Factual Report – Attachment 8

Engineering analysis by Collins Aerospace of the expected weather radar cockpit display on the accident aircraft immediately prior to the accident time.

METEOROLOGY

DCA19MA086

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NTSB, AS-30

Collins Aerospace

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Engineering Analysis of Expected Weather Display on B767/N1217A

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DATE: 7/1/2019

CUSTOMER: Atlas Air

AIRCRAFT TYPE / TAIL: B767 / N1217A

DESCRIPTION / PART# / SERIAL#: WRT-701X / 622-5132-633 / Unknown

REPORTED PROBLEM:

Atlas Air incident of February 23rd, 2019.

Collins Aerospace

1 Report Overview and Background

This plan/report will document the investigation process and the resulting findings, if any concerning the WXR-701 system installed on the affected aircraft.

Received Date: 6/26/2019

Aircraft: B767

Aircraft Tail Number: N1217A

Customer: Atlas Air

1.1 Investigation Team

Table 1-1 - Team Members

	NAME	TITLE
Cognizant Engineer:	Anthony Schoepske	Sr Systems Engineer

1.2 Customer Incident Report

From NTSB investigator Mike Richards;

While I know we can't know for sure, we are trying to determine as best as possible what the Atlas wx radar could have been painting as the aircraft approached the cold front (coincident with upset), if we make some type of assumptions on settings (e.g. tilt/gain). In addition, I am not sure if this radar had some sort of predictive turbulence detection capability, but we'd like to learn a bit more.

I am not any sort of expert with this equipment, so not sure what the best way forward would be.

Right now I can provide ground-based wx radar information for the area (in dBZ) at various heights, as well as the particular part numbers onboard the aircraft (note that for the WX Transceiver, LH and RH should be switched)…

My thinking is perhaps we can first understand what minimum levels for aerosols are for painting something on the cockpit display, either precip or any turbulence parameter, and go from there. Thoughts?

2 Analysis

It must be made clear, because Collins does not know the specific settings on the radar control panel and does not have the actual flight recorder information, that any information contained in this analysis is only conjecture and only made on a ‘best guess’ basis.

In order to make an estimate of the radar imagery, assumptions must be made about the radar controls at the time of the incident.

1. It is assumed that the flight crew was familiar with the operation of the Collins WXR-701 radar system
2. It is assumed that the tilt was selected to a position to minimize ground clutter on approach. At roughly 8000 feet this would be between zero and two degrees up
3. It is assumed that gain was at the calibrated selection

Data from logged ADS-B transmissions will be used in lieu of actual flight recorder position data.

Considerations of the Collins WRT-701X radar operation;

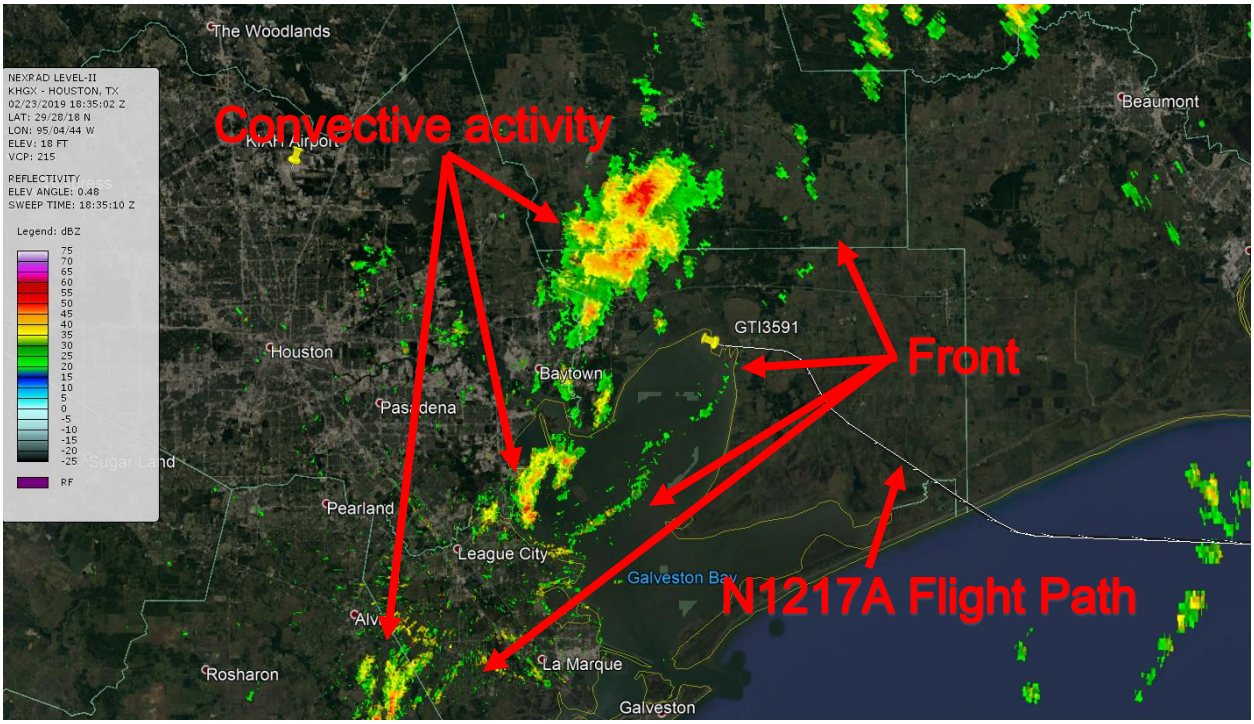
1. Detected reflectivity must be greater than 20dBz in order to be presented as precipitation in the cockpit. This is per industry specification for Airborne Weather Radar Systems display encoding
2. The WRT-701X that was installed on N1217A is capable of detecting turbulence and displaying turbulence as a magenta color on the radar display
3. It is possible to show areas of detected turbulence lower than 20dBz, as long as the associated reflectivity levels are greater than or equal to 15dBz
4. The WRT-701X is a manual tilt radar system and will not display any weather features outside of the selected radar beam elevation

2.1 Weather Analysis

Volumetric scan data was acquired from the Houston NOAA radar station, KHGX. This data was analyzed in two and three dimensional representations to give a better understanding of what the radar could have seen as N1217A made its descent into Houston.

The reflectivity near the time of the incident, shown in Figure 2-1 - KHGX Reflectivity and N1217A ADS-B Flight Path, shows a frontal boundary moving southeast away from a series of convective cells in the area

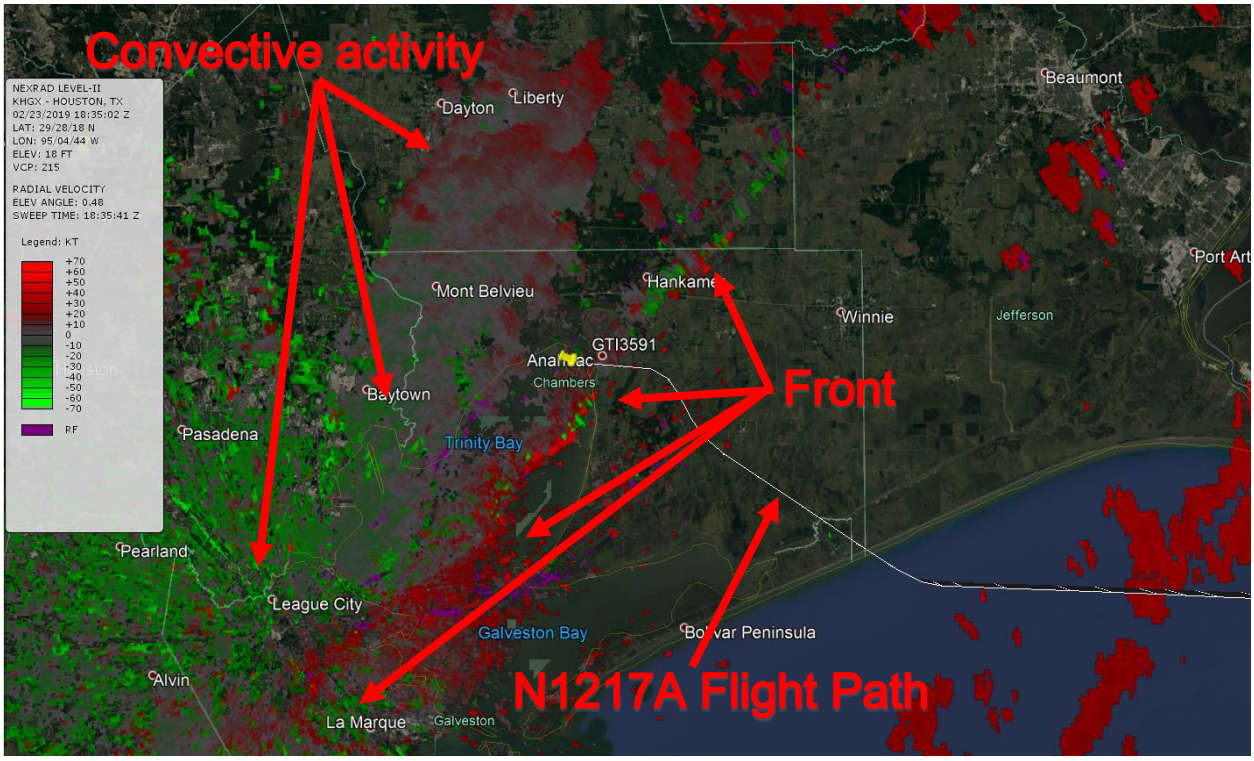
Figure 2-1 - KHGX Reflectivity and N1217A ADS-B Flight Path



The full volumetric radar scan from 6:35PM UTC, shows a few key pieces of information.

1. There were convective cells on the normal approach path into Houston, approximately 5 nautical miles ahead of where the last ADS-B position was reported
2. The convective cells were following a front that was proceeding southeast, away from the cells as shown by low tilt reflectivity. This front was intercepted and crossed by N1217A just prior to the excessive pitch down maneuver. Refer to the reflectivity and velocity data provided in figures Figure 2-1 - KHGX Reflectivity and N1217A ADS-B Flight Path and
3. Figure 2-2 - KHGX Velocity and N1217A ADS-B Flight Path

Figure 2-2 - KHGX Velocity and N1217A ADS-B Flight Path



4. The reflectivity levels of the main convective cells were greater than 40dBz, however, there was no reflectivity within 6000 feet above or below N1217A at the point where N1217A began rapidly losing altitude. Refer to Figure 2-3 - KHGX 3D 15dBz Reflectivity with ADS-B Flight Path and Figure 2-4 - KHGX 3D 15dBz Reflectivity with ADS-B Flight Path - Side View. This indicated that N1217A was not in any convective weather at the time of rapid descent.

Figure 2-3 - KHGX 3D 15dBz Reflectivity with ADS-B Flight Path

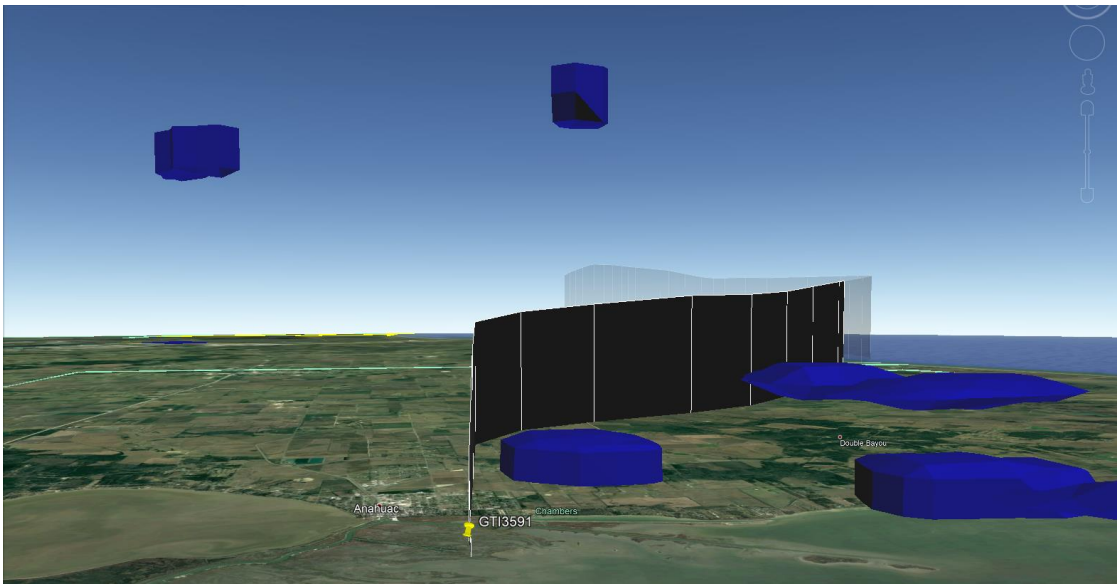
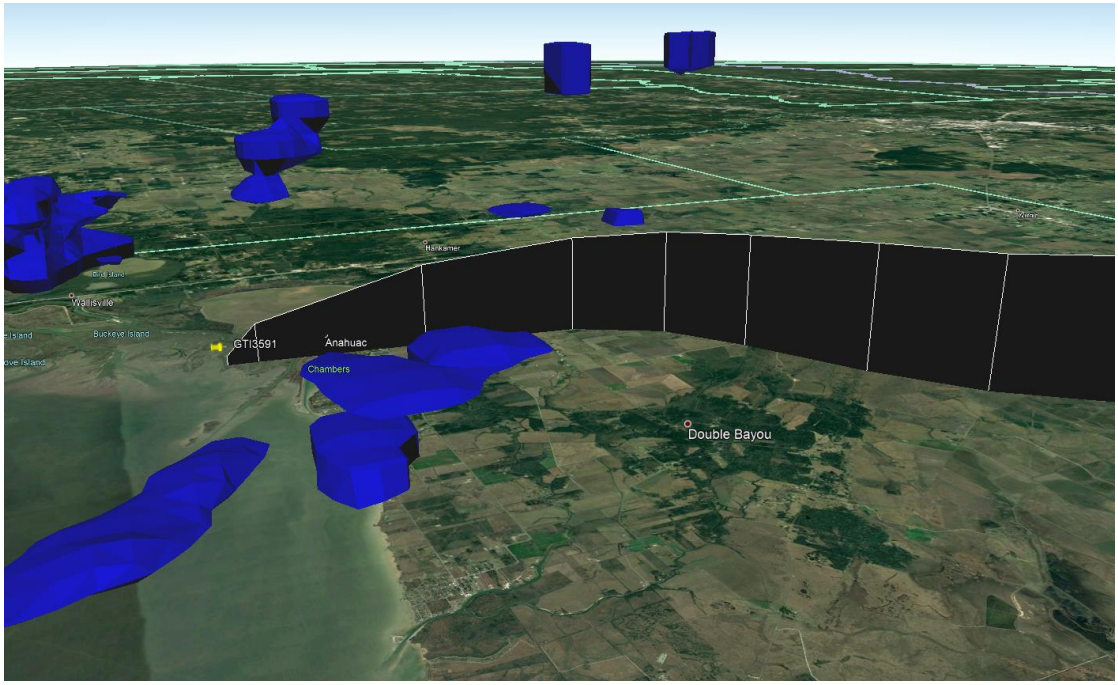


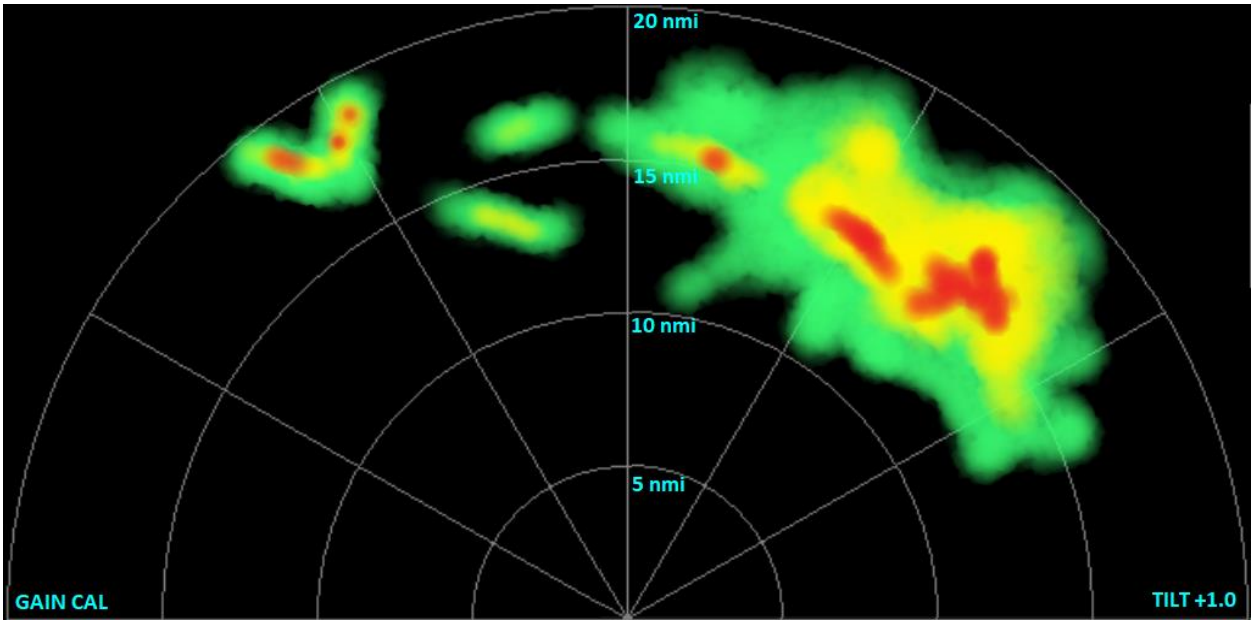
Figure 2-4 - KHGX 3D 15dBz Reflectivity with ADS-B Flight Path - Side View



2.2 Estimated Radar Display

The estimated radar image is based off reflectivity levels at the aircraft altitude, measured by the nearest ground station, coupled with assumptions made concerning the radar tilt and gain settings. This generated image represents the weather presentation on the flight display at the moment that N1217A began to lose altitude and rapidly increase airspeed.

Figure 2-5 - Estimated Reflectivity from the WRT-701X at 8000 Feet AGL



3 Conclusions

There is evidence to suggest that there was turbulence and shearing along a cold front within the flight path of N1217A. All of the reflectivity levels of the returns along the front were just at or below 20dBz with most returns showing less than 15dBz. The returns were also far enough below the radar beam that they would not be detected by the WRT. This is based on assumptions of what would be an appropriate tilt at the time that N1217A began to rapidly lose altitude and increase airspeed which was approximately 8000 feet AGL. In order for the WRT-701X to detect and display turbulence, the associated reflectivity levels must be greater than or equal to 15dBz. In order for the WRT-701X to display precipitation the associated reflectivity levels must be greater than or equal to 20dBz.