



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

December 4, 2019

Group Chairman's Factual Report

METEOROLOGY

WPR19FA084

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A. ACCIDENT

Location: Ely, Nevada
Date: February 15, 2019
Time: about 1730 Pacific standard time (about 0130 UTC¹ on February 16, 2019)
Airplane: Cirrus SR22; N917SR

B. METEOROLOGY GROUP

Mike Richards	Arthur Patrick
Group Chairman	Group Member
Senior Meteorologist	Electronic Systems Analyst
Operational Factors Division (AS-30)	Weather Forecast Office, Sterling, Virginia
National Transportation Safety Board	National Weather Service

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's meteorological specialist travelled in support of this accident investigation and also gathered weather data remotely. Unless otherwise noted, all times are in Pacific standard time (PST) for February 15, 2019 (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).

Coordinates used for the accident location: 39.334167° north latitude, 114.780556° west longitude, at an elevation of about 6,920 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

The National Weather Service (NWS) Surface Analysis Charts for 1600 and 1900 PST are presented in figures 1 and 2. These surface analysis charts show a cold front northwest of the accident location at 1600 PST advancing southeast. At this time, the chart depicted a section of the front immediately northwest of the accident location as a warm front. A low pressure center was located immediately southwest of the accident location. By 1900 PST this front was southeast of the accident location and the entire front was depicted as a cold front. Continuous light snow was identified near the accident location at 1900 PST. Overcast skies were depicted near the accident site at both times.

¹ UTC – abbreviation for Coordinated Universal Time

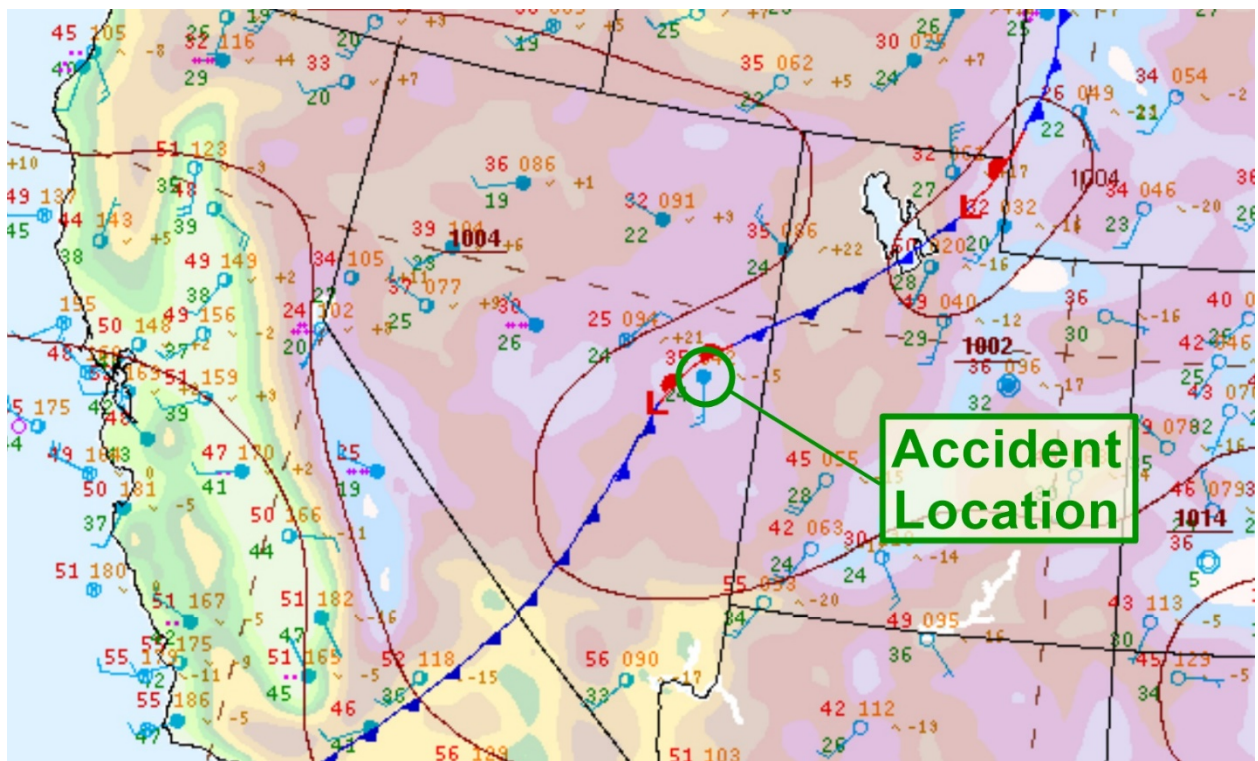


Figure 1 - NWS Surface Analysis Chart for 1600 PST.

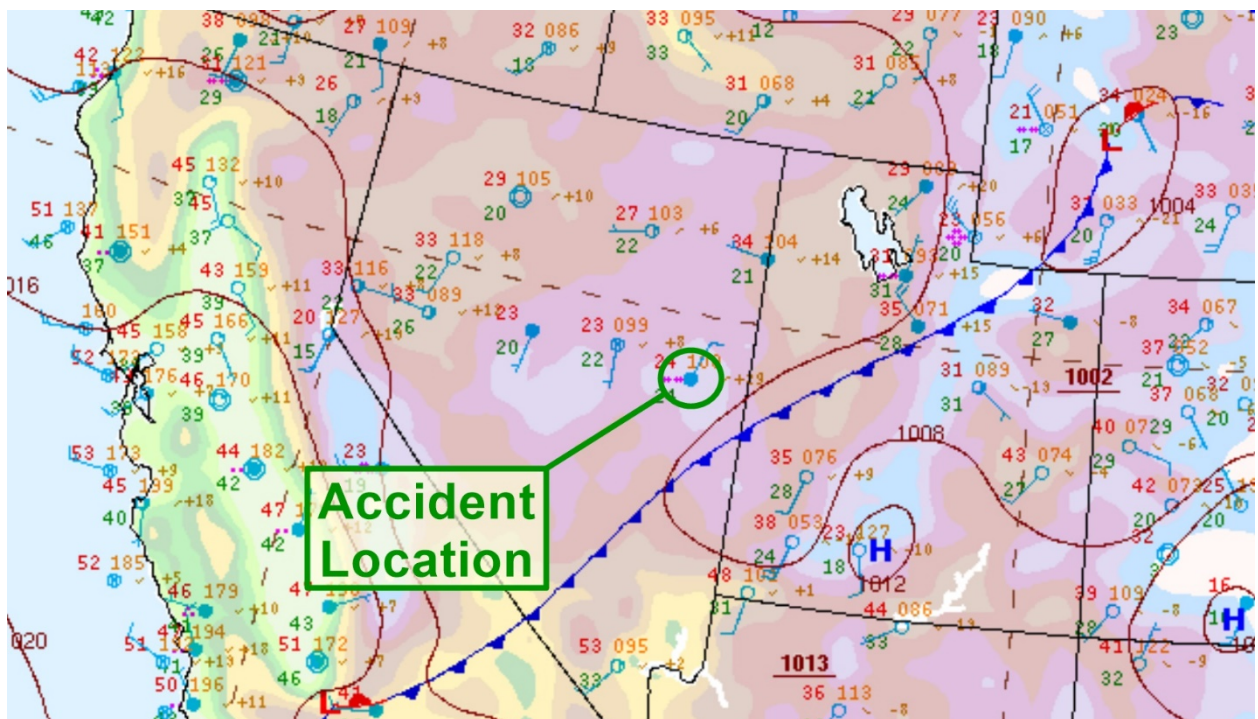


Figure 2 - NWS Surface Analysis Chart for 1900 PST.

2.0 Surface Observations

2.1 ELY ASOS Observations

An Automated Surface Observing System (ASOS) was located at Ely Airport (Yelland Field; ELY²) in Ely, Nevada, which was located about 3 miles southwest of the accident location at an elevation of 6,260 feet. The ELY ASOS was owned by the NWS and was maintained by the NWS Weather Forecast Office (WFO) in Elko, Nevada (LKN). Automated reports from KELY during the times surrounding the accident time are presented here.

[1453 PST] METAR KELY 152253Z AUTO 16019G25KT 9SM SCT048 BKN060
OVC070 02/M03 A2968 RMK AO2 SNB26E52 SLP046 P0000
T00171033=
[1553 PST] METAR KELY 152353Z AUTO 17014G22KT 10SM BKN050 OVC065
02/M04 A2967 RMK AO2 UPB31E39 SLP042 P0000 60000 T00171044
10028 20006 56015=
[1653 PST] **METAR KELY 160053Z AUTO 18015G20KT 10SM BKN042 BKN055
OVC070 02/M04 A2967 RMK AO2 SLP040 T00171044=**
[1724 PST] **SPECI KELY 160124Z AUTO 31017G28KT 9SM -SN BKN016 BKN028
OVC038 M04/M04 A2971 RMK AO2 PK WND 30028/0112 WSHFT
0110 SNB02 PRESRR P0000 T10391044=**
[1732 PST] **SPECI KELY 160132Z AUTO 32012KT 9SM -SN BKN012 BKN028
OVC038 M04/M04 A2973 RMK AO2 PK WND 30028/0112 WSHFT
0110 SNB02 PRESRR P0003 T10391044=**
[1744 PST] SPECI KELY 160144Z AUTO 31006KT 9SM -SN OVC006 M04/M04
A2974 RMK AO2 PK WND 30028/0112 WSHFT 0110 SNB02 P0008
T10391044=

At 1653 PST, KELY reported a wind from 180° at 15 knots with gusts to 20 knots, visibility of 10 statute miles or greater, ceiling broken at 4,200 feet above ground level (agl), broken clouds at 5,500 feet agl, overcast clouds at 7,000 feet agl, temperature of 2° Celsius (C) and a dew point temperature of -4°C, altimeter setting of 29.67 inches of mercury; remarks: station with a precipitation discriminator, sea level pressure of 1004.0 hectopascals (hPa), temperature of 1.7°C and dew point temperature of -4.4°C.

At 1724 PST, KELY reported a wind from 310° at 17 knots with gusts to 28 knots, visibility of 9 statute miles, light snow, ceiling broken at 1,600 feet agl, broken clouds at 2,800 feet agl, overcast clouds at 3,800 feet agl, temperature of -4°C and a dew point temperature of -4°C, altimeter setting of 29.71 inches of mercury; remarks: station with a precipitation discriminator, peak wind of 28 knots from 300° at 1712 PST, wind shift at 1710 PST, snow began at 1702 PST, pressure rising

² The National Weather Service 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.

rapidly, trace amount of liquid equivalent precipitation since 1653 PST, temperature of -3.9°C and dew point temperature of -4.4°C.

At 1732 PST, ELY reported a wind from 320° at 12 knots, visibility of 9 statute miles, light snow, ceiling broken at 1,200 feet agl, broken clouds at 2,800 feet agl, overcast clouds at 3,800 feet agl, temperature of -4°C and a dew point temperature of -4°C, altimeter setting of 29.73 inches of mercury; remarks: station with a precipitation discriminator, peak wind of 28 knots from 300° at 1712 PST, wind shift at 1710 PST, snow began at 1702 PST, pressure rising rapidly, 0.03 inches of liquid equivalent precipitation since 1653 PST, temperature of -3.9°C and dew point temperature of -4.4°C.

Five-minute data from the ELY ASOS for times surrounding the accident time are provided here. See Attachment 1 for all ELY ASOS five-minute data between 1200 and 2200 PST.

[1645 PST] 5-MIN KELY 160045Z AUTO 16015G20KT 10SM BKN048 BKN055
OVC070 02/M04 A2966 6500 64 6500 150/15G20 RMK AO2 T00171044

[1650 PST] 5-MIN KELY 160050Z AUTO 18014G20KT 10SM BKN044 BKN060
OVC075 02/M05 A2967 6500 61 6500 170/14G20 RMK AO2 SLP040
T00171050

[1655 PST] 5-MIN KELY 160055Z AUTO 18016KT 10SM BKN042 BKN055 OVC070
02/M04 A2967 6500 64 6500 170/16 RMK AO2 T00171044

[1700 PST] 5-MIN KELY 160100Z AUTO 17015KT 10SM BKN040 OVC055 01/M04
A2967 6500 66 6400 150/15 RMK AO2 T00111044

[1705 PST] 5-MIN KELY 160105Z AUTO 16010KT 10SM -SN OVC040 01/M04
A2967 6500 69 6400 150/10 RMK AO2 SNB02 P0000 T00111039

[1710 PST] 5-MIN KELY 160110Z AUTO 20010KT 160V220 9SM -SN OVC040
01/M04 A2967 6490 69 6400 190/10 150V210 RMK AO2 SNB02 P0000
T00111039

[1715 PST] 5-MIN KELY 160115Z AUTO 30020G28KT 9SM -SN FEW028 OVC038
M02/M05 A2969 6470 78 6000 290/20G28 RMK AO2 PK WND
30028/0112 SNB02 PRESRR P0000 T10171050

[1720 PST] 5-MIN KELY 160120Z AUTO 31020G28KT 9SM -SN BKN024 OVC038
M03/M04 A2970 6470 92 5800 290/20G28 RMK AO2 PK WND
30028/0112 SNB02 PRESRR P0000 T10331044

[1725 PST] 5-MIN KELY 160125Z AUTO 31016G28KT 9SM -SN BKN016 BKN028
OVC038 M04/M04 A2971 6460 96 5800 300/16G28 RMK AO2 PK WND
30028/0112 WSHFT 0110 SNB02 PRESRR P0001 T10391044

[1730 PST] 5-MIN KELY 160130Z AUTO 32014KT 9SM -SN BKN012 BKN028
OVC038 M04/M04 A2972 6440 96 5700 300/14 RMK AO2 PK WND
30028/0112 WSHFT 0110 SNB02 PRESRR P0003 T10391044

[1735 PST] 5-MIN KELY 160135Z AUTO 33011KT 9SM -SN BKN010 OVC038
M04/M04 A2973 6440 96 5700 320/11 RMK AO2 PK WND 30028/0112
WSHFT 0110 SNB02 PRESRR P0005 T10391044

[1740 PST] 5-MIN KELY 160140Z AUTO VRB04KT 9SM -SN BKN008 OVC036
M03/M04 A2974 6430 92 5800 VRB/04 RMK AO2 PK WND 30028/0112
WSHFT 0110 SNB02 PRESRR P0006 T10331044

One minute ELY ASOS “page two” data in raw form between 1100 and 2200 PST can be found in Attachment 1.

2.2 TMT AWOS

An Automated Weather Observing System (AWOS) was located at Austin Airport (TMT) in Austin, Nevada, which was located about 113 miles west of the accident location at an elevation of 5,735 feet. Automated reports from TMT during the times leading up to the accident time are presented here.

[1315 PST] METAR KTMT 152115Z AUTO 31003KT 10SM SCT018 BKN024
OVC038 M01/M05 A2979 RMK AO2 T10111049=

[1315 PST] METAR KTMT 152135Z AUTO 00000KT 10SM SCT016 OVC022
M01/M05 A2979 RMK AO2 T10121052=

[1355 PST] METAR KTMT 152155Z AUTO 18006KT 1SM -SN BKN011 OVC022
M01/M04 A2979 RMK AO2 VIS 1/2V5 T10131040=

[1415 PST] METAR KTMT 152215Z AUTO 15003KT 1/2SM SN OVC008 M02/M03
A2978 RMK AO2 P0001 T10181031=

[1435 PST] METAR KTMT 152235Z AUTO 16003KT 3/4SM -SN OVC008 M02/M03
A2978 RMK AO2 P0002 T10211035=

[1455 PST] METAR KTMT 152255Z AUTO 17005KT 3/4SM -SN OVC008 M02/M03
A2978 RMK AO2 P0003 T10171031=

[1515 PST] METAR KTMT 152315Z AUTO 15005KT 3SM -SN BKN007 BKN014
OVC021 M01/M03 A2977 RMK AO2 T10111031=

[1535 PST] METAR KTMT 152335Z AUTO 00000KT 10SM SCT007 BKN027
OVC100 M01/M03 A2977 RMK AO2 T10101035=

[1555 PST] METAR KTMT 152355Z AUTO 30005KT 5SM -SN SCT011 BKN018
OVC041 M01/M03 A2979 RMK AO2 60003 T10111031 10033 21021=

[1615 PST] METAR KTMT 160015Z AUTO 31008KT 1/2SM SN BKN004 OVC009
M02/M03 A2980 RMK AO2 T10201031=

[1635 PST] METAR KTMT 160035Z AUTO 00000KT 4SM BR SCT004 BKN017
OVC050 M03/M04 A2980 RMK AO2 T10261037=

[1655 PST] METAR KTMT 160055Z AUTO 15004KT 10SM SCT050 OVC065
M03/M04 A2980 RMK AO2 T10271043=

2.3 ELY ASOS Maintenance

Following the accident, written statements provided to the NTSB by individuals familiar with the ELY ASOS (see Attachment 2) identified weather conditions near ELY in the 1700-1720 PST timeframe included heavy snow, visibility down to 1/4 mile and ceilings as low as 200 feet agl. These statements also indicated that visibility reporting at ELY had not been accurate for weeks prior to the accident and had been a concern for pilots.

"...in the weeks prior to the 2/15/2019, the KELY ASOS was erratically reporting the visibility component. Sometimes it was missing, sometimes apparently accurate, and other times reporting 9 miles visibility when it was substantially less in my observation. I noted that the online text weather occasionally contained the "\$ maintenance needed" indication at the end of the report. Later, at the airport advisory board meeting on March 5, 2019, other pilots commented with similar observations about the ASOS reports in the previous weeks (or months?), and the airport manager [REDACTED] reported that NWS (I believe the Elko, NV office) was aware of the problem, had diagnosed it, and was awaiting parts to repair it on Friday of that week, March 8. Subsequently, when I was at the airport on March 10, one Medflight pilot mentioned that NWS was seen at the airport on the 8th, but that they understood that the ASOS remained unrepaired."

"...Our ASOS here on the field had not been accurate regarding visibility for at least 2 weeks prior to the 15th. The problem had been reported by the Airport Manager, as well as pilots. I had more than one pilot upset because the reporting was not correct. On jet pilot came in the week before and the ASOS reported 9 miles visibility. When he got on the ground, he was very upset and said that it was 1 ¼ mile at best. He called Flight Service and Salt Lake Center while he was in our office to complain about our ASOS. The week after the accident, the ASOS was changed to simply list the visibility as "missing". It was that way for a couple of weeks. I understand parts had to be ordered to make the repairs. The repairs are complete now, and everything is working properly."

According to the ELY Airport Manager (see Attachment 3) at about 1630 PST the clouds at ELY were about 5,000 feet agl and the visibility was between 3-5 miles, but in the 1700-1715 PST timeframe the visibility went down to about 1/2 mile. On February 6, 2019, he had noted that the ELY ASOS was reporting erroneous visibility, which he reported to the LKN. On February 10, 2019, he noted that the ELY ASOS was working properly, and he had assumed that the NWS had physically come to ELY to fix the issue, possibly as early as February 8, 2019. He assumed the NWS came to ELY in-person to fix the issue because the ASOS was on a secured part of the airport, but he did not see them himself. On February 12, 2019, the NWS sent a notice that the ASOS was repaired, but on March 12, 2019, he noted that the ASOS visibility was erroneous. It was again reporting appropriately on March 15, 2019. As best as he could recall, the visibility reporting issues with the ELY ASOS began in mid-2018, and people from LKN had been out to ELY about 4-5 times in response to calls on this issue but had been out to ELY for maintenance

more than that. Every time they had come out to address the visibility reporting problem it had been a “parts issue.”

According to National Weather Service Instruction (NWSI) 30-2111³, the ASOS Operations and Monitoring Center (AOMC) “...provides around-the-clock operational and maintenance support for ASOS. The foreground portion of the AOMC computer system helps in the monitoring and maintenance notification process.” NWSI 30-2111 describes one of AOMC’s functions as a “trouble desk for tracking and documenting ASOS malfunctions” and discusses opening and closing trouble tickets (or “trouble reports”). The NWS also provided additional information (see Attachment 4 and Attachment 9) regarding AOMC trouble tickets.

Attachment 5 presents all AOMC trouble tickets for the ELY ASOS from January 1, 2018, through April 16, 2019. Times in these trouble tickets are UTC. Attachment 6 presents the LKN maintenance shift logs provided by their Electronic Systems Analyst (ESA) that covers the time period of July 2018 through April 22, 2019. Times in these logs are in local (Pacific standard) time. Presented here are select AOMC trouble tickets and LKN maintenance shift log entries applicable to the ELY ASOS in chronological order from the beginning of 2019.

Report For Ticket: 901210056

Ticket Comments	
em7script	[2019-01-21 06:08:22]
KELY 210553Z AUTO 16014KT 10SM CLR 03/M02 A2973 RMK AO2 SLP041 T00281022 10056 20017 \$ Site Identifier: KELY ;Location: Ely, NV ;AOMC/RMM ID: KELY Class: C1 Small ;SvcLvl: D ;Agency: FAA ;Region: WRH ;Office: WFO LKN (Elko, NV) ;OCC: AFOS PIL/WMO Header LKNMTRELY ;LongLineComms: ADAS ;ALDARS Site: YES Equipment: ACU WARM START ;Type: C ;Action Taken: ____ ;HOMAL: ____ ;Tech's ID: ____ Point of Contact: _____ ----- Filled in upon resolution ----- Serial Number: ##### edited via automated script	
kmason	[2019-01-21 06:08:22]
Opened ticket. AOMC dialed into the site and found multiple errors on CL31 and Freezing rain caused by ACU Warm Start. WFO LKN (Elko, NV)POC was notified via email.	
dblack	[2019-01-21 19:24:25]
Updated ticket. OBS [REDACTED] is reporting Visibility is not reliable. Site measured 4 to 6 inches of snow and Visibility read 9 miles. WFO [REDACTED] contacted.	
dblack	[2019-01-22 15:49:59]
close this ticket. Cleared remotely [REDACTED] 1532Z	

MET [REDACTED] 2019/01/21 10:57:36 ASOS Ticket Problem with KELY ASOS VIS/Snow sensor? Our snow observer, [REDACTED] in Ely reported 5 inches fell late last night (after midnight) through early this morning. I also called Hotel Nevada in downtown Ely for a comparison and they estimated 4 to 6 inches of snow had fallen in town. KELY ASOS lowest VIS and snow intensity through the entire event from 10z through 1730 Z was 9 miles in -SN (flurries)!

MET [REDACTED] 2019/01/21 11:21:29 ASOS Ticket Called AMOC to give details on KELY visibility and snow intensity issues as \$ was indicated in OBs.

³ <https://www.nws.noaa.gov/directives/sym/pd03021011curr.pdf>

LMET [REDACTED] 2019/01/21 11:25:06 ASOS Ticket KELY 901210056 1 Observer [REDACTED] called AOMC to report that Ely observer [REDACTED] got five inches of snow, but the airport never went below 9SM all night. There is a \$ in the observation. AOMC issued a trouble ticket.

HMT/INTERN [REDACTED] 2019/02/05 16:46:33 ASOS Ticket KELY 902060013 1 AOMC called saying someone from "the tower" at KELY called saying VIS and WINDS are unreliable on the obs. (According to the FAA's website, KELY doesn't have a tower.)

Report For Ticket: 902060013

Ticket Comments	
dblack	[2019-02-06 00:44:13 @ [REDACTED]]
Ticket Comments	
Site Identifier: KELY ;Location: Ely, NV ;AOMC/RMM ID: KELY Class: C1 Small ;SvcLvl: D ;Agency: FAA ;Region: WRH ;Office: WFO LKN (Elko, NV) ;OCC: AFOS PIL/WMO Header: LKNMTRRELY ;LongLineComms: ZDC ;ALDARS Site: NO Equipment: VIS1 ;Type: C Point of Contact: [REDACTED] Maintenance Type: Corrective Ticket Type: Maintenance ----- Filled in upon resolution ----- Action Taken: _____ ;HOMAL: _____ ;Tech's ID: _____ Resolution Date: _____ ;(MM/DD/YY) Resolution Time: _____ ;(HHMMZ) Serial Number: ##### edited via automated script	
dblack	[2019-02-06 00:44:13 @ [REDACTED]]
opened ticket. NEMC [REDACTED] reporting VIS and WIND are unreliable. WFO [REDACTED] contacted.	
gerald.floyd	[2019-02-25 21:49:26 @ [REDACTED]]
Updated ticket. Tech [REDACTED] unable to visit site due to high WINDS. They will attempt later this week.	
dblack	[2019-02-27 22:10:39 @ [REDACTED]]
WFO: LKN, [REDACTED] 2153Z, Technicians visited the site and repaired the visibility sensor	

MET [REDACTED] 2019/02/05 17:07:56 ASOS Ticket NEMC [REDACTED] opened the trouble ticket for the ASOS at KELY. It seems that AOMC thought this was the tower (which does not exist) and logged it as such (AOMC and CWSU both did not know who NEMC is). The obs of different spotters [REDACTED], and spotter living 2 miles S of airport) seem to fall in line with the ASOS observations with no mention of winds or any visibility restrictions. The trouble ticket may have been opened due to the pilot report, as the questionable sensors are the ones which don't line up with his questionable observation. The ASOS did line up with the model or foretasted [sic] conditions. Even looking around Ely, no station reported wind gusts beyond 18 mph. (speculation: could the pilot have been at a different airport? and who is NEMC).

ESA [REDACTED] 2019/02/06 10:29:19 ASOS Ticket KELY 902060013 1 Technicians will have to visit the site to verify the accuracy of the wind and visibility sensors. Please monitor the TAFs for this site and let me know if you find irregularities with these readings.

ESA [REDACTED] 2019/02/11 08:02:32 ASOS Ticket KELY 1 Technicians will be scheduled to visit the KELY ASOS site to investigate the visibility issue. I am planning for sometime this week.

LMET [REDACTED] 2019/02/15 17:59:57 ASOS Ticket There still may be some visibility issues with KELY as we are watching a band on satellite along with past obs from Eureka. Did call [REDACTED] in Ely and he mentioned heavy snow with an unofficial vsby of approx 100 meters and strong wind (there was a PK WND remark in the obs of 30028 knots).

LMET [REDACTED] 2019/02/16 17:55:24 ASOS Ticket Just a heads up: [REDACTED] and [REDACTED] will be installing a new vsby sensor at the Ely ASOS next week sometime.

ADMIN [REDACTED] 2019/02/25 16:31:09 ASOS Ticket ETs need 10kts or less to work on Ely. Next chance is Wed (iffy) with another opportunity on Friday

ESA [REDACTED] 2019/02/27 13:55:53 ASOS Ticket KELY 902060013 1 Has been repaired. The site is watching properly.

Report For Ticket: 903020257

Ticket Comments	
em7script	[2019-03-02 22:52:05 @ [REDACTED]]
KELY 022246Z AUTO 0000KT - SN FEW004 OVC024 M01/M01 A2982 RMK AO2 P0002 T10061011 \$ Site Identifier: KELY ;Location: Ely, NV ;AOMC/RMM ID: KELY Class: C1 Small ;SvcLvl: D ;Agency: FAA ;Region: WRH ;Office: WFO LKN (Elko, NV) ;OCC: AFOS PIL/WMO Header LKNMTRELY ;LongLineComms: ADAS ;ALDARS Site: YES Equipment: vis ;Type: C ;Action Taken: ____ ; HOMAL: ____ ; Tech's ID: ____ Point of Contact: _____ ----- Filled in upon resolution ----- Serial Number: ##### edited via automated script	
kmason	[2019-03-02 22:57:22 @ [REDACTED]]
Opened ticket. AOMC dialed into the site and found multiple errors on VIS#1. WFO LKN (Elko, NV) POC [REDACTED] notified.	
jgilleland	[2019-03-05 12:45:18 @ 10.90.194.74]
@1237Z received an email from NSB ([REDACTED]) stating: Alert received during maintenance window from 03/05/2019 3:29 - 03/05/2019 3:40am. Site has been up and stable since. This ticket is ok to close....([REDACTED])	

MET [REDACTED] 2019/03/02 16:14:54 ASOS Ticket AOMC called at 3pm with P1 Ticket # 93020257 Multiple errors on VIS sensor. Called [REDACTED] he will check on Monday

LMET [REDACTED] 2019/03/05 23:31:01 ASOS Ticket FYI - Ely ASOS needs another part for the vsby sensor. [REDACTED] let me know that [REDACTED] are scheduled to go down on Friday to install the replacement. Previous shifts put AMD NOT SKED in the ELY TAF.

ESA [REDACTED] 2019/03/14 11:03:55 ASOS Ticket KELY 903050158 1 Technicians will be on site today (03/14/2019) in Ely, NV to complete repairs to the Visibility sensor.

MET [REDACTED] 2019/03/14 21:18:09 ASOS Ticket [REDACTED] have returned and Ely is back to working order. Removed the note in the aviation section. Thanks [REDACTED] and [REDACTED]!

According to these AOMC trouble tickets and LKN maintenance shift log entries, on January 21, 2019, a concern of unreliable visibility from the ELY ASOS was identified by LKN, however the

AOMC ticket was closed the following day after the ASOS errors were cleared remotely⁴ as noted by the LKN ESA (“SJL”; see Attachment 4 for further information). According to the ESA (see Attachment 7), the technicians at LKN remotely checked the ELY ASOS in response to the AOMC ticket and did not find any flags with the visibility sensor and cleared the system remotely as there was nothing of concern. The ESA indicated that normally they will first dial in to an ASOS remotely and check out the maintenance section of the equipment and try to determine what the problem is, and if they need to respond to the site physically. This is all accomplished from their office.⁵ He indicated that between then and February 5, 2019, there was no further discussion or action regarding the ELY ASOS visibility sensor and he assumed everything was alright. According to the ESA, prior to January 21, 2019, technicians were on-site at the ELY ASOS three times in December 2018 (see attachment 4), and on December 7, 2018, the visibility transmitter was removed and replaced.

On February 5, 2019, LKN received concerns about unreliable visibility reporting from the ELY ASOS. About this time, the AOMC also received a call regarding visibility reporting from the ELY ASOS and opened a trouble ticket (ticket #902060013). An LKN maintenance shift log entry expressed skepticism about any erroneous observations from the ELY ASOS. According to the ESA, this was the day that forecasters at LKN started talking about the visibility issues with the ELY ASOS. He indicated that between January 21, 2019, and February 15, 2019, there was likely an opportunity weather-wise to get to ELY, however he was not sure how that all coincided with any ASOS parts that were on order. The following day, an entry was made in the maintenance shift log that LKN technicians would have to visit the ASOS to determine visibility sensor accuracy, and for people at LKN to alert technicians about any further irregularities. The next maintenance shift log entry on this issue was written on February 11, 2019, and indicated that technicians would be visiting ELY to investigate the visibility reporting issue and that that visit would be planned for that week (February 11, 2019, was a Monday). According to the ESA, a receiver for the ELY ASOS was ordered on this day, and the receiver arrived at LKN on February 14, 2019. The ESA indicated that a receiver was ordered because experience had shown that the majority of visibility sensor issues had been due to its receiver.

According to the ESA, a technician and the receiver were enroute to ELY the following day (February 15, 2019, the day of the accident), however the technician encountered adverse weather. The technician checked with LKN, who indicated that weather at ELY would not be suitable for maintenance on the ASOS that day, so they returned to LKN. A maintenance shift log entry on that day expressed concern with the ELY ASOS visibility observations, citing a local (unofficial) visibility report. The following day, a maintenance shift log entry indicated that technicians would be installing a new visibility sensor on the ELY ASOS sometime the following week (February 16, 2019, was a Saturday).

⁴ According to the NWS (see Attachment 4), remotely clearing an issue means that a technician has dialed into the ASOS and has cleared the alert flag(s). This is usually done when the technician sees from the ASOS logs that the issue is probably not a hardware failure that requires an on-site visit.

⁵ According to the NWS (see Attachment 4), on January 22, 2019, the technicians may have rebooted the system or noticed that readings looked correct at that moment and attributed the alert flag to some brief issue (e.g., a bird landed on the visibility sensor or a brief power spike). In this case, the LKN ESA did not specify what he determined to be the nature of the issue, just that the alert flags were removed. In most cases, the technician will reset the alert flag, wait for an observation to be taken, and verify that the flag did not return.

According to the ESA, technicians from LKN arrived at ELY on February 20, 2019, with the intent to replace the receiver for the visibility sensor, but it was determined that the issue was with the visibility sensor's transmitter. On that day report processing for the visibility sensor was turned off and a transmitter was ordered. A maintenance shift log entry on February 25, 2019, indicated that due to wind at ELY, the next opportunity to perform maintenance at the site would be February 27, 2019 (but that that was "iffy"). The transmitter was replaced (visibility reporting issue was resolved), report processing for the visibility sensor was turned back on, and AOMC trouble ticket #902060013 was closed on February 27, 2019.⁶

On March 2, 2019, (which was a Saturday) the AOMC opened a trouble ticket for the ELY ASOS indicating multiple errors were found with the visibility sensor. According to the NWS (Attachment 4), it was determined by the AOMC that the visibility parameter was missing from the observations, so it opened a Priority 1 ticket. A maintenance shift log entry on that day indicated technicians were notified and that the system would be checked that Monday (March 4, 2019). According to the ESA, visibility reporting for the ELY ASOS was turned off on March 5, 2019, and a maintenance shift log entry that day indicated that another part was needed for the visibility sensor and that according to the ESA, technicians were scheduled to visit the ELY ASOS that Friday (March 8, 2019) to make repairs, however repairs were not made until March 14, 2019.⁷

The ESA indicated that he believed that the ELY ASOS visibility sensor was reporting erroneously on the day of the accident, and that if visibility is reporting erroneously, it will affect the snowfall intensity reporting. According to the NWS (see Attachment 4), snow intensity reported in ASOS observations is a function of the visibility measurement (which itself is the 10-minute harmonic mean of 1-minute visibility values). ASOS checks snow intensity against the visibility and adjusts it if necessary, to comply with the Federal Meteorological Handbook Number 1⁸ reporting standards for snow intensity. According to the NWS, between 1700 and 1730 PST on the day of the accident, because the ELY ASOS was reporting a visibility of nine statute miles, the ASOS would have been reporting light snow between 1702 and 1711 PST (inclusive) and between 1714 and 1730 PST (inclusive). Moderate snow must, by definition, reduce visibility to below three-quarter of a statute mile and heavy snow must reduce visibility to below one-half a statute mile.

According to the ESA (see attachment 4), visibility criteria that would trigger a SPECI at ELY were a new visibility observation reaching, falling below or rising above: three statute miles, two statute miles, one and one-half statute miles, one statute mile and one-half statute mile. According to the NWS (see attachment 4), "...erroneous observational elements can and do affect the issuance of automated SPECIs. The generation of automated SPECIs is particularly sensitive to the visibility and sky condition reports."

⁶ According to the ESA (see attachment 4), the parts replaced on the ELY ASOS visibility sensor on that day were the optical transmitter (S100-2MT5A2A3) and the "detector, optical" (S100-2MT5A2A4).

⁷ According to the ESA (see attachment 4), the part replaced on the ELY ASOS visibility sensor on that day was the controller (S100-2MT5A1A1).

⁸ https://www.ofcm.gov/publications/fmh/FMH1/FMH1_2017.pdf

2.4 ASOS Spare Parts

According to the Maintenance Manager for the ASOS Program at the NWS (see Attachment 8), it was expected that all NWS WFOs had available every spare ASOS part according to and listed in “ASOS Maintenance Note 18, Revision A” found in section 2.6 of the NWS Engineering Handbook 11 and its “Attachment A – List of ASOS Spares Kits” (see Attachment 9), which had not been updated since 2008.⁹ He had not heard of a “limited” list of spare ASOS parts and the “Attachment A – List of ASOS Spares Kits” is the only spare ASOS parts list he was aware of. During the investigation, the NTSB learned that a “limited” or “mini” spare ASOS parts list may have been in use at some NWS WFOs, and it was referenced by the LKN ESA (see below), however no actual mini-list was ever found. According to the Director for the Surface and Upper Air Division at the NWS (see Attachment 4), “It [is] reasonable to assume [a] Mini Spares Kit was established in [the second errata sheet for the Maintenance Note 18 in Engineering Handbook 11 volume 2 from 1995]. The Mini Spares Kit contained 26 Items in March of 1999. In December of 1999, 42 additional items were added for a total of 93 items on the Mini Spares Kit List.” The Maintenance Manager for the ASOS Program at the NWS did not know if any NWS regions had made changes to the spare parts list, but “Attachment A – List of ASOS Spares Kits” was the only list from NWS headquarters and changes to that list were not allowed. The spares kit consisted of parts that were most likely to fail and would most likely interrupt airport operations, and most of these parts were available to ASOS technicians via emergency order overnight shipment. According to the Systems Operations Division (SOD) Chief at the NWS Western Region Headquarters¹⁰ (WRH; see Attachment 4), their region did not have any spare parts list beyond the “Attachment A – List of ASOS Spares Kits.”

According to the ESA, between January 21, 2019, and February 15, 2019, everything seemed normal with the ELY ASOS on the maintenance side and that they ordered the parts for the ELY ASOS in response to forecaster comments. Their office did not carry spare visibility transmitter and receiver parts. The repairs made to the ELY ASOS on February 27, 2019, included replacement of an optical transmitter (S100-2MT5A2A3) and an optical detector (S100-2MT5A2A4), both of which had to be ordered. The repairs made to the ELY ASOS on March 14, 2019, included replacement of a controller (S100-2MT5A1A1), which had to be ordered. All three of these parts were found in the “Attachment A – List of ASOS Spares Kits.” According to the ESA, he was not aware of the ASOS Maintenance Note 18 until September 2019, about seven months after the accident. He indicated, “we had some spare parts available here at the WFO when I got here [in 2016] and I assumed that was our allotted spare parts. The process with ordering spare parts replacements and non-spare parts replacements was through the return parts program (order a part from NRC send a defective part back to them for repair and place back in to their stock). [Our spare parts standard] could have been the mini parts kit we got originally but I can not confirm that [anywhere].”

NWS Engineering Management Reporting System (EMRS) logs for the ELY ASOS during the days surrounding the accident time are included in Attachment 9 and indicate about 520 hours (about 21 days) for trouble ticket #902060013 were logged as Non Operational Logistics Hours.

⁹ According to the Maintenance Manager for the ASOS Program at the NWS, sometimes there may be issues back-ordering parts, but ASOS technicians are expected to order replacements when spares are installed.

¹⁰ The Elko WFO was in the NWS Western Region.

According to NWS Engineering Handbook Number 4 (see Attachment 9 to this report), “Non Operational” means the there is a loss of all primary products on the system, or the equipment cannot perform any of its primary functions, and “Logistics Delay” is the duration of time the system or equipment was not operational due to a logistics delay. According to the NWS Engineering Handbook Number 4, “An operational status of ‘Logistics Delay’ shows the time spent waiting for parts or other logistics activities. Record all time not associated with a logistics delay in the ‘All Other’ category. The ‘All Other’ category includes delay time when the ET is not on duty. It also includes delay time due to weather, travel conditions, or when staff has been assigned to a higher priority maintenance activity.”

2.5 Maintenance Ticket Priority

According to Appendix B in NWSI 30-2111, failure of an ASOS visibility sensor is a “Priority 1” (safety-related) failure and the ASOS equipment “will” be restored to full operation within 36 hours (the maximum outage time) at Service Level D, Airport Class II airports, “at least 95 percent of the time.”^{11,12,13} According to NWSI 30-2111, the outage is considered to begin (the clocks starts) “when the AOMC is made aware of a failure.” It also states that “if a delay is encountered due to the effects of weather, flight schedules (commercial or chartered), or space availability, and the delay could result in an equipment outage time exceeding that specified in the Maximum Outage Times table, the AOMC will be immediately notified. The maintenance activity report (e.g., EMRS) includes the time that the equipment exceeded the maximum outage time, and the actions taken to minimize the delay.” According to the Maintenance Manager for the ASOS Program at the NWS, once the AOMC traces down the failed sensor, “at this point a ticket is opened and the clock starts on resolution (as described in NWS Instruction 30-2111 – Appendix B). The ticket is closed when an ASOS technician goes to the site within 36 hours (in the case of a safety-related failure for a Service Level D airport) and calls or e-mails the AOMC stating the problem has been fixed.” According to the ESA, response to a Priority 1 ASOS issue needs to be immediate and the issue must be taken care of as quickly as possible. He indicated that according to the ASOS maintenance manual, there was a 36-hour timeline for response to a Priority 1 issue on the ELY ASOS, however he did not know what “response” should mean specifically. The ESA indicated that he takes “response” to mean that the issue must be addressed, such as having technicians assigned to fix the problem if needed.

According to the Program Manager for the ASOS at the NWS (see Attachment 4), it would not be considered an “outage” if NWS WFO staff observed that an ASOS (located three to four hours from the WFO) appeared to not be representative of current conditions, if there were no maintenance equipment failures/flags noted. The NWS WRH SOD Chief concurred with this assessment (see Attachment 4). Further, the NWS ASOS Program Manager provided several references from the “NWS Engineering Handbook 4 Section 6.0, EMRS Maintenance Note 5 EHB-4, A-1, ATTACHMENT A – Procedures for Documenting NWR Maintenance Events, 5/23/2018” for the term “outage”: (1) “When forecast products are not being broadcast, this is considered to be an NWR transmitter ‘outage’. The NWR transmitter is ‘Not Operational’ as there

¹¹ The AOMC established trouble ticket #902060013 as “Priority 1” (see attachment 4).

¹² ELY was a Service Level D airport.

¹³ It is not known what is meant by “at least 95 percent of the time,” though it may be accounting for the occasions when delay is unavoidable (e.g., due to adverse weather at the ASOS site or delay in reception of ordered parts).

is a loss of all primary products and the equipment/system cannot perform its primary function.”, (2) “Note: ASOS Outage not specifically defined in this Maintenance Note. However, here Outage is used as a generally accepted engineering terminology to reference the highest level of system or equipment failure (complete system failure) as there is a loss of all primary products and the equipment/system cannot perform its primary function.” and (3) “The term Outage is used in EMRS as the generally accepted engineering terminology to reference the highest level of system or equipment failure (complete system failure). There is a loss of all primary products and the equipment/system cannot perform its primary function.” However, the NWS ASOS Program Manager also indicated (and the NWS WRH SOD Chief concurred) that “An outage doesn’t necessarily mean that the system isn’t at least partially operational; for example if the wind sensor goes down, that has no effect on the temperature, dew point, altimeter etc. and the METAR will still be generated but the wind data will be missing.”

2.6 Report Processing

According to the NWS (see Attachment 4), ASOS data that is unrepresentative (e.g., visibility is reporting incorrectly) or is turned off (e.g., report processing is turned off for an unreliable visibility sensor and therefore there is no automated visibility report) at sites that are staffed by weather observers can be augmented by the observers. In such a case, the observer will ensure representative data is contained in the ASOS observations. However, at ASOS sites that are not staffed by weather observers (“unattended” sites), if a sensor is recognized to be reporting erroneous information, ASOS technicians can turn off report processing for that particular sensor until the problem is corrected. According to the NWS, “because of the impact on the operation and safety of the NAS, no data is preferred to bad data.”

According to the Maintenance Manager for the ASOS Program at the NWS, it is better to have no data than bad data, however, he indicated that NWS WFO meteorologists do not have permissions to turn off report processing for ASOS sensors (however ASOS technicians at the NWS WFOs do). He is not aware of any policy related to NWS WFO meteorologists having access to turn off report processing for working ASOS sensors or discussing any negotiation between meteorologists and ASOS technicians on turning off report processing. His personal opinion is if there is a discrepancy in an observation, turn it off, replace the sensor and then take a look at repairing the sensor

According to the ESA, when he would receive a notification on ASOS issues from the AOMC, he would call the forecasters at LKN and see how they were receiving the METARs from the ASOS in question and determine what was needed to address the issue. He indicated that his office did not have a written policy concerning when to turn off remote processing for a visibility sensor when erroneous reporting may be, or is, present. General policy was that if there was a questionable sensor, or word of a questionable sensor, then that sensor would be shut off and be replaced or recalibrated. He had spoken with his Meteorologist In Charge (MIC)¹⁴ about allowing forecasters at LKN to turn off report processing until technicians can check the sensor out, and he believed

¹⁴ According to NWSI 10-1305 section 3.4, “The [MIC] is responsible for execution of the QC program for observations within the designated County Warning Area (CWA) and Hydrologic Service Area (HSA) of the WFO.” It identifies one of the duties associated with the QC/QA program as “monitoring and reviewing observations.” NWSI 10-1305 may be found here: <https://www.nws.noaa.gov/directives/sym/pd01013005curr.pdf>

that a policy like that would be appropriate for any WFO with ASOSs at smaller airports with no human observer present. He believed that if there was a question as to the accuracy of an ASOS sensor's reporting, there was no reason to have that information out there. Assuming proper connectivity, report processing can be turned off remotely and does not require a visit to the ASOS site. The ESA stated that if report processing was turned off on an ASOS, the station's very high frequency (VHF) broadcast of its observations would report "visibility missing."

Although it does not specifically discuss situations similar to what occurred with the ELY ASOS visibility sensor, NWSI 30-2112¹⁵ (Section 2.7) establishes procedures for the senior individual on duty at a WFO to act on technical issues that could affect public safety: "If public safety is or could be affected by a system, equipment, or communication failure, as specified in Section 3, the senior individual on duty at a WFO, Weather Service Office, River Forecast Center, Data Collection Office, Center Weather Service Unit, NTWC, PTWC, NCEP Central Operations, HPC, AWC, SPC, MPC, TPC, NDBC, or TOC reports immediately via USOS."

2.7 NOTAMs for ASOS

A review of the archived Notices to Airmen (NOTAMs) for ELY revealed that there were no NOTAMs regarding the ELY ASOS or related equipment in effect on the day of the accident or in the days leading up to the accident. According to the ESA, sometimes forecasters at LKN would put information about ASOS issues into Area Forecast Discussions (AFDs) and Terminal Aerodrome Forecasts (TAFs), but he has not advised the Federal Aviation Administration (FAA) of erroneous ASOS sensor data, and was not sure who would put in for a NOTAM with the FAA on an issue like that. According to the ELY airport manager, he had only put in for a NOTAM on the ASOS once, and in that instance the ASOS had gone completely down. For that NOTAM he had called the FAA NOTAM phone number.

According to the FAA (see Attachment 10), who referenced NWSI 10-1305, one of the following three criteria must be met in order for a NOTAM to be issued on an ASOS: (1) the entire ASOS observation is missing and no backup observation is available for long-line dissemination, (2) the altimeter setting is missing and is not backed up, and (3) the date/time group is erroneous and has not been corrected. According to the FAA, if an NWS WFO called Flight Service to report that an unreliable visibility sensor was operating at a ASOS, and that that sensor may be providing erroneous information in the ASOS observations, a NOTAM would not be issued.

FAA Order 7930.2S¹⁶ also lists these three criteria for issuing a NOTAM for an ASOS. For issuance of other NOTAMs, the order includes "AWOS unreliable/inaccurate elements" as a criterion, and states "ASOS NOTAMs do not get issued using the same criteria as the AWOS systems, as they (ASOS) are monitored and maintained by the NWS and not the FAA." When asked why it was that the fact that it is the NWS and not the FAA that monitors and maintains the ASOS means that NOTAMs cannot be issued for the ASOS using the same criteria as the AWOS, the FAA responded stating that the "NWS determines the criteria for ASOS system availability and FAA Tech Ops determines the criteria for AWOS."

¹⁵ <https://www.nws.noaa.gov/directives/sym/pd03021012curr.pdf>

¹⁶ [https://www.faa.gov/documentLibrary/media/Order/7930.2S_Notices_to_Airmen_\(NOTAM\).pdf](https://www.faa.gov/documentLibrary/media/Order/7930.2S_Notices_to_Airmen_(NOTAM).pdf)

3.0 Upper Air Data

High-Resolution Rapid Refresh (HRRR) model¹⁷ soundings for the accident site at 1700 PST (figure 3) and 1800 PST (figure 4) were retrieved from the National Oceanic and Atmospheric Administration's Air Resources Laboratory.

At 1700 PST, near the surface the wind was from the south-southwest at about 15 knots and increased in magnitude and veered slightly with height to a southwest wind of about 30 knots near 10,000 feet. Calculations made by the Rawinsonde OBservation Program (RAOB) indicated the potential for clouds above 8,400 feet with light and moderate icing between about 7,800 and 15,200 feet and moderate low level wind shear (LLWS) near the surface.

At 1800 PST, near the surface the wind was from the southwest at about 10 knots and increased in magnitude and veered with height to a west-northwest wind of about 15 knots near 10,000 feet. Calculations made by RAOB indicated the potential for clouds above about 7,200 feet with moderate icing from the surface to about 11,300 feet and light low level wind shear (LLWS) near the surface.

¹⁷ The HRRR is a 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.

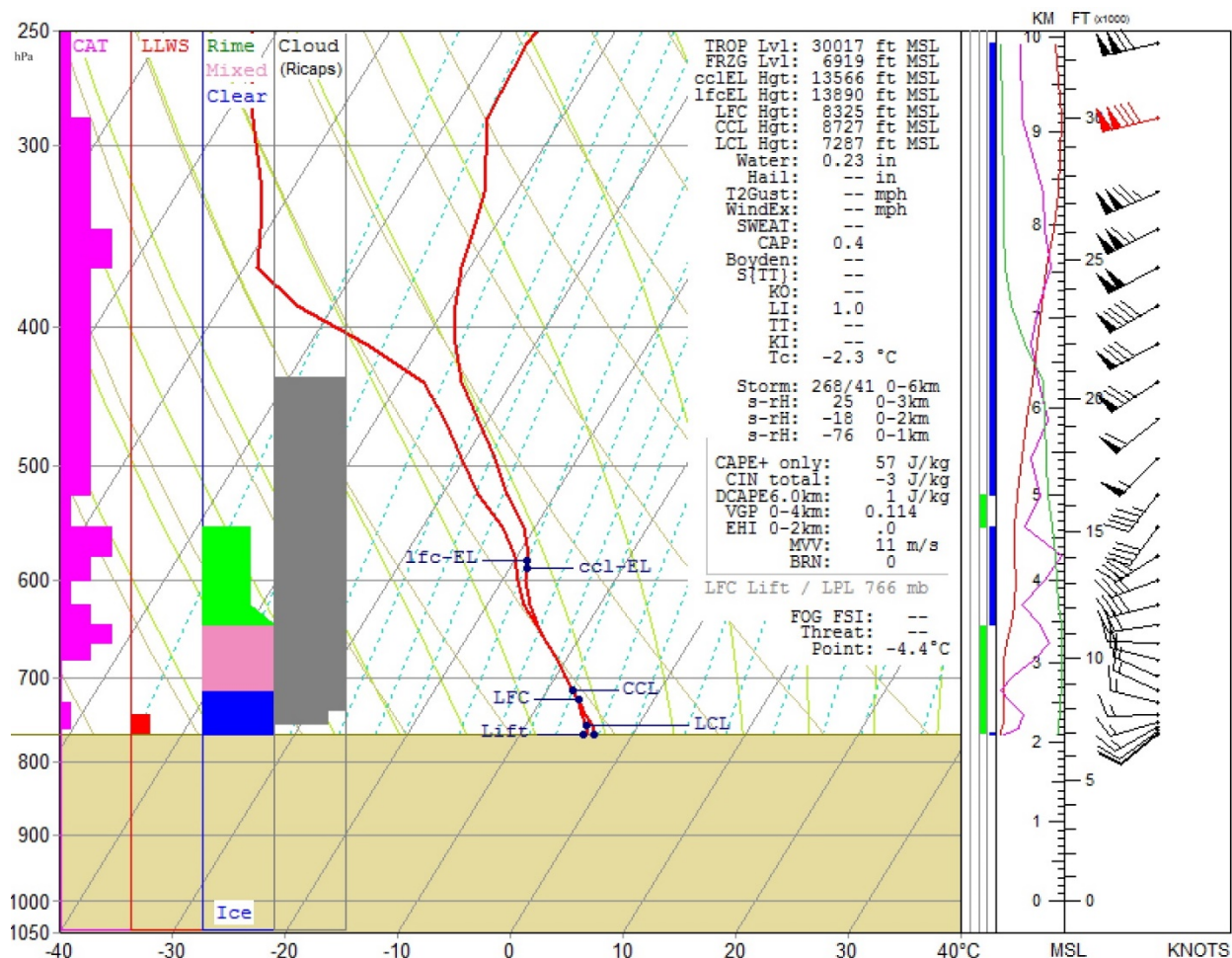


Figure 4 – HRRR model sounding data in SkewT/LogP format for 1800 PST at the accident site, surface to 250 hPa.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 infrared (10.3 μ m) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 1632, 1702, 1717 and 1732 PST are presented in figures 5-8. The GOES-17 infrared imagery depicted an area of relatively high cloud, oriented in a southwest-to-northwest fashion, advancing to the southeast and through the accident region around the accident time. Infrared cloud-top temperatures for these relatively high clouds were about -37°C ($\pm$ 2°C), which, when considering the 1700 PST HRRR sounding, corresponded to cloud top heights of about 22,200 feet. Brightness temperatures in the area immediate ahead of these advancing clouds in the accident region at 1632 PST were about -8°C, which, according to the 1700 PST HRRR sounding, corresponded to cloud top heights of about 9,500 feet.

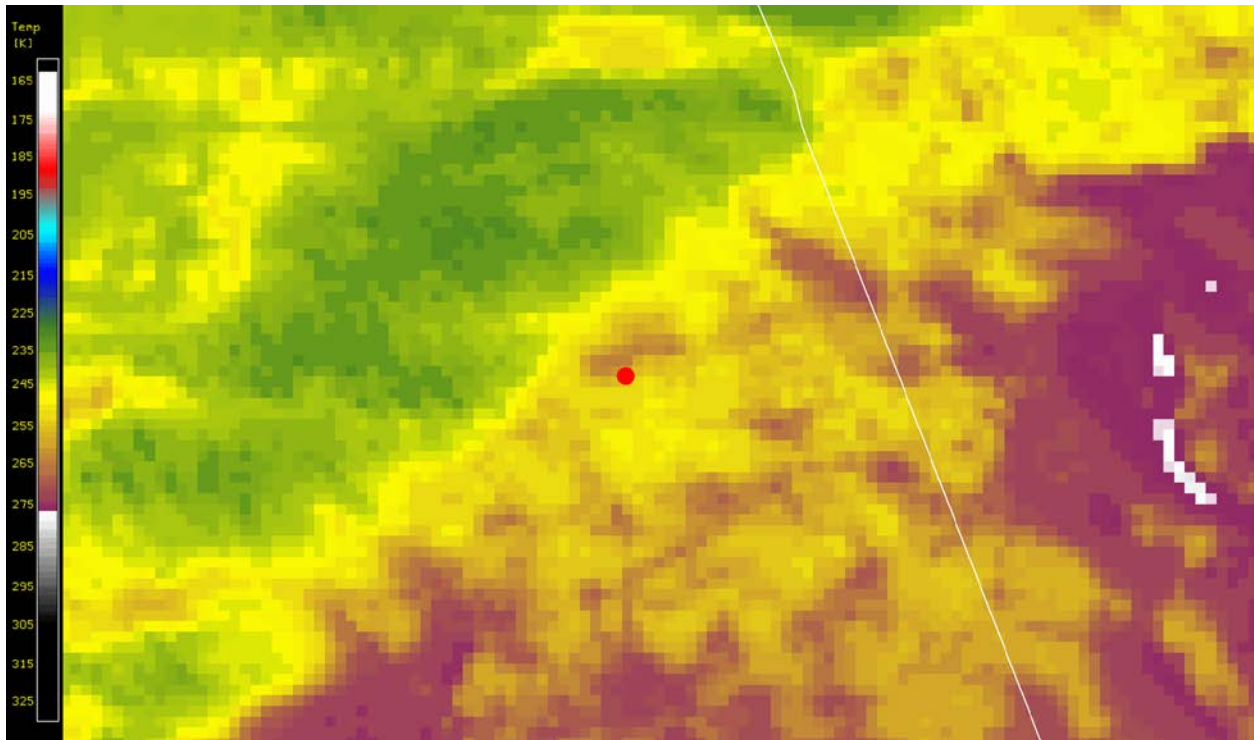


Figure 5 – GOES-17 infrared imagery (brightness temperature in degrees Kelvin) from 1632 PST. Accident location denoted by red dot. This image has not been corrected for any parallax error.

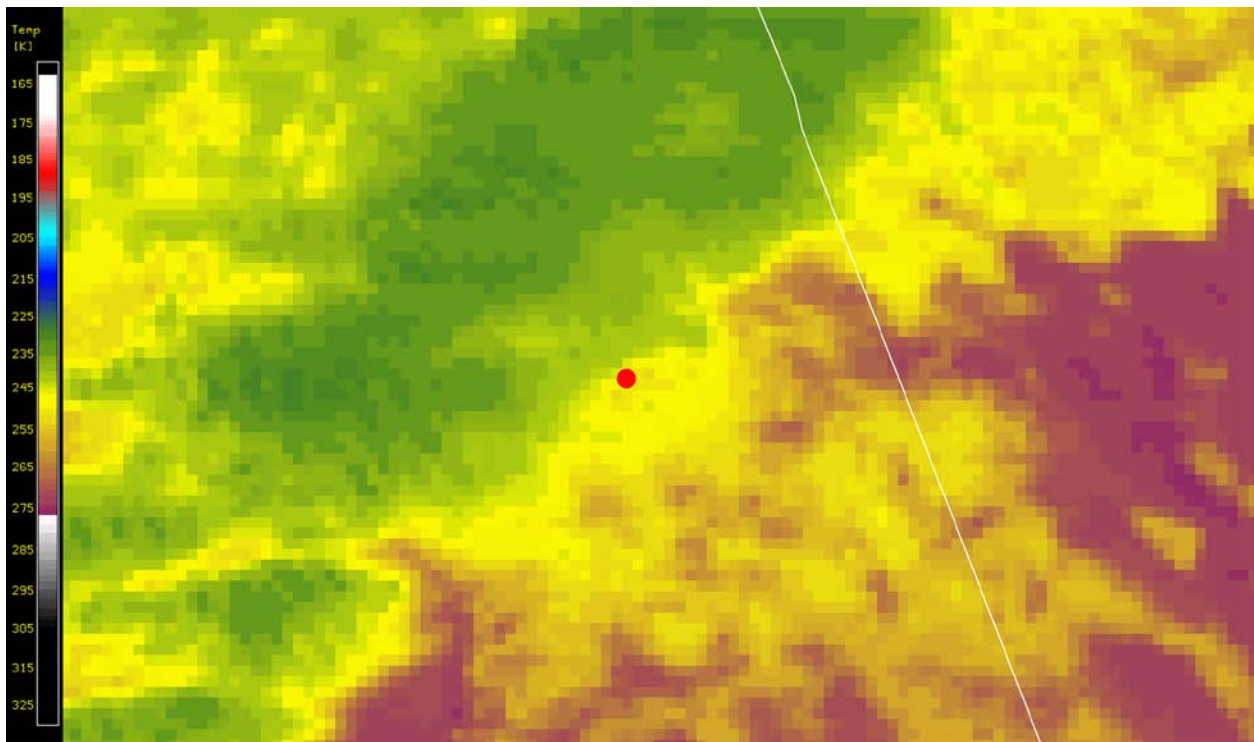


Figure 6 – GOES-17 infrared imagery (brightness temperature in degrees Kelvin) from 1702 PST. Accident location denoted by red dot. This image has not been corrected for any parallax error.

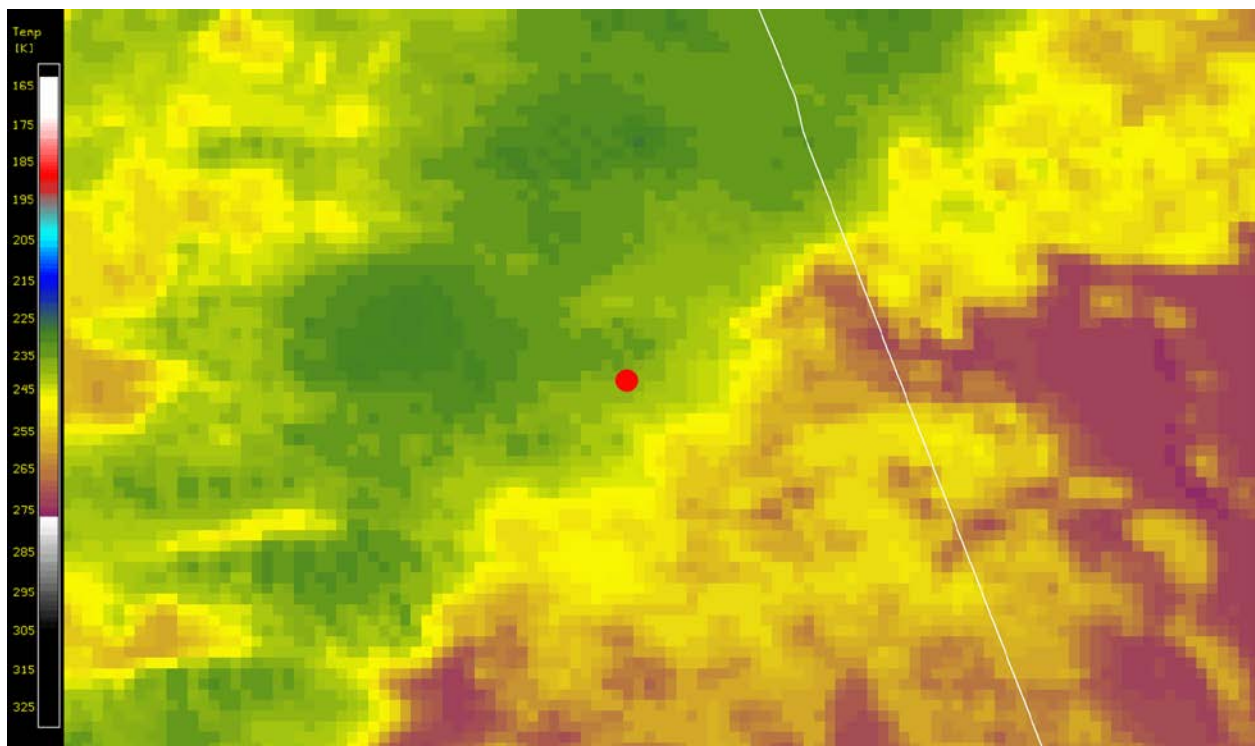


Figure 7 – GOES-17 infrared imagery (brightness temperature in degrees Kelvin) from 1717 PST. Accident location denoted by red dot. This image has not been corrected for any parallax error.

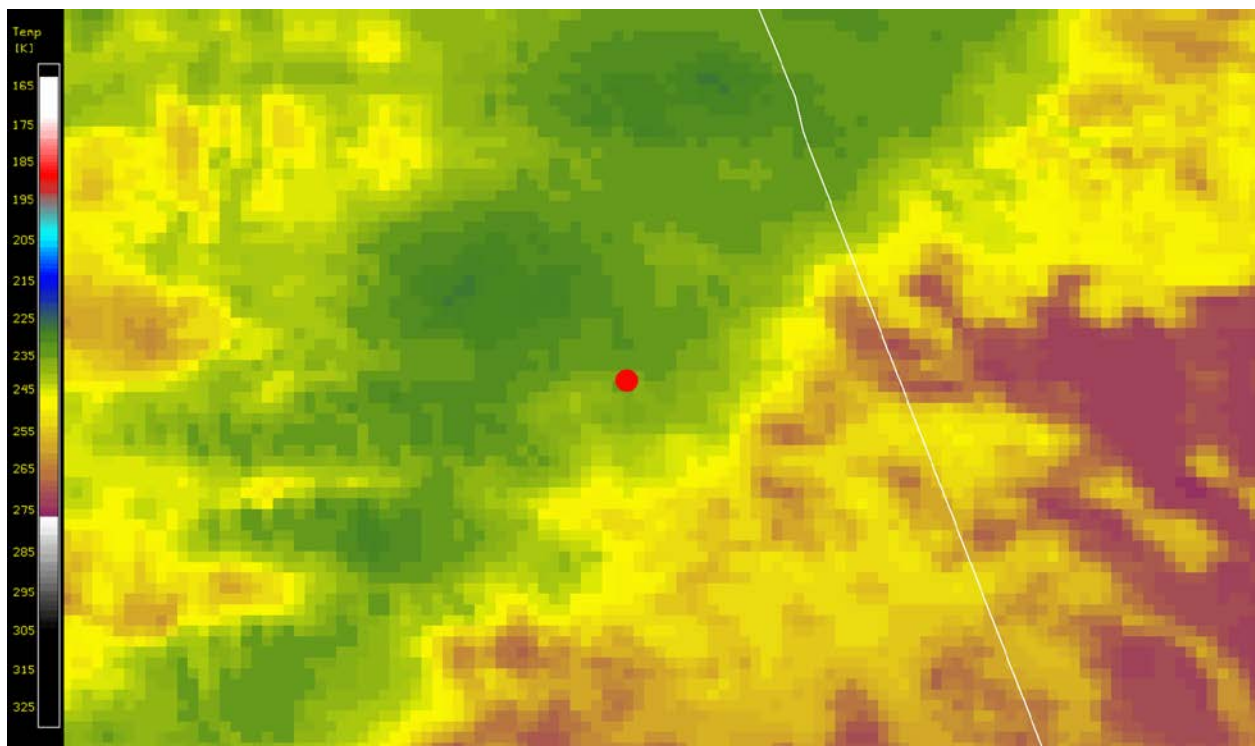


Figure 8 – GOES-17 infrared imagery (brightness temperature in degrees Kelvin) from 1732 PST. Accident location denoted by red dot. This image has not been corrected for any parallax error.

5.0 Weather Radar

The WSR-88D¹⁸ Level-II weather radar imagery from the KLRX site is presented in figure 9. KLRX was located approximately 125 miles northwest of the accident location at an elevation of about 6,760 feet. Assuming standard refraction and considering the 0.95° beam width¹⁹ for the WSR-88D radar beam, the KLRX 0.483° tilt would have “seen” altitudes above the accident location of between about 17,200 and 29,800 feet. Around the time of the accident, light values of reflectivity were seen to the north, northwest and west of the accident location.

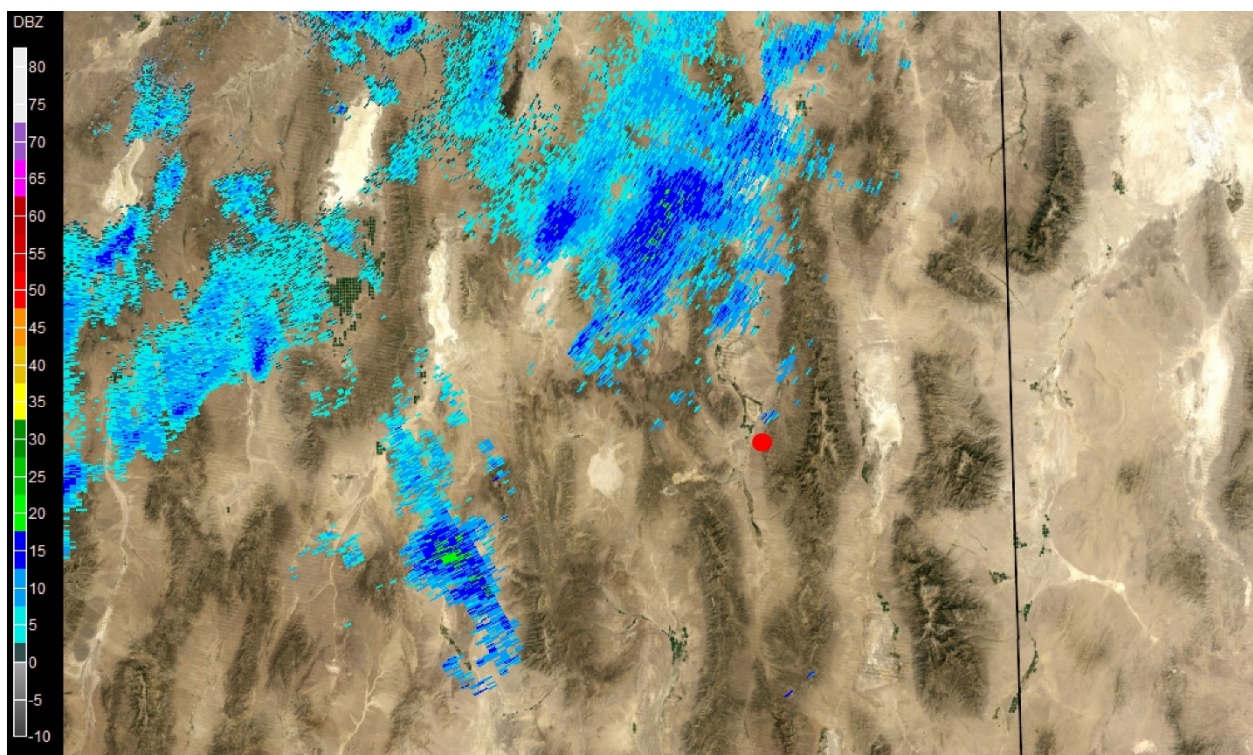


Figure 9 – KLRX 0.483° Level-II reflectivity product from a sweep initiated at 1725:16 PST. Accident location marked by red circle.

¹⁸ Weather Surveillance Radar 88 Doppler (WSR-88D)

¹⁹ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

6.0 Pilot Reports

The only publicly disseminated pilot report²⁰ (PIREP) made within 100 miles of the accident location between 1600 and 1900 PST below 10,000 feet reported ice on the runway and taxiway and poor braking action at Elko Regional Airport in Elko, Nevada.

EKO UA /OV EKO /TM 0240 /FL051 /TP UNKN /RM ICE ON RWY AND TWY
BRAKING ACTION POOR=

7.0 Area Forecast Discussion

Presented here are the “Aviation” sections of AFDs issued by LKN at 1534 and 1735 PST.

*FXUS65 KLKN 152334
AFDLKN
Area Forecast Discussion
National Weather Service Elko NV
334 PM PST Fri Feb 15 2019*

*AVIATION...A cold front will continue to pass from NW to SE across the region this afternoon and into this evening bringing light to moderate snowfall along with gusty winds. **Main impacts into this evening are expected at KELY where CIGs and VIS may be reduced to IFR or LIFR levels.** Otherwise, some lingering light snow showers will hang around the region this evening and on Saturday which may briefly impact all TAF sites.*

*FXUS65 KLKN 160135
AFDLKN
Area Forecast Discussion
National Weather Service Elko NV
535 PM PST Fri Feb 15 2019*

.AVIATION UPDATE...Snow showers will continue across the KTPH terminal through the early evening hours. Have updated forecast to include the shower activity with reductions to CIGS/VSBY.

Note: Current information is not being transmitted to the internet as communications is down. However, observations can still be obtained by calling into the ASOS. Therefore, AMD NOT SKED has been added to the KTPH TAF until further notice.

A band of snow showers will be moving into the KELY area and forecast has been updated to reflect deteriorating conditions through the evening hours.

²⁰ Pilot reports with 3-letter station identifiers in Nevada were retrieved from the National Centers for Environmental Information. Pilot reports publicly-disseminated only over radio were not captured.

8.0 Terminal Aerodrome Forecasts

Presented here are the two most recent ELY TAFs issued by LKN prior to the accident time.

TAF KELY 151737Z 1518/1618 16020G30KT P6SM SCT050
FM152300 19023G33KT 5SM -SN OVC040
FM160100 19017G30KT 1SM -SN VV010
FM160400 24010KT P6SM VCSH SCT025 BKN050=

At 0937 PST a TAF was issued for ELY that forecasted for the accident time: wind from 190° at 17 knots with gusts to 30 knots, visibility of one mile, light snow, vertical visibility of 1,000 feet.

TAF KELY 152320Z 1600/1624 17012KT P6SM -SHSN SCT040 OVC060
FM160100 18012G22KT 5SM -SN SCT015 OVC025
TEMPO 1601/1605 1SM -SN VV012
FM160500 20010KT P6SM -SHSN SCT025 BKN050=

At 1520 PST a TAF was issued for ELY that forecasted for the accident time: wind from 180° at 12 knots with gusts to 22 knots, visibility of five miles, light snow, scattered clouds at 1,500 feet, ceiling overcast at 2,500 feet; temporary conditions²¹ between 1700 and 2100 PST a visibility of one mile, light snow, vertical visibility of 1,200 feet.

9.0 AIRMETs

Airmen's Meteorological Information (AIRMET) advisories for instrument flight rule (IFR)²² conditions, mountain obscuration, moderate turbulence below FL180²³ and moderate icing between the freezing level and FL180 were active for the accident site at the accident time.

At 1245 PST, the NWS Aviation Weather Center (AWC) issued the following AIRMETs for IFR conditions and mountain obscuration that were active for the accident site at the accident time.

*WAUS45 KKCI 152045
WA5S
-SLCS WA 152045
AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 160300

AIRMET IFR...ID MT WY NV UT AZ NM
FROM 70SW BIL TO 50NNE OCS TO 50E DTA TO TBC TO 50SSE SJN TO 40NW SSO
TO 40SE PGS TO 20WNW ILC TO 80WSW ELY TO 60WSW BAM TO 60ESE BOI TO
40WNW PIH TO 40SE DLN TO 70SW BIL*

²¹ Temporary conditions - fluctuations to forecast conditions which are expected to last less than one hour in each instance and, in the aggregate, to cover less than half of the indicated period.

²² IFR conditions - Ceilings less than 1,000 feet agl and/or visibility less than three statute miles.

²³ Flight Level (FL) - a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the international standard pressure datum of 1013.25 hPa (29.92 inches of mercury), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or agl.

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET MTN OBSCN...ID MT WY NV UT CO AZ NM WA OR CA
FROM 40SSW YQL TO GTF TO HVR TO CYS TO 30ENE FTI TO 40ENE TUS TO 40SW
PGS TO 20S HEC TO 60SSE TRM TO MZB TO 50W RZS TO FOT TO ONP TO TOU
TO HUH TO 40SSW YQL
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

At 1536 PST, the AWC issued the following AIRMET for moderate turbulence below FL180 that was active for the accident site at the accident time.

WAUS45 KKCI 152336 AAB
WA5T
-SLCT WA 152336 AMD
AIRMET TANGO UPDT 6 FOR TURB STG WNDS AND LLWS VALID UNTIL 160300
.
...SEE SIGMET QUEBEC SERIES...
.
...SEE SIGMET VICTOR SERIES...
.
AIRMET TURB...ID MT WY NV UT CO AZ NM OR CA AND CSTL WTRS
FROM MLS TO 90SSW DIK TO 70SW RAP TO BFF TO GLD TO 50W LBL TO 30ESE
TBE TO INK TO ELP TO 60SE SSO TO 70SW SJN TO 30SSW MZB TO 20W RZS TO
20SSE ENI TO 40S ONP TO 40SSE DSD TO 90S LKV TO MLS
MOD TURB BLW FL180. CONDS CONTG BYD 03Z THRU 09Z.

At 1430 PST, the AWC issued the following AIRMET for moderate icing between the freezing level and FL180 that was active for the accident site at the accident time.

WAUS45 KKCI 152230 AAA
WA5Z
-SLCZ WA 152230 AMD
AIRMET ZULU UPDT 6 FOR ICE AND FRZLVL VALID UNTIL 160300
.
AIRMET ICE...ID WY NV UT CO...UPDT
FROM 50SSW BIL TO 40WSW SHR TO 30SW DDY TO 20SW LAR TO 40ESE HBU TO
30SSE OAL TO 70SW BAM TO 20N DBS TO 50SSW BIL
**MOD ICE BTN FRZLVL AND FL180. FRZLVL SFC-080. CONDS CONTG BYD 03Z
THRU 09Z.**

10.0 SIGMETs

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories active below 15,000 feet for the accident location at the accident time.

11.0 CWSU Products

There were no Center Weather Advisories issued by the Center Weather Service Unit (CWSU) at the Salt Lake City Air Route Traffic Control Center (ZLC) that were active for the accident location at the accident time.

At 1000 PST, the ZLC CWSU issued the following Meteorological Impact Statement which was valid until 2000 PST.

*FAUS20 KZLC 151814
ZLC MIS 01 VALID 151800-160400
...FOR ATC PLANNING PURPOSES ONLY...
A STRONG WESTERLY JET STREAM COMBINED WITH GUSTY RIDGE TOP
WINDS AND SURFACE WINDS WILL PRODUCT OCNL SEV TURBULENCE WITH
AREAS OF LLWS POSSIBLE. MTN WAVE AND LLWS ARE POSSIBLE ESPECIALLY
ACROSS WESTERN WYOMING. **RAIN AND SNOW WILL CONTINUE TO
SPREAD SOUTH AND EAST ACROSS ZLC AIRSPACE WITH A CHANCE FOR
ISOL TS WITH FRONTAL PASSAGE THIS AFTERNOON/EVENING.
WIDESPREAD LOW CIGS, MTN OBSCUR AND IFR ARE EXPECTED WITH
PRECIP. PILOTS SHOULD ENSURE A WX BRIEF BEFORE FLYING AND
MONITOR FCST.***

12.0 Flight Service

According to Leidos, neither they nor and third-party vendors utilizing the LFS system had any contact with the accident aircraft on the accident day.

E. LIST OF ATTACHMENTS

- Attachment 1 - ELY ASOS five-minute data between 1200 and 2200 PST, ELY ASOS “page two” data in raw form between 1100 and 2200 PST, and ELY ASOS syslogs for February 15-17, 2019.
- Attachment 2 - Statements provided to the NTSB following the accident by individuals familiar with the ELY ASOS reporting.
- Attachment 3 - Record of conversation with the ELY Airport Manager.

- Attachment 4 - Correspondence with the National Weather Service.
- Attachment 5 - All AOMC trouble tickets for the ELY ASOS from January 1, 2018, through April 16, 2019.
- Attachment 6 - The National Weather Service Elko Weather Forecast Office maintenance shift logs from July 2018 through April 22, 2019.
- Attachment 7 - Summary of interview with the Electronic Systems Analyst at the National Weather Service Elko Weather Forecast Office.
- Attachment 8 - Record of conversation with the Maintenance Manager for ASOS Program at the National Weather Service.
- Attachment 9 - “ASOS Maintenance Note 18, Revision A” found in section 2.6 of the National Weather Service (NWS) Engineering Handbook 11 and its “Attachment A – List of ASOS Spares Kits,” Engineering Management Reporting System logs for the ELY ASOS during the days surrounding the accident time, and NWS Engineering Handbook Number 4.
- Attachment 10 - Correspondence with the Federal Aviation Administration.

Submitted by:

Mike Richards
Senior Meteorologist

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