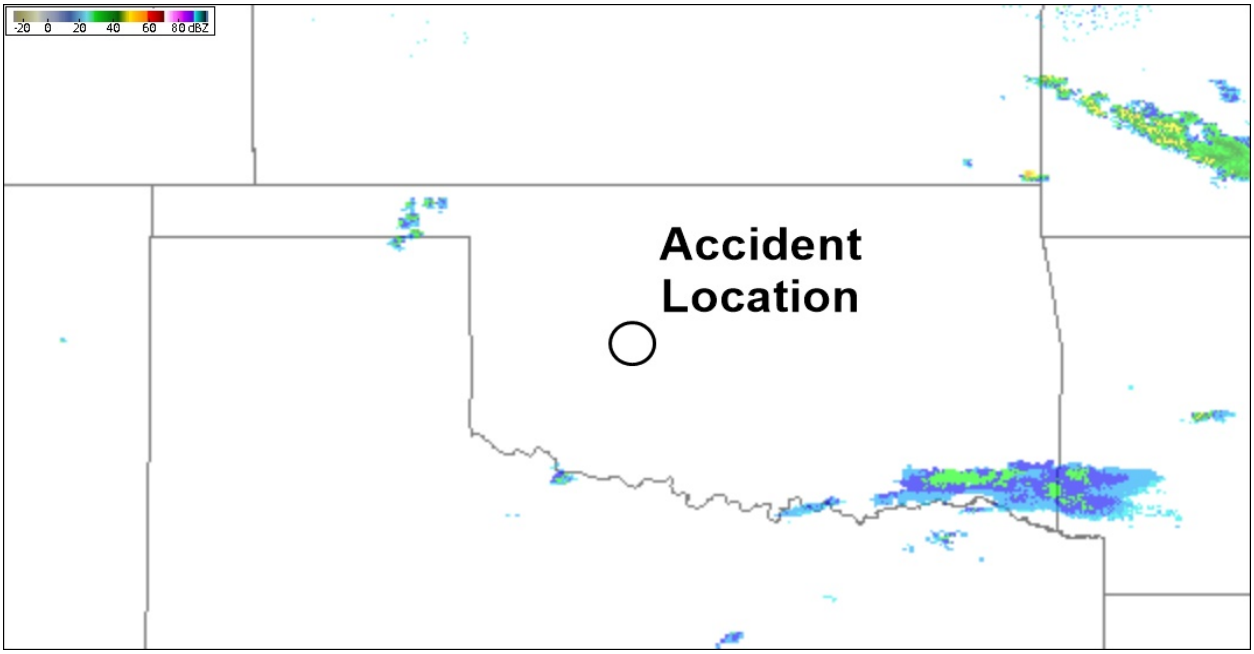

Figure 2 – NCEI WSR-88D mosaic from 2135 CDT.

2.0 Surface Observations

An Automated Weather Observing System (AWOS) was located at Thomas P. Stafford Airport (OJA)[2] in Weatherford, Oklahoma, which was located about 7 miles northwest of the accident location at an elevation of about 1,600 feet. Automated observations from OJA during the times surrounding the accident time are presented here. Select observations that highlight changes in sky condition and/or visibility are emphasized.

[1955 CDT] METAR KOJA 260055Z AUTO 13015KT 10SM CLR 20/13 A2974 RMK AO2=

[2015 CDT] METAR KOJA 260115Z AUTO 13017G22KT 10SM CLR 19/15 A2975 RMK AO2=

[2035 CDT] METAR KOJA 260135Z AUTO 13017G22KT 10SM SCT024 18/15 A2976 RMK AO2=

[2055 CDT] METAR KOJA 260155Z AUTO 13014G20KT 7SM SCT024 17/15 A2975 RMK AO2=

[2115 CDT] METAR KOJA 260215Z AUTO 13014G20KT 7SM SCT010 SCT013 17/16 A2976 RMK AO2=

[2135 CDT] METAR KOJA 260235Z AUTO 12011G18KT 7SM OVC008 17/16 A2977 RMK AO2=

[2155 CDT] METAR KOJA 260255Z AUTO 12009G14KT 7SM OVC008 17/17 A2977 RMK AO2=

At 2015 CDT, OJA reported a wind from 130° at 17 knots with gusts to 22 knots, visibility of 10 statute miles or greater, clear skies below 12,000 feet above ground level (agl), temperature 19° Celsius (C) and dew point temperature 15°C, altimeter setting of 29.75 inches of mercury; remarks: station with a precipitation discriminator.

At 2055 CDT, OJA reported a wind from 130° at 14 knots with gusts to 20 knots, visibility of 7 statute miles, scattered clouds at 2,400 feet agl, temperature 17°C and dew point temperature 15°C, altimeter setting of 29.75 inches of mercury; remarks: station with a precipitation discriminator.

At 2135 CDT, OJA reported a wind from 120° at 11 knots with gusts to 18 knots, visibility of 7 statute miles, ceiling overcast at 800 feet agl, temperature 17°C and dew point temperature 16°C, altimeter setting of 29.77 inches of mercury; remarks: station with a precipitation discriminator.

An AWOS was located at Watonga Regional Airport (JWG) in Watonga, Oklahoma, which was located about 25 miles north-northeast of the accident location at an elevation of about 1,550 feet.

[2] The NWS uses the 4-digit International Civil Aviation Organization (ICAO) format for station identifiers (as seen in the body of some formatted weather observations). This report uses the 3-digit International Air Transport Association format for station identification, which does not use the geographic designating digit ("K" for stations in the continental U.S. and "P" for U.S. stations in Alaska and the Pacific region) as found in the ICAO format.

Automated observations from JWG during the times surrounding the accident time are presented here. Select observations that highlight changes in sky condition and/or visibility are emphasized.

[1955 CDT] METAR KJWG 260055Z AUTO 10015G18KT 10SM CLR 18/14 A2977 RMK AO2 T01830136=

[2015 CDT] METAR KJWG 260115Z AUTO 11012KT 10SM SCT015 18/14 A2977 RMK AO2 T01760140=

[2035 CDT] METAR KJWG 260135Z AUTO 12011G18KT 10SM BKN015 18/15 A2977 RMK AO2 T01770148=

[2055 CDT] METAR KJWG 260155Z AUTO 12011G19KT 10SM OVC011 18/16 A2977 RMK AO2 T01810156=

[2115 CDT] METAR KJWG 260215Z AUTO 12010G17KT 10SM OVC011 18/17 A2978 RMK AO2 T01820165=

[2135 CDT] METAR KJWG 260235Z AUTO 12014G18KT 7SM OVC009 18/17 A2979 RMK AO2 T01830173=

[2155 CDT] METAR KJWG 260255Z AUTO 13011G17KT 7SM OVC009 18/17 A2980 RMK AO2 T01810173=

At 1955 CDT, JWG reported a wind from 100° at 15 knots with gusts to 18 knots, visibility of 10 statute miles or greater, sky clear below 12,000 feet agl, temperature 18°C and dew point temperature 14°C, altimeter setting of 29.77 inches of mercury; remarks included: station with a precipitation discriminator.

At 2015 CDT, JWG reported a wind from 110° at 12 knots, visibility of 10 statute miles or greater, scattered clouds at 1,500 feet agl, temperature 18°C and dew point temperature 14°C, altimeter setting of 29.77 inches of mercury; remarks included: station with a precipitation discriminator.

At 2055 CDT, JWG reported a wind from 120° at 11 knots with gusts to 19 knots, visibility of 10 statute miles or greater, ceiling overcast at 1,100 feet agl, temperature 18°C and dew point temperature 16°C, altimeter setting of 29.77 inches of mercury; remarks included: station with a precipitation discriminator.

An AWOS was located at El Reno Regional Airport (RQO) in El Reno, Oklahoma, which was located about 27 miles east of the accident location at an elevation of about 1,420 feet. Automated observations from RQO during times prior to the accident time are presented here. Select observations that highlight changes in sky condition and/or visibility are emphasized.

[1835 CDT] METAR KRQO 252335Z AUTO 13013KT 7SM HZ CLR 20/14 A2980 RMK AO2 T01980137=

[1855 CDT] METAR KRQO 252355Z AUTO 13018G21KT 7SM HZ SCT014 19/15 A2979 RMK AO2 T01920148 10224 20134 402240064=

[1915 CDT] METAR KRQO 260015Z AUTO 12014KT 7SM HZ SCT014 18/14 A2979 RMK AO2 T01810144=

[1935 CDT] METAR KRQO 260035Z AUTO 13019KT 7SM HZ SCT012 18/15 A2979 RMK AO2 T01770151=

[1955 CDT] METAR KRQO 260055Z AUTO 13015KT 7SM BR BKN012 18/16 A2979 RMK AO2 T01800155=

[2015 CDT] METAR KRQO 260115Z AUTO 13016KT 7SM OVC010 18/16 A2979 RMK AO2 T01790155=

At 1835 CDT, RQO reported a wind from 130° at 13 knots, visibility of 7 statute miles, haze, sky clear below 12000 feet agl, temperature 20°C and dew point temperature 14°C, altimeter setting of 29.80 inches of mercury; remarks included: station with a precipitation discriminator.

At 1835 CDT, RQO reported a wind from 130° at 18 knots with gusts to 21 knots, visibility of 7 statute miles, haze, scattered clouds below 1,400 feet agl, temperature 19°C and dew point temperature 15°C, altimeter setting of 29.79 inches of mercury; remarks included: station with a precipitation discriminator.

At 2015 CDT, RQO reported a wind from 130° at 16 knots, visibility of 7 statute miles, ceiling overcast at 1,000 agl, temperature 18°C and dew point temperature 16°C, altimeter setting of 29.79 inches of mercury; remarks included: station with a precipitation discriminator.

3.0 Pilot Reports

All region publicly-disseminated pilot reports (PIREPs)[3] made within two hours of the accident time originated from the Oklahoma City, Oklahoma, area, which was centered roughly 50 miles east of the accident location. These aircraft reported overcast cloud conditions as low as 1,200 feet agl and as high as 3,800 feet agl.

PWA UA /OV 4 NM N PWA/TM 0057/FL038/TP C560/SK OVC012 TOPS 038=

OKC UA /OV 7N OKC/TM 0136/FL036/TP B737/SK OVC MULTIPLE LAYERS/RM TOPS 036 RPTD DURD=

OKC UA /OV 4 N OKC/TM 0303/FL033/TP B737/SK OVC/WX 9/RM BASES 018 TOPS 033=

OKC UA /OV 8 N OKC/TM 0340/FL2000/TP B737/RM BASES RPTD 2000 TOPS 3200=

OKC UA /OV 5 NORTH OKC/TM 0343/FL032/TP B737/SK OVC=

OKC UA /OV 2 NORTH OKC/TM 0345/FL020/TP B737/SK OVC=

[3] Only pilot reports with the WMO header UBOK** were considered. Pilot reports publicly-disseminated only over radio were not captured.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model[4] sounding (figure 3) valid for the accident location at 2200 CDT was retrieved from the NOAA Air Resources Laboratory. The wind near the surface was from the southeast at about 15 knots. Above this level, the wind *veered*[5] slightly and increased in magnitude to a south-southeast wind of about 40 knots at about 3,750 feet. Above this level the wind continued to veer and decreased in magnitude to a south-southwest wind of about 30 knots at about 7,200 feet. Between near the surface and about 3,500 feet the relative humidity was 94 percent or greater. The freezing level was at about 12,500. Below 5,000 feet, calculations made by the Rawinsonde OBservation Program (RAOB) identified a risk of moderate turbulence very near the surface and between about 2,200 and 2,600 feet and identified a light low level wind (LLWS) shear threat below 2,600 feet with a moderate LLWS threat very near the surface.

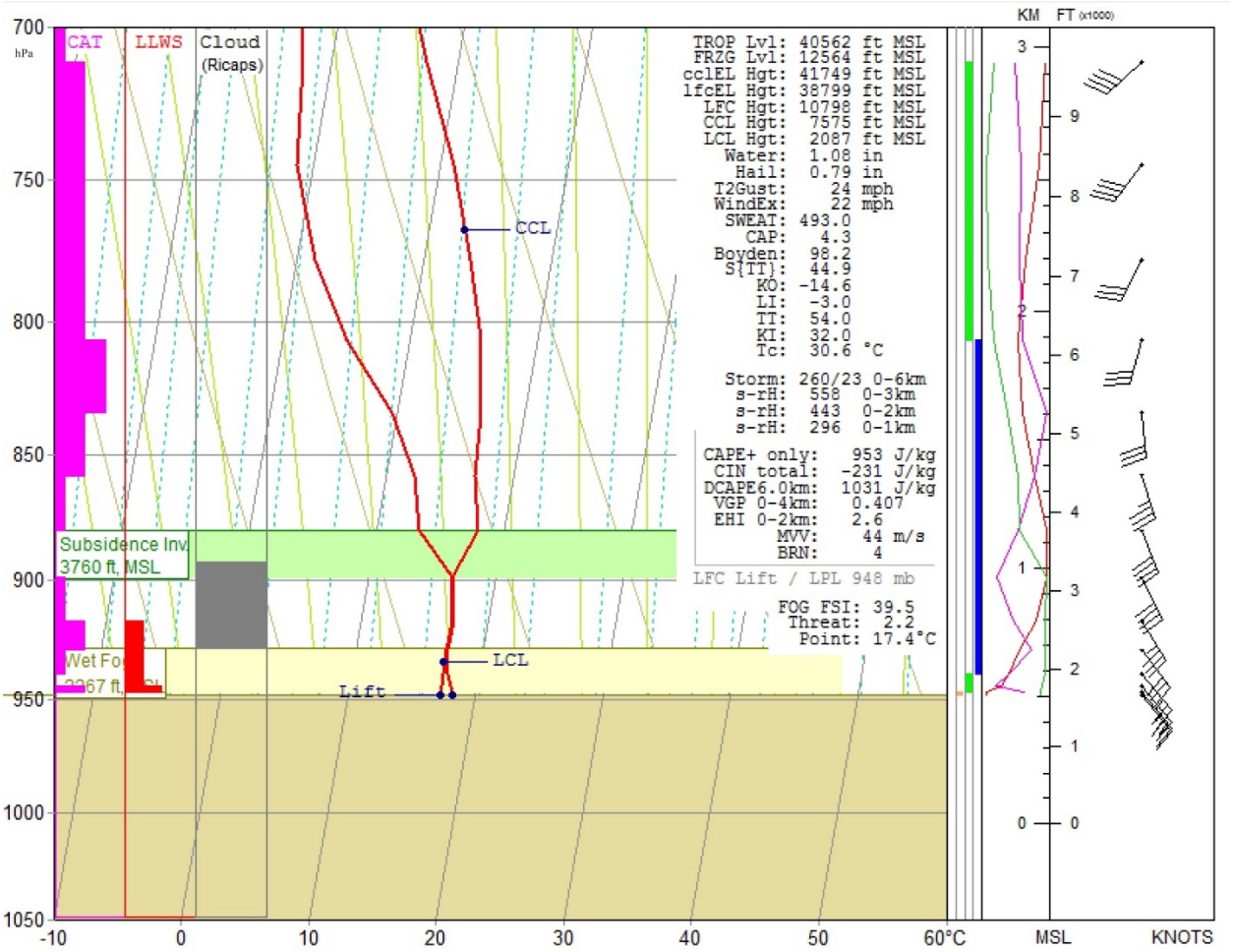

Figure 3 – HRRR model sounding data in SkewT/LogP format for 2200 CDT at the accident site, surface to 700 hPa.

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

[5] A veering wind's wind barbs turns clock-wise with increasing height.

5.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-16 infrared (12.3µm, 10.3µm and 3.89µm) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 2137 CDT are presented in figures 4 and 5. 10µm cloud-top temperatures (figure 4) immediately surrounding the accident location were between 12°C and -27°C, which, according to the HRRR model sounding, corresponded to cloud top heights of between 8,000 and 25,500 feet msl. "Nighttime microphysical RGB" imagery is presented in figure 5. This imagery is useful in identifying height and phase of cloud when sunlight is absent and is created by combining various GOES-16 infrared bands into a red, blue and green combination.[6] At the time of the accident, the nighttime microphysical RGB imagery identified low, warm cloud in the accident region.

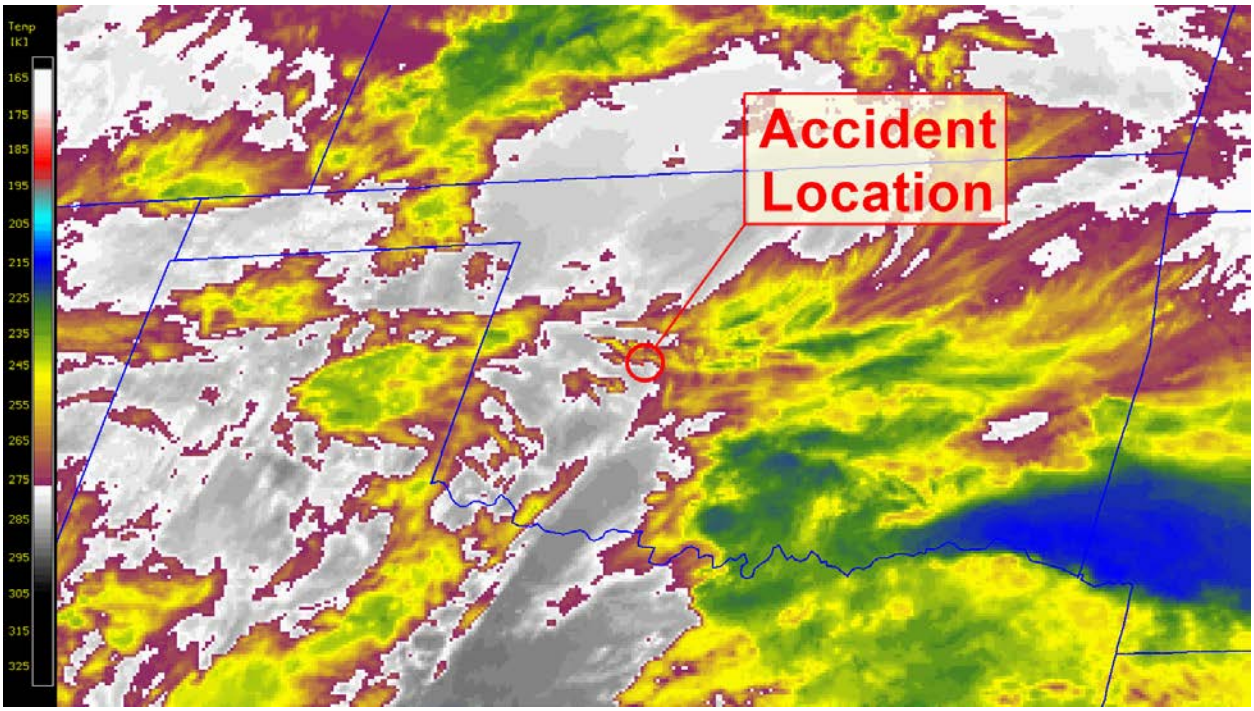

Figure 4 – GOES-16 infrared (10.3µm) brightness temperature (degrees Kelvin) imagery from 2137 CDT.

[6] Further information can be found here: https://weather.msfc.nasa.gov/sport/training/quickGuides/rgb/QuickGuide_NtMicro_GOESR_NASA_SPoRT_20170914.pdf

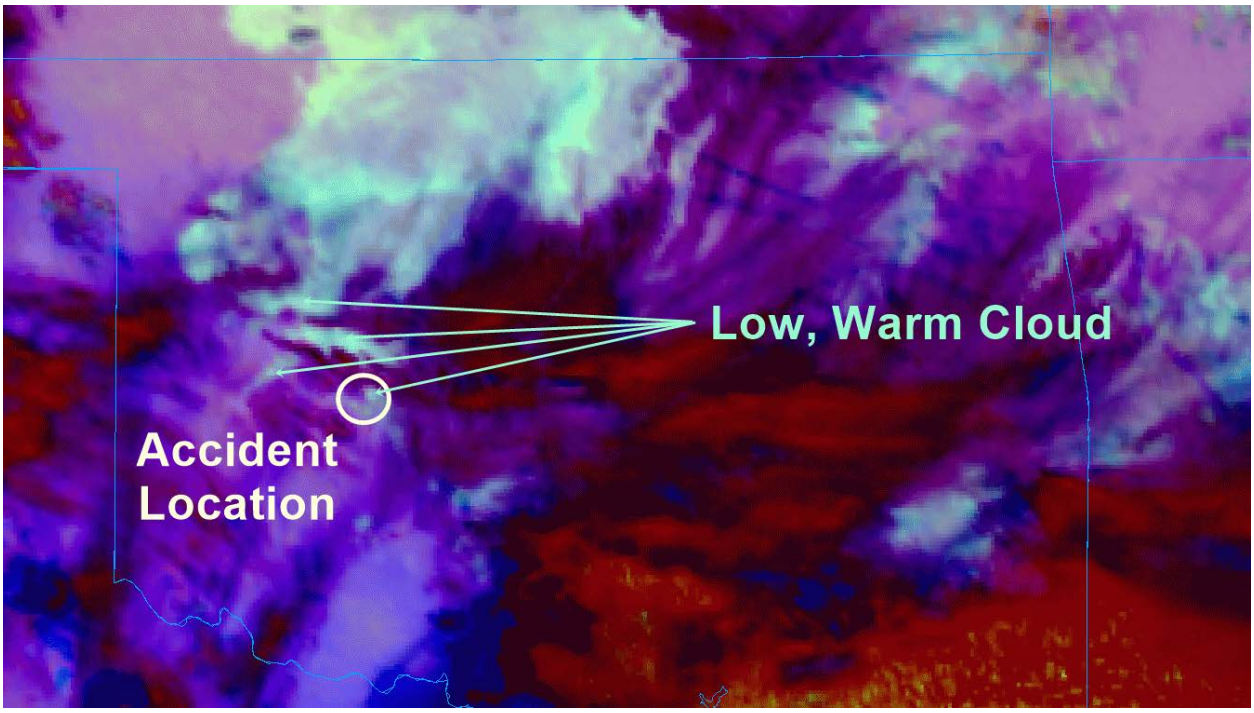

Figure 5 – GOES-16 "Nighttime Microphysical RGB" imagery from 2137 CDT.

6.0 AIRMETs for Turbulence, LLWS and IFR Conditions

Amended Airmen's Meteorological Information (AIRMET) TANGO advisories for moderate turbulence and LLWS potential were issued at 1630 CDT by the NWS Aviation Weather Center (AWC) and were active for the accident site at the accident time.

WAUS44 KKCI 252130 AAA
WA4T
-DFWT WA 252130 AMD
AIRMET TANGO UPDT 4 FOR TURB AND LLWS VALID UNTIL 260300
.
AIRMET TURB...OK TX AR LA KS...UPDT
FROM 20NW SLN TO 60W BUM TO 30WSW RZC TO 20SSE FSM TO 30SSW EIC TO 20WNW DLF TO 90S MRF TO 20W ELP TO INK TO 30ESE TBE TO 50W LBL TO 40SSW GLD TO 20NW SLN
MOD TURB BLW 140. CONDS CONTG BYD 03Z THRU 09Z.
.
LLWS POTENTIAL...OK TX KS
BOUNDED BY GLD-20SE HLC-70ESE GCK-50W OSW-20ESE TUL-20ENE MLC-20ENE OKC-20WSW OKC-20NE SPS-30SE CDS-GLD
LLWS EXP. CONDS DVLPG 00-03Z. CONDS CONTG BYD 03Z THRU 09Z.

An AIRMET SIERRA advisory for IFR[7] conditions was issued at 1545 CDT by the AWC for a region that included a portion of Oklahoma to the east of the accident location and the accident aircraft's destination of El Reno Regional Airport (RQO) in El Reno, Oklahoma.

WAUS44 KKCI 252045
WA4S
-DFWS WA 252045
AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 260300
.
AIRMET IFR...OK TX AR KS
FROM 50ESE SLN TO 30ENE TUL TO 30SE RZC TO 60SE FSM TO 20NE TXK TO 40NNW GGG TO 50SE ADM TO 20NNW ADM TO 70WNW ICT TO 30NNW ICT TO 50ESE SLN
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS DVLPG 00-03Z. CONDS CONTG BYD 03Z THRU 09Z.

At 2145 CDT (eight minutes after the accident time), the AWC issued an AIRMET SIERRA advisory for IFR conditions that included the accident location.

WAUS44 KKCI 260245
WA4S
-DFWS WA 260245
AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 260900
.
AIRMET IFR...OK TX AR
FROM OSW TO 20SE RZC TO 30SE FSM TO 60S MLC TO 40SSW ADM TO 40SW MMB TO 20W LBL TO 40N MMB TO OSW
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.

7.0 SIGMETs

There were no Significant Meteorological Information (SIGMET) advisories active for the accident location at the accident time.

8.0 Area Forecast Discussion

An amended Area Forecast Discussion (AFD) that covered the accident location was issued at 2101 CDT by the NWS Weather Forecast Office in Norman, Oklahoma. The updated "Discussion" section of that AFD is presented here, along with the "Aviation" section, which was originally disseminated with the AFD issued at 1836 CDT (the most recent AFD prior to the 2101 CDT AFD).

[7] Instrument Flight Rule (IFR) conditions - ceiling less than 1,000 feet agl and/or visibility less than three statute miles

FXUS64 KOUN 260201 AAA
AFDOUN

Area Forecast Discussion...UPDATED
National Weather Service Norman OK
901 PM CDT Sun Mar 25 2018

...Update...

&&

.DISCUSSION...
Just completed an update which keeps precipitation chances fairly low overnight. Generally neutral mid-level heights are seen in model guidance and persistent southwesterly flow aloft. With veering low level flow and strengthening EML, the best chance of precipitation will come from mid-level moistening above capping EML in the form of some showers, and possibly weak thunderstorms. Deep intense convection seems unlikely with this thermodynamic structure.

We also expanded the area of fog to include all of northern Oklahoma and portions of central, and southern Oklahoma as well. Low level easterly flow and moisture advection is a good pattern for fog and locally dense fog may occur, especially across northern Oklahoma. Grids and graphics have been updated and we will continue to monitor trends in visibilities and see if we can better delineate where the most likely chance of dense fog will be.

.PREV DISCUSSION... /issued 636 PM CDT Sun Mar 25 2018/

AVIATION...
26/00Z TAFs. Primarily MVFR forecast through about 15Z most areas with VFR locations across western Oklahoma and KSPS initially filling in as moisture increases from the south and east. IFR conditions possible mainly across northwest Oklahoma toward and after 06Z as richer moisture moves north with retreating warm front. With low confidence in evolution of convection this evening and overnight, did not include TSRA in any terminals and will update with amendments if confidence increases. Current isolated storm northeast of KSPS not expected to affect any terminals.

Veering flow after 14Z tomorrow will spread VFR conditions across western Oklahoma, with MVFR to VFR central Oklahoma after 18Z. Widespread TSRA expected across central portions of Oklahoma toward end of forecast period but will not be included in this forecast.

9.0 Terminal Aerodrome Forecasts

Terminal Aerodrome Forecasts (TAF) were not issued for RQO and the closest NWS TAF site to RQO was Will Rogers World Airport (OKC) in Oklahoma City, Oklahoma, which was located about 20 miles east-southeast of RQO at an elevation of about 1,300 feet. The closest NWS TAF site to the accident location was Clinton-Sherman Airport (CSM) in Burns Flat, Oklahoma, which was located about 32 miles west-southwest of the accident location at an elevation of about 1,920 feet. According to National Weather Service Instruction 10-813, “A NWS TAF consists of the

expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."[8]

The NWS OKC TAF issued at 1828 CDT forecasted for the accident time: wind from 110° at 14 knots, visibility greater than 6 statute miles, ceiling overcast at 1,500 feet agl.

TAF KOKC 252328Z 2600/2624 **11014KT P6SM OVC015**
FM260600 14015G24KT 6SM BR OVC008
FM261800 19018G26KT P6SM BKN015=

The NWS CSM TAF issued at 1828 CDT forecasted for the accident time: wind from 130° at 18 knots, visibility greater than 6 statute miles, sky clear below 12,000 feet agl.

TAF KCSM 252328Z 2600/2624 **13018KT P6SM SKC**
FM260400 15015G24KT P6SM BKN012
FM261300 20015G22KT P6SM BKN150=

10.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit (CWSU) at the Fort Worth Air Route Traffic Control Center that were active for the accident site at the accident time.

11.0 Astronomical

The astronomical data obtained from the United States Naval Observatory for 35° 27' north latitude and 98° 34' west longitude, indicated the following:

Sun Times

Sunset	1950 CDT
End Civil Twilight	2016 CDT

Moon Times

Moonrise	1348 CDT
Moonset	0417 CDT (on March 26, 2018)

[8] www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

Phase of the Moon

Waxing Gibbous with 62 percent of the moon's visible disk illuminated.

Submitted by:

_____

Mike Richards
Senior Meteorologist

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