

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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AIR TRAFFIC CONTROL

Group Chairman's Factual Report

March 11, 2026

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A. ACCIDENT

Location: Franklin, Tennessee
Date: May 15, 2024
Time: 1202 CDT¹
1702 UTC²
Airplane: N47WT, Beech V35-TC

B. AIR TRAFFIC CONTROL GROUP

Group Chairman	Sarah LC Lewis National Transportation Safety Board Washington, DC
Group Co-Chairman	Betty Koschig National Transportation Safety Board Washington, DC
Subject Matter Expert ³ (Meteorology)	Paul Suffern National Transportation Safety Board Washington, DC
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C. SUMMARY

On May 15, 2024, at 1202 central daylight time, a Beech V35-TC, N47WT, was substantially damaged when it was involved in an accident near Franklin, Tennessee. The private pilot and the two passengers were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

¹ All times are in central daylight time (CDT) unless otherwise noted.

² UTC- coordinated universal time is the international time standard (formally Greenwich Mean Time, or GMT). Zero hours UTC is midnight in Greenwich, England, which is located at 0 degrees longitude. Everything east of Greenwich (up to 180 degrees) is later in time; everything west is earlier. For example, the CDT zone in the U.S. is UTC minus (-) 5.

³ A Meteorologist from the NTSB was embedded with the ATC group. More meteorological information has been included in the Meteorological Factual Report.

D. DETAILS OF THE INVESTIGATION

On May 16, 2024, the decision was made to form an air traffic control (ATC) group and conduct an on-scene investigation at both the Nashville Airport Traffic Control Tower (BNA ATCT) in Nashville, TN and at the Memphis Air Route Traffic Control Center (ZME ARTCC) in Memphis, TN. Notification was made to the Federal Aviation Administration (FAA) safety intelligence and response group (SIRG), of the NTSB's intent to conduct the onsite investigations at both ATC facilities.

The ATC group was formed and consisted of the group chairman from the NTSB, a Senior Air Traffic investigator from the NTSB, a Meteorologist from the NTSB, a subject matter expert from the FAA, and an air safety investigator (ASI) from the National Air Traffic Controllers Association (NATCA). Travel was planned for the week of May 19, 2024. The group traveled to Nashville, TN on Monday, May 20.

On May 21, 2024, the group held a brief organizational meeting at the hotel and traveled to the BNA ATCT. The group was provided an in-brief by the air traffic manager (ATM) and members of their staff. The in-brief included a synopsis of the event, as well as facility staffing at the time of the accident. Additionally, information was provided on mitigations, SSR outcomes, and other pertinent post-event information. A FALCON⁴ replay with voice was provided. Others in attendance were members of the FAA's Safety and Intelligence Response Group (SIRG), Eastern Service Area (ESA) Quality Control Group (QCG), and FAA legal counsel from AGC-300. The group was then provided an operational tour of the facility with an emphasis on the positions that were staffed at the time of the accident. The group then conducted interviews with the Departure Radar West Controller (DRW), a member of the Local Safety Council (LSC), and the operations supervisor (OS) on duty at the time of the accident. The group then reviewed received data and concluded on-site investigative activities for the day.

On May 22, 2024, the group reconvened at the BNA ATCT and conducted an interview with the Air Traffic Manager (ATM). The group was able to observe weather move through the airspace in real time and were able to document a discrepancy with the ASR-9 displayed weather levels on the radar display. (See section H for more information on the discrepancy.) Additional data was collected and reviewed before concluding on-site investigative activities at the BNA ATCT. The group then traveled to Memphis, TN and prepared for the onsite portion of the investigation at the ZME ARTCC.

On May 23, 2024, the group convened at the ZME ARTCC and attended an in-brief with the ATM, Executive Officer (XO), NATCA facility representative and vice president, other members of ZME staff and district personnel. The in-brief included a

⁴ FALCON - A software system utilized for the instant / rapid replay of air traffic control operational incidents in a format much like the one displayed to the air traffic control specialist. It is used in terminal radar facilities to review training management issues, investigate accidents and operational errors, develop facility specific specialty training programs, and present facility-wide briefings on operational incidents.

synopsis of the event, as well as facility staffing at the time of the accident. Others in attendance at the in-brief were members of SIRG and ESA QCG. The group was then provided with an operational tour of the facility with an emphasis on the Area that participated in providing service to the accident aircraft, Traffic Management Unit, and the Memphis Center Weather Service Unit (CWSU). The group was provided with an opportunity to review in-depth the archived weather depicted on the involved controller's radar display. The group's main focus at ZME was to understand the weather that was available to the controllers during the time of the accident and compare what was available to what the BNA ATCT controllers had available. The group then conducted interviews with the R14 radar controller, and the OS who were providing services to the aircraft prior to entering BNA's airspace. Additionally, a TMU Coordinator at the time of the accident was interviewed. The group then reviewed received data and concluded on-site investigative activities for this investigation.

On May 24, 2024, the group met at the hotel, reviewed data, completed field notes and obtained concurrence. The IIC then released the group, concluding the field phase of the investigation.

On May 24 and May 25, 2024, the group traveled home.

E. FACTUAL INFORMATION

1.0 History of Flight

The following history of flight / sequence of events was constructed using an ATC partial voice transcript⁵, certified audio recordings⁶, surveillance data, services rendered telcon (SRT) and other information provided by the FAA, as well as flight plan information provided by ForeFlight⁷, and post-accident on-site investigative interviews⁸ conducted at both BNA ATCT and ZME ARTCC. Altitudes are in feet above mean sea level⁹ (msl) unless otherwise noted. Times have been rounded to the nearest minute up until the pilot of N47WT contacted BNA ATCT. Beginning at that time the times are written to the nearest second.

⁵ See Attachment 1: ATC Partial Voice Transcript. This transcript was made using certified audio provided by the FAA.

⁶ Certified ATC audio recordings are in Attachments 2 and 3: BNA ATCT and ZME ARTCC Audio Recordings.

⁷ [ForeFlight](#) is an Electronic Flight Bag (EFB) application for Apple iOS devices (iPad/iPhone) used by pilots for flight planning, charts, weather briefings, and in-flight situational awareness. It provides interactive maps, hazard awareness, and includes features like synthetic vision and logbooks.

⁸ See Attachment 4: Interview transcripts.

⁹ Mean Sea Level - Height above sea level. Used for en-route navigation and air traffic control.

At about 0845, the pilot of N47WT was issued an instrument flight rules (IFR)¹⁰ flight plan by the Baton Rouge approach control (BTR ATCT) while on the ground at Louisiana Regional Airport (REG).

At about 0853, the pilot of N47WT departed KREG and was provided with routine air traffic control services while transitioning through airspace by BTR ATCT, Houston Air Route Traffic Control Center (ZHU ARTCC), Jackson ATCT (JAN ATCT), Columbus ATCT (CBM ATCT), and ZME ARTCC through about 1141.

At about 1142, the pilot of N47WT requested a short deviation and the ZME ARTCC Radar 14 (R14) controller was issued 20 degrees left or right, on course direct to the Louisville VORTAC¹¹ (IIU) when able.

At about 1151, the pilot of N47WT requested a higher altitude and communications were transferred to BNA ATCT Departure Radar West (DRW) controller to make that request. The R14 controller coordinated with the DRW controller about N47WT deviating left and right of course. The DRW controller approved the deviation.

At 1151:58, the pilot of N47WT checked in with the DRW controller and requested a higher altitude.

At 1152:12, the DRW controller asked the pilot of N47WT what altitude was requested. The pilot of N47WT responded 9,000 feet.

At 1152:18, the DRW controller told the pilot of N47WT to standby and coordinated with the R14 controller for control for N47WT to climb higher in ZME ARTCC airspace. This request was approved by the R14 controller.

At 1152:42, the DRW controller instructs the pilot of N47WT to climb and maintain 9,000 feet. The pilot of N47WT read back the climb instruction correctly.

At 1157:23, the DRW controller instructed the pilot of N47WT to fly heading 360 for traffic inbound for Nashville International Airport.

At 1157:30, the pilot of N47WT responded, "Uh three six zero four seven whisky tango."

¹⁰ IFR - Instrument Flight Rules [ICAO]- A set of rules governing the conduct of flight under instrument meteorological conditions.

¹¹ VORTAC - A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance measuring equipment (DME) at one site.

At 1157:35, the DRW controller advised the pilot of N47WT to "expect on course in probably about fifteen miles." There was no response from the pilot of N47WT.

At 1158:18, the DRW controller asked the pilot of N47WT if they could navigate to EWO (New Hope, KY VOR/DME¹²).

At 1158:23, the pilot of N47WT told the DRW controller that they could not go to EWO on a 360 heading.

At 1158:33, the DRW controller explained that they previously needed the pilot of N47WT to be on a heading but if the pilot of N47WT could go direct to EWO they could go direct at that time.

At 1158:41, the pilot of N47WT responded that they would navigate to EWO.

At 1158:46, DRW controller instructed the pilot of N47WT to turn right direct EWO. The pilot of N47WT stated direct EWO.

At 1159:08, the DRW controller instructed the pilot of N47WT to maintain 9,000 feet. Radar return showed N47WT at 9,500 ft. The pilot of N47WT responded maintain 9,000 feet.

At 1159:54, the DRW controller asked the pilot of N47WT if they wanted to climb to 9,000 feet, the radar return showed N47WT at 9,500 feet. The pilot of N47WT was issued the Nashville International Airport (BNA) altimeter setting.

At 1200:00, the pilot of N47WT responded that they were descending to 9,000 feet.

At 1200:39, the DRW controller told the pilot of N47WT that the radar return showed N47WT at 9,400 feet.

At 1200:42, the pilot of N47WT responded that they were descending to 9,000 feet. There were no further transmissions received from the pilot of N47WT.

At 1201:19, N47WT appeared to be at 9,000 feet.

At 1201:45, N47WT appeared to be in a rapid descent.

¹² VOR - VHF Omni Directional Radio Range - A type of short-range radio navigation system for aircraft, enabling aircraft with a receiving unit to determine their position and stay on course by receiving radio signals transmitted by a network of fixed ground radio beacons.

DME - Distance Measuring Equipment - An aviation radio navigation technology that measures the slant range distance—in nautical miles—between an aircraft and a ground-based station.

At 1201:56, N47WT appeared to be at 7,800 feet and radar data did not indicate any other radar returns associated with N47WT after 1202:02.

At 1201:59 the DRW controller advised the pilot of N47WT that the aircraft was traveling southbound.

From 1202:24 to 1204:09 the DRW controller attempted to contact the pilot of N47WT five times.

At 1204:16 the DRW controller asked Southwest flight 6129 if they could try to relay a transmission to the pilot of N47WT. Southwest flight 6129 attempted contact without success.

At 1205:11 the DRW controller attempted to contact the pilot of N47WT on the emergency guard frequency. They then again attempted to contact the pilot of N47WT on the approach frequency.

At 1210:29 the DRW controller contacted the R14 controller to inquire if the pilot of N47WT had returned to their frequency. After some discussion, the R14 controller agreed to send the pilot of N47WT back to the DRW controller if the aircraft came back to their frequency.

2.0 Surveillance Information

2.1 Automatic Dependent Surveillance - Broadcast Information

Certified Automatic Dependent Surveillance-Broadcast (ADS-B)¹³ data were provided by the FAA. These data were provided in .csv format, as well as .kml. The ADS-B data provided flight track surveillance information for N47WT. ADS-B data is included as Attachment 5.

2.2 OpsVue Information

OpsVue data is track data only. Passur's OpsVue uses NextGen Data which includes flight identification and location data for advisory purposes only. This NextGen Data is a multi-sensor system that aggregates and georeferences FAA data sources including data from FAA ASDE-X and ASSC systems, FAA Terminal and En Route Radars, the FAA certified ADS-B Network and Flight Plan data from the En

¹³ ADS-B - Automatic Dependent Surveillance-Broadcast - A surveillance system in which an aircraft or vehicle to be detected is fitted with cooperative equipment in the form of a data link transmitter. The aircraft or vehicle periodically broadcasts its GPS-derived position and other information such as velocity over the data link, which is received by a ground-based transmitter/receiver (transceiver) for processing and display at an air traffic control facility.

Route Automation Modernization (ERAM) system. The reported altitude is derived from the reported pressure altitude, adjusted for the local pressure reported with the Rapid Update Cycle (RUC) data within the Continental United States (CONUS). Outside of the CONUS, only pressure altitude is reported. The accuracy of altitude data can vary, sometimes up to several hundred feet, however trend information (ie; rates of climb and descent) is considered accurate and reliable.

OpsVue data and ADS-B data were both used in creating figures 1-3 below. The flight track is indicated in yellow, with data from the final portion of the flight indicated in blue.

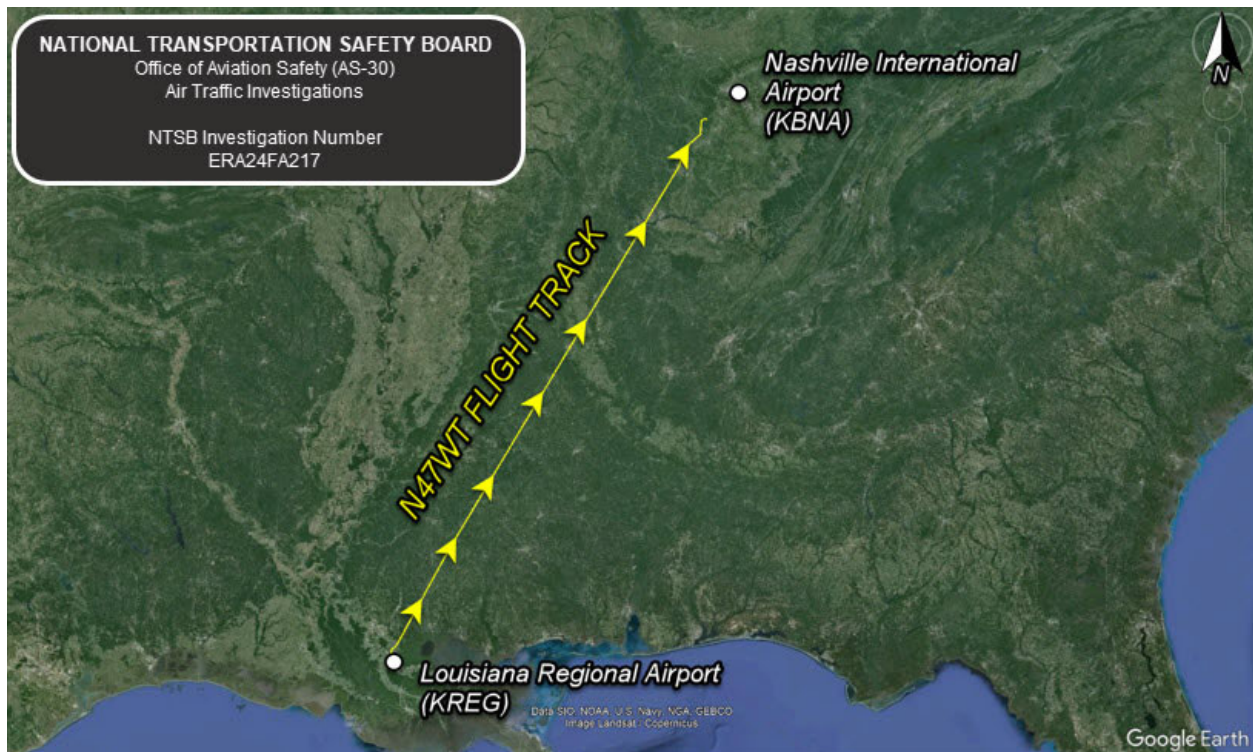


Figure 1. Overhead view of entire flight.

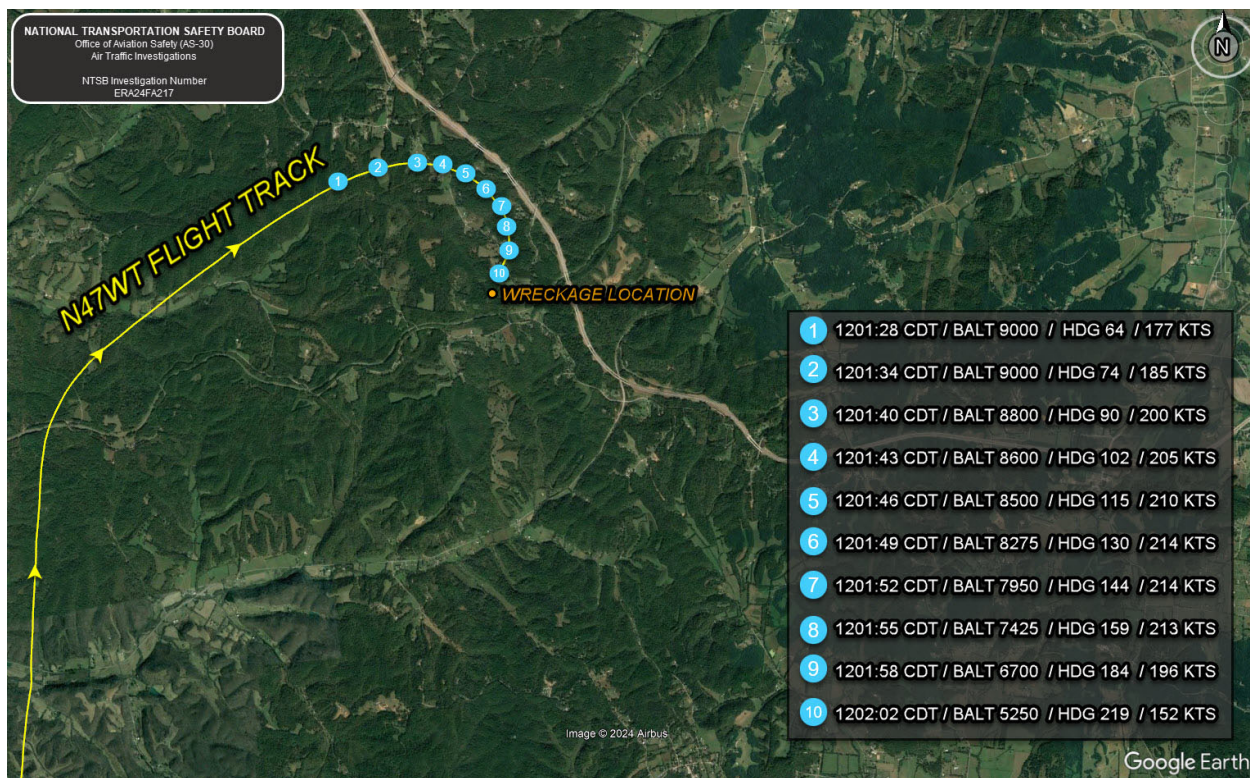


Figure 2. Overhead view of final segment of flight.

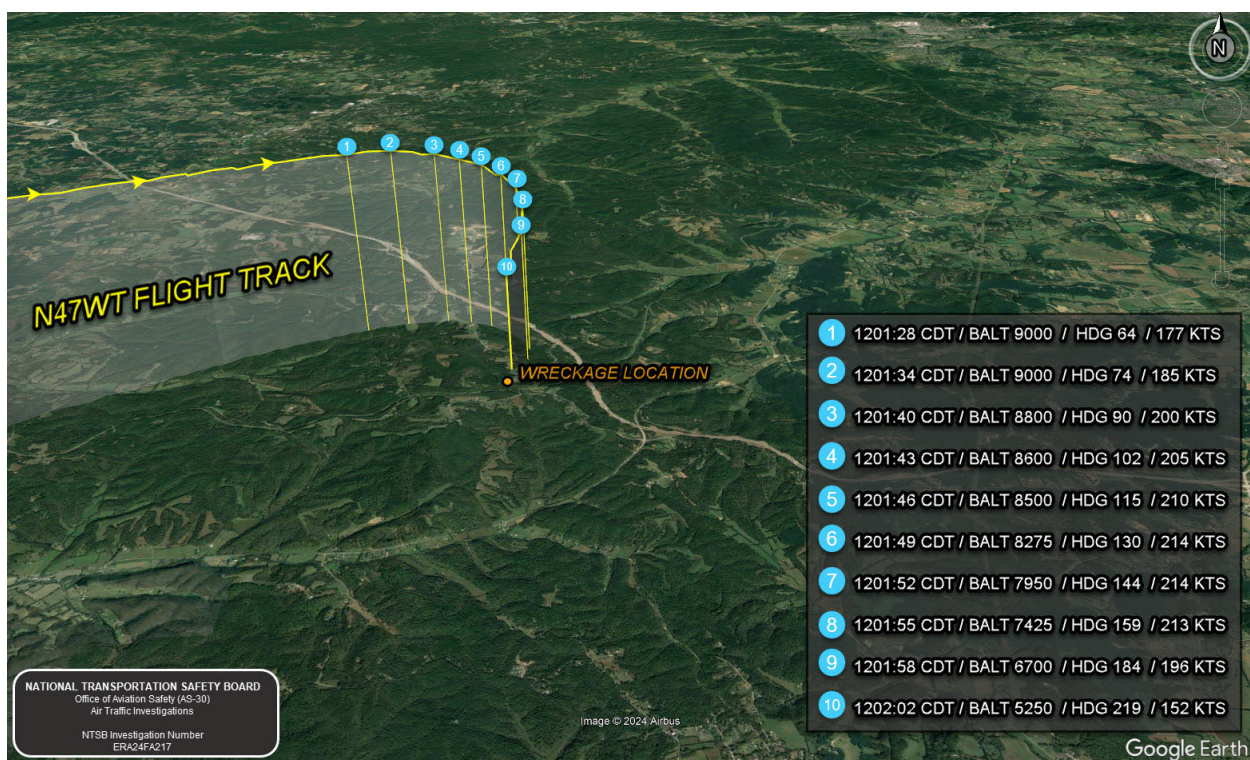


Figure 3. Profile view of final segment of the flight.

3.0 Weather Information

Surface Observations around the accident site are detailed in section 3.1. For more detailed weather information see the Meteorology Group Chairman's Factual Report.

3.1 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (SPECIs)¹⁴. The following observations were taken from standard code and are provided in plain language. A magnetic variation¹⁵ of 3.5° west was indicated over the area.

Maury County Regional Airport (KMRC) had the closest official weather station to the accident site. KMRC had an Automated Weather Observing System (AWOS¹⁶) and its longline¹⁷ reports were not augmented. The KMRC AWOS was located 18 miles south-southwest of the accident site, at an elevation of 681 ft, and issued the following observations surrounding the accident time:¹⁸

[1030 CDT] METAR KMRC 151530Z AUTO VRB05KT 10SM FEW022 SCT033
OVC041 22/19 A2976 RMK A01

[1055 CDT] METAR KMRC 151555Z AUTO VRB05G10KT 10SM SCT022
BKN044 OVC050 22/18 A2976 RMK A01

[1110 CDT] METAR KMRC 151610Z AUTO 33004G12KT 10SM SCT023
BKN033 BKN043 22/18 A2976 RMK A01

[1130 CDT] METAR KMRC 151630Z AUTO 25005KT 10SM BKN024 BKN037
BKN043 22/18 A2976 RMK A01

¹⁴ Latest criteria for SPECIs can be found in the Federal Meteorological Handbook: [Federal Meteorological Handbook Number 1, Surface Weather Observations and Reports \(icams-portal.gov\)](https://www.federalregister.gov/documents/2018/01/16/2018-01-16-federal-meteorological-handbook-number-1-surface-weather-observations-and-reports)

¹⁵ Magnetic variation - The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

¹⁶ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

¹⁷ Longline refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the weather observations are distributed.

¹⁸ The bold sections of products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident region around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times.

**[1155 CDT] METAR KMRC 151655Z AUTO VRB04KT 10SM FEW026
SCT035 BKN050 22/17 A2976 RMK A01**

[1202 CDT] ACCIDENT TIME

**[1210 CDT] METAR KMRC 151710Z AUTO VRB04G10KT 10SM SCT025
SCT030 BKN035 22/17 A2977 RMK A01**

[1230 CDT] METAR KMRC 151730Z AUTO VRB04G11KT 10SM FEW025
SCT036 BKN060 23/18 A2977 RMK A01

The bold type observations decoded in plain language were as follows:

KMRC weather at 1155 CDT, automated, wind variable at 4 knots, visibility 10 statute miles or greater, few clouds at 2,600 ft above ground level (agl), scattered clouds at 3,500 ft agl, broken ceiling at 5,000 ft agl, temperature of 22°C, dew point temperature of 17°C, and an altimeter setting of 29.76 inches of mercury (inHg). Remarks, automated station without a precipitation discriminator.

KMRC weather at 1210 CDT, automated, wind variable at 4 knots with gusts to 10 knots, visibility 10 statute miles or greater, scattered clouds at 2,500 ft agl, scattered clouds at 3,000 ft agl, broken ceiling at 3,500 ft agl, temperature of 22°C, dew point temperature of 17°C, and an altimeter setting of 29.77 inHg. Remarks, automated station without a precipitation discriminator.

The observations from the KMRC AWOS around the accident time identified VFR¹⁹ conditions.

¹⁹ The NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 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.

F. NASHVILLE AIRPORT TRAFFIC CONTROL TOWER

1.0 GENERAL

BNA ATCT was a 24-hour operational level 10 combined tower/terminal radar approach control (TRACON). The facility was upgraded from a level 9 on September 10, 2023. The total aircraft year-to-date operations from May 2023 to May 2024, increased by 4.1%. In May 2023, the year-to-date number for aircraft operations was 240,078 compared to a total of 249,923 in May 2024.²⁰ The facility was a part of the Eastern Service area and was overseen by the Memphis district.

BNA ATCT airspace included from the surface to 15,000 feet, and the airspace that comprised approximately 70 square miles of Middle Tennessee between Dickson to the west to Smithville to the east, and from Russellville, Kentucky, to the north and Lewisburg, Tennessee to the south. BNA ATCT had seven satellite airports within the confines of the facility airspace and about 10 satellite airports within 10 miles or less of the facility's airspace boundaries. Figure 4 is a photo of the BNA airport traffic control tower which was 31 years old and 185 feet tall.

²⁰ Statistics provided by www.flynashville.com



Figure 4. A photo of BNA Tower taken from www.faa.gov/sites/faa.gov/files/BNA.

2.0 Control Room

The BNA ATCT TRACON had 9 control positions broken into two sections. The first section was the Departure/West Wall. This included the accident radar position along with four other positions. The Arrival/East Wall included four control positions. Between the two walls was the Operations Supervisor desk. Figure 5 in section 2.1 shows the BNA ATCT TRACON layout diagram.

2.1 Control Room Layout

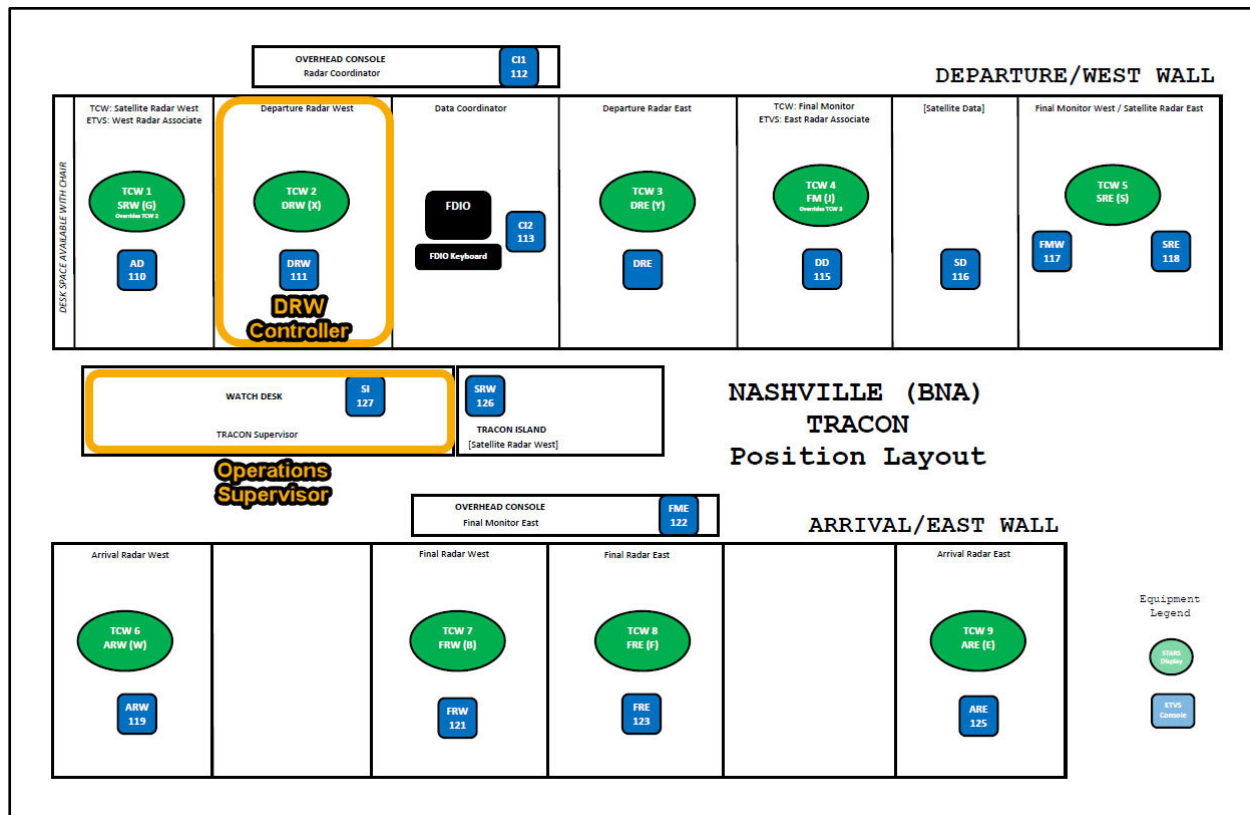


Figure 5. TRACON layout with Departure Radar West and Operations Supervisor positions labeled. Source NTSB.

2.2 Pertinent Equipment

2.2.1 Airport Surveillance Radar-9 (ASR-9)

Approach control radar was used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 miles. At the time of the accident, BNA ASR-9 had a known outage relating to polarization. More information is available in section H of this report. Figure 6 is a photograph of an exemplar ASR-9.



Figure 6. ASR-9. Source: FAA.

2.2.2 Standard Terminal Automation Replacement System (STARS)

STARS was a system that receives radar data and flight plan information and presents the information to air traffic controllers on high resolution, 20" x 20" color displays. This allowed the controller to monitor, control, accept hand-off of air traffic, and assist with weather avoidance. Figures 7-9 below show images of the STARS radar display with the accident aircraft circled.



Figure 7. STARS radar display photo showing the accident aircraft and depicting weather in the route of flight at 1159:00. Source: NTSB.



Figure 8. STARS radar display photo showing the accident aircraft and not depicting weather in the route of flight at 1201:00. Source: NTSB.



Figure 9. STARS radar display photo showing the accident aircraft and not depicting weather in the route of flight at 1202:00. Source: NTSB.

2.2.3 Integrated Terminal Weather System (ITWS)

ITWS was an automated weather information system, and it used a variety of weather sensors to make full use of airport runways in all kinds of weather. The ITWS received data from weather and surveillance radars and sensors and then used computer software to display current weather information in graphic and text formats.

3.0 Facility Health

3.1 Staffing

Staffing numbers for this facility are broken down into three separate areas as provided below. First is the overall facility staffing (sub-section 3.1.1), which provides the total ATC staffing numbers for the facility - this does not include administrative personnel not assigned in a staff support role, and does not include technicians. Second, is the staffing that was working at the time of the event for that shift (sub-section 3.1.2), and includes those on position, on break, or performing other work-related duties within the facility. The ATM categorized the overall facility staffing was challenging and below what was needed to provide adequate services. BNA ATCT Facility Administrative data is included as Attachment 6.

3.1.1 Facility Staffing

There was a total of 51 ATC personnel assigned to BNA ATCT (not counting technicians, meteorologists, or other contractors outside of ATC). Table 1 below lists each Staffing Category (job position) with their corresponding facility target (TGT), actual onboard (AOB), and available (AVL) staffing as of the day of the accident. TGT is the target staffing level as determined by the latest FAA/NATCA Collaborative Resource Working Group (CRWG) for Certified Professional Controllers (CPCs), and number authorized for all other positions. AOB is the total number of personnel actually onboard in each category, regardless of their status (i.e., on detail, medically incapacitated, legal hold, etc.). AVL is the number of people in each category that are available to work in the position to which they were assigned. Lastly, the percentage (PCT) value is the percentage of TGT to AOB only and does not consider AVL. Staffing numbers do not include those still in training; however, trainees have been identified here to provide for staffing projection estimates.

Table 1. Facility staffing - target vs. onboard plus trainees.

STAFFING CATEGORY	TGT	AOB	AVL	PCT
Certified Professional Controllers (CPC)	39	29	27	74.36%
Operations Supervisors (OS)	6	6	5	100.00%
Support Specialist (SS)	3	3	3	100.00%
Staff Support Managers (SM)	1	1	1	100.00%
Traffic Management Coordinators (TMC)	0	0	0	0.00%

Operations Managers (OM)	1	1	1	100.00%
Air Traffic Manager (ATM)	1	1	1	100.00%
**CPC In-Training (CPC-IT) / Developmental (DEV)	N/A	9	8	N/A

** Trainees are not counted in staffing target numbers.

3.1.2 Event Staffing (Resource Management)

At the time of the event there were four positions open in the tower and three positions open in the TRACON. There was an OS on duty in the TRACON. A total of 13 personnel on-shift in an operational capacity. Operational refers to those actually working or staffed to work in the operational environment, and does not include staff support, support managers, ATM, administrative support, contractors, etc. Table 2 below contains a listing of all personnel that were assigned for operational work at the time of the accident, and whether on-position, performing other duties, or otherwise available (i.e., on break, meeting with other staff, etc.).

Table 2. Operational staffing at the time of the event.

Operational Staffing - Time of Event	On Position	Other	Available
Certified Professional Controllers (CPC)	7	0	2
Operations Supervisors (OS)	1	0	1
CPC-It / DEV	0	0	2

4.0 Training

4.1 Simulator Program

The personnel interviewed stated that at the time of the accident, BNA ATCT did not have a Tower Simulation System (TSS) on-site. It was stated that they would have to drive to Memphis ATCT to conduct simulation training.

5.0 Quality Control (QC) Management

5.1 Compliance Verification

Compliance verification was done to assess facilities overall compliance to rules and procedures. If non-compliance is found, a corrective action plan (CAP) could be implemented to help bring the facility back into compliance. (Information on CAPs is provided in section 5.2.) Non-compliant ratings for Internal Compliance Verification (ICV) and External Compliance Verification (ECV) were as follows:

- Non-compliant Low Risk (NL): Finding is non-compliant but does not represent a moderate or significant safety risk to the NAS.

- Non-compliant Medium Risk (NM): Finding is non-compliant and represents a moderate safety risk to the NAS.
- Non-compliant High Risk (NH): Finding is non-compliant and represents a significant safety risk to the NAS.

5.1.1 Internal Compliance Verification (ICV)

ICVs were expected to be conducted by an ICV team designated by the Manager following all applicable national collective bargaining agreements. ATC Facilities must conduct an ICV annually each fiscal year. An ICV for 2023 was conducted from April 17 through April 21, 2023 with the following results.

1. Line 53 - Emergency Procedures - Exemplary
2. Line 153 - Strip Marking - Noncompliant - Low

5.1.2 External Compliance Verification (ECV)

An ECV was an externally initiated assessment of a facility, conducted primarily by the Quality Control Group (QCG) and/or additional personnel, in response to data-driven indicators of potential risk and/or practices. An ECV may be conducted on-site, using a customized checklist, to assess a facility's overall performance. ECVs were conducted on an as-needed basis as determined via indicators of potential risk and non-compliance.

On April 24, 2023, an ECV was completed by the Quality Control Group (QCG). The following items were marked as Noncompliant:

1. Line 30 - Bird Hazard Procedures/Advisories - Noncompliant-Low
2. Line 48 - Strip Marking - Noncompliant-Low (CAP in place)
3. Line 87 - national Traffic Management Log (NTML) - Noncompliant-Low
4. Line 118 - Position Certification Process - Noncompliant-Medium
5. Line 120 - position Relief Briefings - Noncompliant-Low
6. Line 135 - Radio Communication - Noncompliant-Medium
7. Line 136 - Refresher Training - Noncompliant-Medium
8. Line 147 - Skill Enhancement Training - Noncompliant-Low
9. Line 153 - Strip Marking - Noncompliant-Low
10. Line 177 - Visual Scanning - Noncompliant-Low
11. Line 184 - Weather Familiarization - Noncompliant-Low
12. Line 295 - Operational Reference Material - Noncompliant-Low

5.2 Corrective Action Plans (CAP)

CAPs are collaborative activities enacted to correct noncompliance and areas of risk that have been properly identified, validated, and understood through data collection and analysis. A CAP contains a description of the mitigation actions, the scope of the CAP, a timeframe for completion, a defined monitoring plan, and a defined effectiveness target. According to facility records, there were no open CAPs at the time of the accident.

5.3 System Service Review (SSR)

After the accident, an SSR was conducted by facility personnel to review the services provided by ATC to the accident aircraft. Findings of the SSR included the discovery of a discrepancy between the ITWS and STARS displayed weather, that PIREP solicitation/dissemination and the issuing of depicted weather was not done in accordance to FAA JO Order 7110.65AA. Additionally, it was discovered that two weather equipment outages had been documented on the facility daily log for at least a year without being addressed. Recommendations made by the facility personnel during the SSR included, ensure PIREPS were solicited when warranted, revisit previous CAP regarding PIREP solicitation/dissemination and reinstate successful mitigations, and to work with Technical Operations to ensure awareness of equipment issues documented on the facility daily log.

6.0 Local Safety Council (LSC)

The LSC was responsible for doing monthly Safety Awareness for Excellence (SAFE) briefings to the workforce and making decisions that improved and benefit the safety of the facility. The LSC used the safety data portal, QC data, reported occurrences, and member observations to identify safety trends at their facility. They also assisted the facility QC department in conducting Operational Safety Assessments (OSA's), SSR's, Systemic Issue Reviews (SYSIR's) and creating and monitoring CAP's.

7.0 Interviewed personnel

The group interviewed both involved and non-involved personnel during the field phase of this investigation. "Involved personnel" refers to those who were working and involved in providing services to, or in support of, any involved aircraft, vehicle, or facility. "Non-involved personnel" refers to witnesses or those who were not working and/or were not involved in providing services to, or in support of, any involved aircraft, vehicle, or facility. All interviews were recorded, transcribed by a third-party transcription service and transcripts were provided back to group members and individual interviewees for review. Any corrections or edits to transcripts were provided back to the transcription service for final certification. See

7.1 Involved Personnel

7.1.1 Departure Radar West (DRW) Controller

The DRW controller that was working in the TRACON at the time of the accident had been on position for approximately 47 minutes. Although it is FAA policy to relieve a controller as soon as possible after an event, the DRW controller was not relieved from the radar position for an additional 23 minutes. They had received a position relief briefing (PRB) that was recorded. Table 5 contains the DRW controller's working hours for the week leading up to and including the day of the accident.

Table 3. Working hours logged for the week leading up to and including the day of the event.

Day	Date	Shift	Hours (local)	Total Time
Thursday	May 9	RDO	N/A	N/A
Friday	May 10	Eve	1430-2230	8hr + 00min
Saturday	May 11	Swing	1230-1900	6hr + 30min
Sunday	May12	Day	0700-1330	6hr + 30 min
Monday	May 13	Day	0530-1330	8hr + 00min
Tuesday	May 14	Day	0530-1330	8hr + 00min
Wednesday	May 15	OT/Day	0530-1330	8hr + 00min

7.1.1.1 Position Duties and Responsibilities

According to the BNA ATCT SOP, the primary duties and responsibilities of the DRW position included, but were not limited to:

- Prearranged coordination procedures can be applied only to aircraft that have been radar identified and with whom two-way radio communications have been established.
- Apply approved radar separation with Arrival or Satellite traffic by displaying the associated Full Data Block (position symbol, Mode C readout, and Heavy Jet/B757 information).
- Weather Levels of moderate intensity or greater must be selected with a brightness level high enough that the weather can be easily seen on the Terminal Controller Workstation (TCW²¹)/Tower Display Workstation

²¹ TCW – Terminal Controller Workstation – A high resolution, color computer-human interface (CHI) used by air traffic controllers in FAA terminal facilities (TRACONS) and airport towers as part of the Standard Terminal Automation Replacement System (STARS).

(TDW²²). When weather of light intensity is the only weather detected by the radar, it must be displayed.

7.1.1.2 Recent Activities - 72 Hour History

The DRW controller did not report any event or circumstance that would have been disruptive to their normal daily routine in the 72 hours prior to the accident. They were not able to recall at what time they had gone to bed during that time. On the day prior to the accident they had worked a 0530 shift. They reported taking a nap when they got home, woke up later and ate dinner with family.

7.1.1.3 Personnel Background Information

The DRW controller was 34 years old and had a total of 9 years experience in ATCT. They applied for an ATC position during the open bid in 2014. They entered on duty with the FAA on February 18, 2015, and reported directly to the FAA Academy in Oklahoma City, Oklahoma for initial ATC training with the FAA.

7.1.1.4 Duty Location Assignment History

After completing initial training at the FAA Academy in May 2015, the DRW controller reported to their first facility for duty as an air traffic controller. Table 6 below is a chronological listing of the DRW controller's duty assignments and primary positions held at each, in order of their report date to each.

Table 6. History of assignment locations with start date at each and primary position(s) worked.

Facility / Workplace	Start Date	Primary Job Title(s) Held
PNS ATCT	May 15, 2025	CPC
BNA ATCT	Feb 5, 2017	CPC

7.1.1.5 BNA ATCT Position Qualification and Certification

The DRW controller was certified on all control positions at BNA ATCT. Table 7 below is a chronological listing of the DRW controller's position qualification and certification history at BNA ATCT and includes the position identifier and whether they were current in accordance with facility standards on the day of the accident. Certifications are provided in order of the date of qualification or certification.

²² TDW - Tower Display Workstation - A tower situational display that is a part of the Standard Terminal Automation Replacement System (STARS) which displays radar data that has been collected by various sensors and processed by the radar data processor (RDP), combined with flight plan data, and then presented on a color monitor.

Table 7. History of position qualifications at BNA ATCT with certification date and currency status.

Position	Identifier	Date Certified	Current
Clearance Delivery	CD	March 23, 2017	Yes
Ground Control	GC	April 8, 2017	Yes
Local Control 1	LC1	June 23, 2017	Yes
Local Control 2	LC2	June 23, 2017	Yes
Tower Cab Coordinator	CC2	June 26, 2017	Yes
Arrival Radar West	ARW	September 29, 2018	Yes
TRACON Data Coordinator	C12	November 16, 2018	Yes
Arrival Radar East	ARE	March 1, 2019	Yes
Departure Radar East	DRE	March 1, 2019	Yes
Satellite Radar East	SRE	March 1, 2019	Yes
Final Radar East	FRE	June 3, 2019	Yes
Final Radar West	FRW	June 3, 2019	Yes
TRACON Radar Coordinator	CI1	June 4, 2019	Yes
Radar West Associate	AD	July 16, 2023	Yes
Radar East Associate	DD	July 16, 2023	Yes
Tower in Charge	SC	June 22, 2018	Yes
TRACON in Charge	SI/WS	January 20, 2020	Yes

7.1.1.6 Medical Clearance

The DRW controller held a second-class medical clearance at the time of the accident and their last ATC physical was conducted on November 3, 2022. They were qualified with special consideration for a medical condition and/or medication. A copy of their medical clearance certificate is located in MEDICS.

7.1.1.7 Post-Accident Toxicology Testing

Post-accident toxicology testing (drug only) was conducted with the DRW controller five days after this event. Alcohol testing was neither ordered nor conducted. The official drug test determination date was not obtained prior to this writing, however the determination not to test for alcohol was made by the Deputy District Officer. It was undetermined why drug and alcohol testing were not conducted in accordance with Department of Transportation (DOT) and FAA orders.

7.1.1.8 Post-Event Interview Transcripts

The DRW controller was interviewed at BNA ATCT on May 21, 2024. The interview began at 1023 and concluded at 1115. They were accompanied by a representative, and the interview was digitally recorded (audio only).

7.1.2 Operations Supervisor (OS)

The OS that was working in the TRACON at the time of the accident had been on position for approximately 16 minutes. They had received a position relief briefing (PRB) that was recorded. Table 8 contains the OS's working hours for the week leading up to and including the day of the accident.

Table 8. Working hours logged for the week leading up to and including the day of the event.

Day	Date	Shift	Hours (local)	Total Time
Thursday	May 9	Day	0530-1330	8hr + 00min
Friday	May 10	RDO	N/A	N/A
Saturday	May 11	RDO	N/A	N/A
Sunday	May12	Eve	1730-2230	5hr + 00 min
Monday	May 13	Eve	1330-2130	8hr + 00min
Tuesday	May 14	Day	0630-1430	8hr + 00min
Wednesday	May 15	Day	0530-1330	8hr + 00min

7.1.2.1 Position Duties and Responsibilities

According to the BNA ATCT SOP, the primary duties and responsibilities of the DRW position included, but were not limited to:

- Assume the responsibilities of Tower or TRACON Watch Supervision when combined to the SI or SC position, or both. When either position is split, determine and communicate goals and requirements for Tower and TRACON operations after consultation with SI and/or SC.
- Monitor the operation and maintain situational awareness including traffic volume/complexity/flows and area/facility resource needs.
- Monitor air traffic service delivery and (SI/SC) operational oversight and make on-the-spot corrections as necessary.

7.1.2.2 Recent Activities - 72 Hour History

The OS did not report any event or circumstance that would have been disruptive to their normal daily routine in the 72 hours prior to the accident. They recalled that they normally went to bed around 2130 when they worked a 0530 shift the next day. On the night prior to the accident, they stated that their sleep was of good quality.

7.1.2.3 Personnel Background Information

The OS was 40 years old and had a total of 19 years experience in ATC. They were a combat controller in the US Air Force from 2002 until 2006. They applied for

an ATC position with the FAA in 2008. They entered on duty with the FAA on February 11, 2009, and reported directly to the FAA Academy in Oklahoma City, Oklahoma for initial ATC training with the FAA.

7.1.2.4 Duty Location Assignment History

After completing initial training at the FAA Academy in May 2009, the OS reported to their first facility for duty as an air traffic controller. Table 9 below is a chronological listing of the OS's duty assignments and primary positions held at each, in order of their report date to each.

Table 9. History of assignment locations with start date at each and primary position(s) worked.

Facility / Workplace	Start Date	Primary Job Title(s) Held
DAY ATCT	May 11, 2009	CPC
P50 TRACON	June 5, 2011	CPC
ANC ATCT	December 7, 2014	CPC
DVT ATCT	September 16, 2017	OS
M03 TRACON	October 21, 2019	OS
BNA ATCT	June 11, 2023	OS

7.1.2.5 BNA ATCT Position Qualification and Certification

The OS was certified on all control positions at BNA ATCT. Table 10 below is a chronological listing of the DRW controller's position qualification and certification history at BNA ATCT and includes the position identifier and whether they were current in accordance with facility standards on the day of the accident. Certifications are provided in order of the date of qualification or certification.

Table 10. History of position qualifications at BNA ATCT with certification date and currency status.

Position	Identifier	Date Certified	Current
Clearance Delivery	CD	August 2, 2023	Yes
Ground Control	GC	August 11, 2023	Yes
Local Control 1	LC1	September 20, 2023	Yes
Local Control 2	LC2	September 20, 2023	Yes
Tower Cab Coordinator	CC2	October 2, 2023	Yes
Tower in Charge	SC	October 2, 2023	Yes
Arrival Radar West	ARW	December 12, 2023	Yes
Departure Radar West	DRW	December 12, 2023	Yes
Arrival Radar East	ARE	December 12, 2023	Yes
Final Radar East	FRE	December 18, 2023	Yes
Final Radar West	FRW	December 18, 2023	Yes
Departure Radar East	DRE	January 10, 2024	Yes
Satellite Radar East	SRE	January 10, 2024	Yes

TRACON in Charge	SI/WS	January 11, 2024	Yes
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7.1.2.6 Medical Clearance

During post accident interviews, the OS stated that they held a second class medical clearance at the time of the accident. They stated they were qualified without special consideration for a medical condition and/or medication and that they did not have a requirement to wear corrective lenses. A copy of their medical clearance certificate was on request with the FAA but not received at the time of this writing.

7.1.2.7 Post-Accident Toxicology Testing

There was no post-accident toxicology testing performed on the OS.

7.1.2.8 Post-Event Interview Transcripts

The OS was interviewed at BNA ATCT on May 21, 2024. The interview began at 1023 and concluded at 1115. They were accompanied by a representative, and the interview was digitally recorded (audio only).

7.2 Non-Involved Personnel

7.2.1 Local Safety Council Member (LSCM)

7.2.1.1 Personnel Background Information

The LSCM was 43 years old and had a total of 15 years of experience in ATC. They applied for an ATC position during an open bid and they entered on duty with the FAA on May 21, 2009. They reported directly to the FAA Academy in Oklahoma City, Oklahoma for initial ATC training with the FAA.

7.2.1.2 Duty Location Assignment History

After completing initial training at the FAA Academy in August, 2009, the LSCM reported to their first facility for duty as an air traffic controller. Table 11 below is a chronological listing of the LSCM's duty assignments and primary positions held at each, in order of their report date to each.

Table 11. History of assignment locations with start date at each and primary position(s) worked.

Facility / Workplace	Start Date	Primary Job Title(s) Held
BNA ATCT	June 6, 2021	CPC
D01 TRACON	July 9, 2017	CPC-IT
BNA ATCT	August 17, 2009	CPC

7.2.1.3 Facility Duties

Along with the duties of the LSC outlines in section 6.0, the LSCM was involved in many collateral duties. They were the Professional Standards lead, a recurrent training cadre, and a liaison for BNA ATCT for airspace and procedures.

7.2.1.4 Post-Event Interview Transcripts

The LSCM was interviewed at BNA ATCT on May 21, 2024. The interview began at 1325 and concluded at 1353. They were accompanied by a representative, and the interview was digitally recorded (audio only). Interview transcripts can be found in Attachment 8 of this report.

7.2.2 Air Traffic Manager (ATM)

7.2.2.1 Personnel Background Information

The ATM was 40 years old and had a total of 17 years of experience in ATC. They graduated Embry Riddle Aeronautical University, were hired through the CTI program and reported to their first facility in January of 2007.

7.2.2.2 Duty Location Assignment History

Upon being hired, the ATM reported to their first facility for duty as an air traffic controller. Table 12 below is a chronological listing of the ATM's duty assignments and primary positions held at each, in order of their report date to each.

Table 12. History of assignment locations with start date at each and primary position(s) worked.

Facility / Workplace	Start Date	Primary Job Title(s) Held
MCO ATCT	January 2007	CPC
F11 TRACON	January 2009	CPC
A80 TRACON	August 2012	CPC-IT
ATL ATCT	May 2013	CPC, OS
FAA HQ	September 2021	Executive Technical Representative
Eastern Service Area	December 2021	Executive Technical Representative
BNA ATCT	MAY 2023	ATM

7.2.2.3 Position Duties and Responsibilities

According to FAA Order JO 7210.3EE, the primary duties and responsibilities of the ATM included, but were not limited to:

- The ATM has the responsibility to direct all administrative and operational activities of the BNA ATCT.

- Disseminate agency guidance and direction on performance management information to the workforce.
- Issue a SOP Directive. The directive must specify, as a minimum, the required procedures for maintaining a safe and efficient operation and the jurisdiction boundaries for each operational position/sector.

7.2.2.4 Post-Event Interview Transcripts

The ATM was interviewed at BNA ATCT on May 22, 2024. The interview began at 0818 and concluded at 0859. They were accompanied by a representative, and the interview was digitally recorded (audio only).

G. MEMPHIS AIR ROUTE TRAFFIC CONTROL CENTER (ZME)

1.0 General

ZME was a level 12 facility located adjacent to the Memphis International Airport. ZME operated 24-hours a day, 365-days a year. It utilized 11 long range radar sites, 26 air-to-ground sites with 119 frequencies to cover approximately 122,000 square miles of airspace that were covering part of eight different states: Tennessee, Arkansas, Missouri, Kentucky, Louisiana, Mississippi, Alabama, and Illinois. ZME's airspace was divided into six areas of operation. The six areas collectively were further subdivided into 38 sectors of control responsibility. The 38 sectors were made up of 17 low altitude sectors (surface to FL230)²³; 13 high altitude sectors (FL240 to FL340); and eight ultra-high altitude sectors (FL350 and above). Figure 10 is a photograph of ZME.

²³ FLIGHT LEVEL– A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level (FL) 250 represents a barometric altimeter indication of 25,000 feet; FL 255, an indication of 25,500 feet.



Figure 10. Memphis Air Route Traffic Control Center. Source: FAA.

1.1 Sector Video Map

The Radar 14 (R14) sector was providing ATC services prior to the accident. The Radar 42 (R42) sector was combined to the R14 sector at the time. Figure 11 shows the overall ZME airspace with sectors R14, R42 and BNA ATCT airspace

identified. Figure 12 shows the R14 and R42 sector video map with ZME sector boundaries outlined in red and BNA ATCT boundary outlined in green.

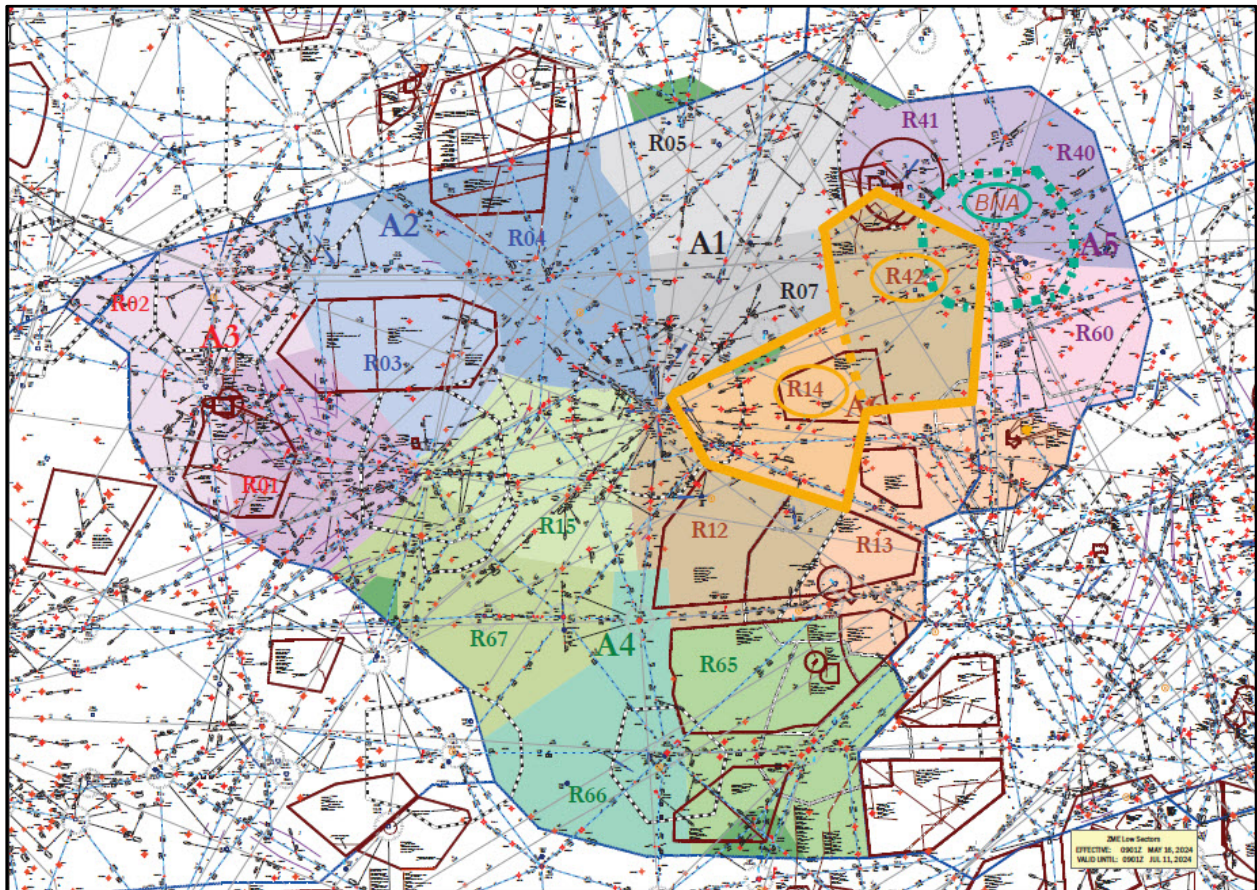


Figure 11. ZME Sector Map. Source: FAA.



Figure 12. ZME Radar 14 / Radar 42 Video Map. Source: FAA.

1.2 Control Room Layout

The ZME control room consisted of 6 control areas, one traffic management unit, one service operations center, and one watch supervisor-in-charge desk. Figure 13 below shows the layout of the control room with area 6 and the sector R14 position location identified.



Figure 13. ZME ARTCC control room layout.

2.0 Pertinent Equipment

2.1 En Route Automation Modernization - (ERAM)

ERAM was the Next Gen system designed to replace the En Route Host and backup system previously utilized at Air Route Traffic Control Centers and allows for faster processing of route requests and in-flight route changes. ZME was utilizing this system on the day of the accident. Figure 14 below shows the area of precipitation that was shown just prior to the time of the accident.



Figure 14. Screenshot of the sector R14 ERAM displayed precipitation (shown in blue pixels) from 1158:00. Source: NTSB.

3.0 Facility Health

3.1 Staffing

Staffing numbers for this facility are broken down into three separate areas as provided below. First is the overall facility staffing (sub-section 3.1.1), which provides the total ATC staffing numbers for the facility - this does not include administrative personnel not assigned in a staff support role, and does not include technicians. Second, is the staffing that was working at the time of the event for that shift (sub-section 3.1.2), and includes those on position, on break, or performing other work-related duties within the facility. The ATM categorized the overall facility staffing was challenging and below what was needed to provide adequate services. ZME ARTCC Facility Administration data is included as Attachment 8.

3.1.1 Facility Staffing

There was a total of 358 ATC personnel assigned to (not counting technicians, meteorologists, or other contractors outside of ATC). Table 13 below lists each Staffing Category (job position) with their corresponding facility target (TGT), actual onboard (AOB), and available (AVL) staffing as of the day of the accident. TGT is the target staffing level as determined by the latest FAA/NATCA Collaborative Resource Working Group (CRWG) for CPCs, and number authorized for all other positions. AOB is the total number of personnel actually onboard in each category, regardless of their status (i.e., on detail, medically incapacitated, legal hold, etc.). AVL is the number of people in each category that are available to work in the position to which they were assigned. Lastly, the percentage (PCT) value is the percentage of TGT to AOB only and does not consider AVL. Staffing numbers do not include those still in training; however, trainees have been identified here to provide for staffing projection estimates.

Table 13. Facility staffing - target vs. onboard plus trainees.

STAFFING CATEGORY	TGT	AOB	AVL	PCT
Certified Professional Controllers (CPC)	264	225	N/A	85.23%
Operations Supervisors (OS)	6	6	N/A	100.00%
Operations Supervisor-in-Training (OS-IT)	N/A	1	N/A	N/A
Support Specialist (SP/AUS)	10	9	N/A	90.00%
Training Support Specialist (TS)	3	2	N/A	66.67%
Staff Support Managers (SM)	3	2	N/A	66.67%
Traffic Management Coordinators (TMC)	19	14	N/A	73.68%
TMC-in-Training (TMC-IT)	N/A	2	N/A	N/A
Supervisory TMC	4	3	N/A	75.00%
Traffic Management Officer (TMO)	1	1	N/A	100.00%

Flight Data Control Specialists (FDCS)	8	7	N/A	87.50%
FDCS Team Lead	0	1	N/A	N/A
Operations Managers (OM)	6	6	N/A	100.00%
Executive Officer (XO)	1	1	N/A	100.00%
Air Traffic Manager (ATM)	1	1	N/A	100.00%
**CPC In-Training level 2 (CPC-IT2)	N/A	1	N/A	N/A
**Developmental 1 (DEV1)	N/A	13	N/A	N/A
**Developmental 2 (DEV2)	N/A	18	N/A	N/A
**Developmental 3 (DEV3)	N/A	9	N/A	N/A
**Academy Graduate (AG)	N/A	21	N/A	N/A

*** Trainees are not counted in staffing target numbers*

4.0 Interviewed Personnel

The group interviewed both involved and non-involved personnel during the field phase of this investigation. "Involved personnel" refers to those who were working and involved in providing services to, or in support of, any involved aircraft, vehicle, or facility. "Non-involved personnel" refers to witnesses or those who were not working and/or were not involved in providing services to, or in support of, any involved aircraft, vehicle, or facility. All interviews were recorded, transcribed by a third-party transcription service and transcripts were provided back to group members and individual interviewees for review. Any corrections or edits to transcripts were provided back to the transcription service for final certification. See *Attachment 7: Personnel Background Worksheets* for background information provided by ZME ARTCC.

4.1 Involved Personnel

4.1.1 Area 6 Radar 14 / Radar 42 (R14) Controller

The R14 controller that was working at the time of the accident had been on position for approximately 92 minutes when they transferred communication with N47WT to the BNA ATCT DRW controller. They were working radar sector 14 and radar sector 42 combined and were physically located at the radar 14 radar position. They had received a position relief briefing (PRB) that was recorded. Table 14 contains the R14 controller's working hours for the week leading up to and including the day of the accident.

Table 14. Working hours logged for the week leading up to and including the day of the event.

Day	Date	Shift	Hours (local)	Total Time
Thursday	May 9	DAY	0545-1345	8hr + 00min
Friday	May 10	MID	2145-0610 ²⁴	8hr + 25min

²⁴ The midnight shifts started on May 9, 2024 and ended on May 10, 2024. The shift is assigned the

Saturday	May 11	RDO	N/A	N/A
Sunday	May 12	RDO	N/A	N/A
Monday	May 13	EVE	1420-2220	8hr + 00min
Tuesday	May 14	EVE	1320-2120	8hr + 00min
Wednesday	May 15	Day	0630-1430	8hr + 00min

4.1.1.1 Personnel Background Information

The R14 controller was 53 years old and had just over 23 years of ATC experience. Their experience began when they attended the MARC program online and in person in Eden Prairie, Minnesota. Shortly after graduating they were hired and entered on duty with the FAA on January 16, 2001, and reported directly to Memphis Center to start their training. Their entire career had been spent at ZME.

4.1.1.2 Medical Clearance

The R14 controller held a second-class medical clearance at the time of the accident. Their last ATC physical was conducted on October 3, 2023, and their clearance was valid until September 30, 2024. The clearance included a requirement to possess vision corrective lenses while performing ATC duties, and they stated that they had them available if needed at the time of the accident. Their clearance also documented a special consideration for medical condition and/or medication. A copy of their medical clearance certificate will be entered into MEDICS.

4.1.1.3 Post-Accident Toxicology Testing

Post-Accident toxicology testing was not done for any personnel at ZME as a result of the accident.

4.1.1.4 Post-Event Interview Transcripts

The R14 controller was interviewed at ZME on May 23, 2024. The interview began at 0925 and concluded at 1021. They were accompanied by a representative, and the interview was digitally recorded (audio only).

4.1.2 Area 6 Operations Supervisor (A6-OS)

The A6-OS that was working at the time of the accident had been on a break prior to the accident and had just returned to the area at the time of the accident. They had received a position relief briefing (PRB) that was recorded. Table 15 contains the OS's working hours for the week leading up to and including the day of the accident.

date that it ends on.

Table 15. Working hours logged for the week leading up to and including the day of the event.

Day	Date	Shift	Hours (local)	Total Time
Thursday	May 9	MID	2200-0600 ²⁵	8hr + 00min
Friday	May 10	RDO	N/A	N/A
Saturday	May 11	RDO	N/A	N/A
Sunday	May12	EVE	1345-2145	8hr + 00min
Monday	May 13	EVE	1300-2100	8hr + 00min
Tuesday	May 14	DAY	0600-1400	8hr + 00min
Wednesday	May 15	DAY	0550-1400	8hr + 10min

4.1.2.1 Personnel Background Information

The A6-OS was 40 years old and had just over 18 years of ATC experience. Their experience began when they served as an air traffic controller in the US Marine Corps from 2002 until 2011. They were hired and entered on duty with the FAA on June 13, 2014, and reported directly to Memphis Center to start their training. Their entire FAA career had been spent at ZME.

4.1.2.2 Medical Clearance

The A6-OS held a second-class medical clearance at the time of the accident. Their last ATC physical was conducted on July 31, 2023, and their clearance was valid until July 31, 2024. The clearance included a requirement to possess vision corrective lenses while performing ATC duties. Their clearance also documented a special consideration for medical condition and/or medication. A copy of their medical clearance certificate will be entered into MEDICS.

4.1.2.3 Post-Accident Toxicology Testing

Post-accident toxicology testing was not done for any personnel at ZME as a result of the accident.

4.1.2.4 Post-Event Interview Transcripts

The A6-OS was interviewed at ZME on May 23, 2024. The interview began at 1203 and concluded at 1233. They were accompanied by a representative, and the interview was digitally recorded (audio only).

²⁵ The Midnight shift began at 2200 CDT on May 8, 2024.

4.1.3 ZME Traffic Management Coordinator (TMC)

The TMC that was working at the time of the accident had been responsible to ensure safe and efficient traffic flow by balancing demand with system capacity. Table 16 contains the TMC's working hours for the week leading up to and including the day of the accident.

Table 16. Working hours logged for the week leading up to and including the day of the event.

Day	Date	Shift	Hours (local)	Total Time
Thursday	May 9	DAY	0500-1300	8hr + 00min
Friday	May 10	RDO	N/A	N/A
Saturday	May 11	RDO/OT	0545-1345	8hr + 00min
Sunday	May 12	EVE	1300-2115	8hr + 15min
Monday	May 13	EVE	1155-1955	8hr + 00min
Tuesday	May 14	DAY	0545-1445	9hr + 00min
Wednesday	May 15	DAY	0500-1300	8hr + 00min

4.1.3.1 Personnel Background Information

The TMC was 56 years old and had just over 35 years of ATC experience. They applied for an ATC position and they entered on duty with the FAA on July 19, 1989. They reported directly to the FAA Academy in Oklahoma City, Oklahoma for initial ATC training with the FAA, and then reported to ZME. Their entire FAA career had been spent at ZME. Around 2009, they transitioned into the TMC role and had about 15 years of experience.

4.1.3.2 Medical Clearance

The TMC held a second-class medical clearance at the time of the accident. Their last ATC physical was conducted on July 31, 2023, and their clearance was valid until July 31, 2024. The clearance included a requirement to possess vision corrective lenses while performing ATC duties. Their clearance also documented a special consideration for medical condition and/or medication. A copy of their medical clearance certificate will be entered into MEDICS.

4.1.3.3 Post-Accident Toxicology Testing

Post-accident toxicology testing was not done for any personnel at ZME as a result of the accident.

4.1.3.4 Post-Event Interview Transcripts

The TMC was interviewed at ZME on May 23, 2024. The interview began at 1311 and concluded at 1400. They were accompanied by a representative, and the interview was digitally recorded (audio only).

H. WEATHER DISCREPANCIES

During the on-scene investigation, members of the ATC group compared radar display replays at both ATC facilities. Figure 15 is a side-by-side comparison of weather returns from ERAM and STARS at 1202 CDT.

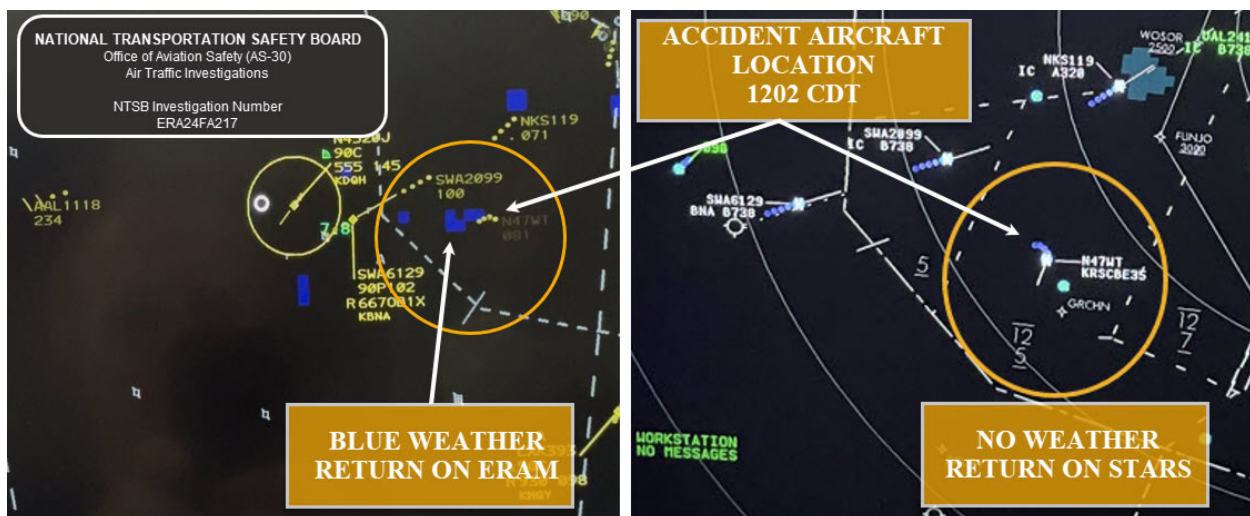


Figure 15. ERAM and STARS comparison for 1202 CDT.

The STARS replay did not show the weather depiction at the time of the accident. The discrepancy was brought to the attention of the FAA. At the time of the accident BNA ATCT had a known outage that had been reported to the FAA Technical Operations personnel. Technicians from the FAA's Surveillance and Weather Group AJW-1434 conducted a study to determine whether the ASR-9 level 6 polarization outage as reported by BNA ATCT was a factor to the under reporting of the weather.²⁶

Figure 16 below was taken from a FAA AJW-1435 report done after the accident and shows an archived view of the ITWS at 1200:03. The left side of the depiction shows the ASR-9 presentation compared to the right-side image which is the combined Next Generation Weather Radar (NEXRAD) and Terminal Doppler Weather Radar (TDWR) presentation. The small red circles on both sides depict the area of the accident. The left circle, which would have been displayed on the DRW controller's radar display, does not show the area of precipitation. The right circle

²⁶ See Attachment 9, page 23.

shows the area of precipitation. The report indicated that "the ASR-9 appeared to be slightly underreporting the weather. According to ITWS personnel, this difference was within normal range of deviation."²⁷ For more comprehensive information refer to Attachment 9.

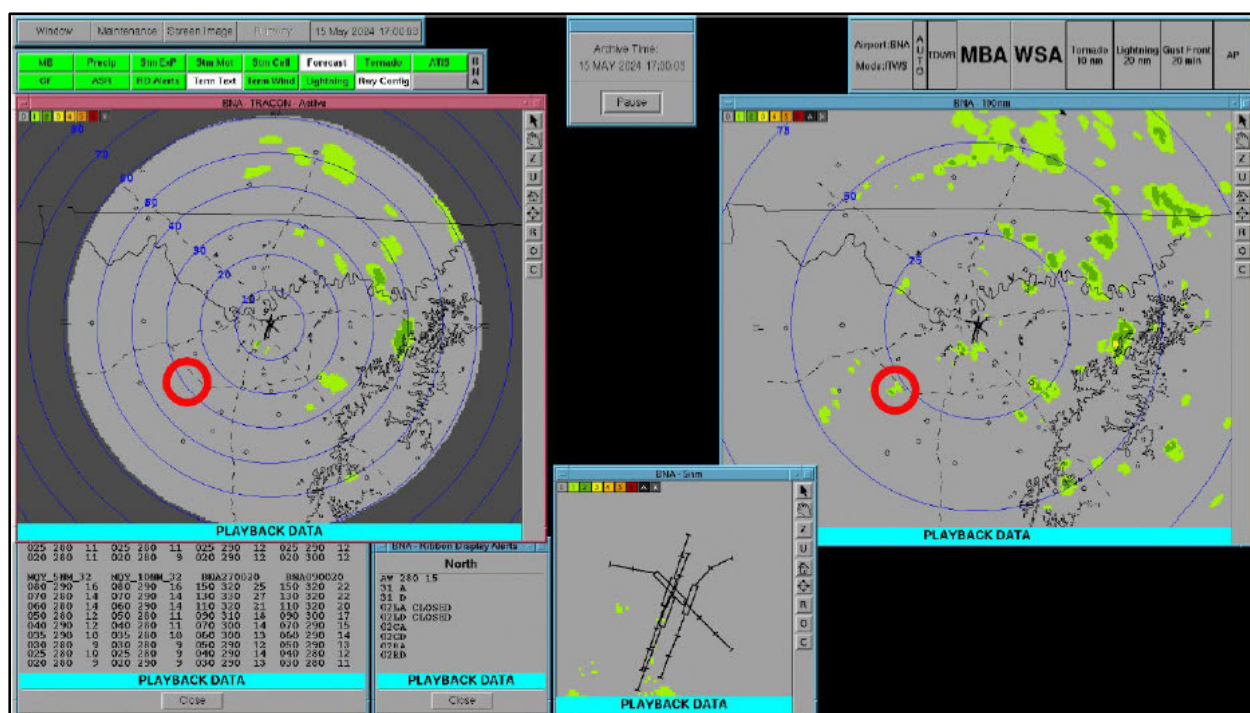


Figure 16. Comparison between ASR-9 weather returns and NEXRAD/TDWR returns. Source: FAA.

The report concluded that although the BNA ASR-9 was having issues with the circular polarization and was experiencing intermittent loss of data in the communication path between the radar and the TRACON, the issues did not affect the weather presentation provided to the STARS. Additionally, the report concluded that the primary reason the storm was not displayed to the controller was that the storm was too small to survive the special smoothing processing in the ASR-9. The report recommended further study to determine if the BNA ASR-9 was consistently underreporting the weather compared to the ITWS. If it was, it was recommended to take further action. The report noted that Terminal Precipitation on the Glass (TPoG) was an upcoming program meant to better display the weather product on STARS. At the time of this writing, there was no known timeline for installation of TPoG at BNA ATCT.²⁸

²⁷ See Attachment 9, page 20.

²⁸ See Attachment 9, page 29.

I. AIR TRAFFIC CONTROL PROCEDURES

1.0 Weather information

FAA Order JO 7110.65AA, Paragraph 2-6-1

FAA Order JO 7110.65AA, Paragraph 2-6-2

FAA Order JO 7110.65AA, Paragraph 2-6-4

FAA Order JO 7110.65AA, Paragraph 2-6-6

J. ADDITIONAL ATC INFORMATION

1.0 Definitions

PRECIPITATION RADAR WEATHER DESCRIPTIONS– Existing radar systems cannot detect turbulence. However, there is a direct correlation between the degree of turbulence and other weather features associated with thunderstorms and the weather radar precipitation intensity. Controllers will issue (where capable) precipitation intensity as observed by radar when using weather and radar processor (WARP) or NAS ground-based digital radars with weather capabilities. When precipitation intensity information is not available, the intensity will be described as UNKNOWN.

When intensity levels can be determined on STARS, they shall be described as:

1. Level 1 = LIGHT (< 26 dBZ)
2. Level 2 = MODERATE (26 to 40 dBZ)
3. Level 3 and 4 = HEAVY (> 40 to 50 dBZ)
4. Level 5 and 6 = EXTREME (> 50 dBZ)

(Refer to the Aviation Weather Handbook, FAA-H-8083-28 and FAA Order JO 7110.65AA, paragraph 2-6-4.)

When intensity levels can be determined on ERAM, they will be described as:

1. Describe the lowest displayable precipitation intensity as MODERATE.
2. Describe the highest displayable precipitation intensity as HEAVY to EXTREME.

On ERAM, while light precipitation is not shown, moderate, heavy, and extreme precipitation are displayed. ERAM focuses on displaying weather that typically impacts flight safety or requires significant rerouting, whereas light precipitation often does not.

K. IMPLEMENTED SAFETY MITIGATIONS

1.0 Safety Results

Result-2024-015 - The Operations Supervisor stated in his interview that he now prompts his controllers to ask every aircraft that reports that they are or want to deviate the reason for the deviation. This was a new development in safety culture since the accident.

L. LIST OF ATTACHMENTS

- Attachment 1: ATC Partial Voice Transcription
- Attachment 2: BNA ATCT Audio Recordings
- Attachment 3: ZME ARTCC Audio Recordings
- Attachment 4: Interview Transcripts
- Attachment 5: ADS-B Data
- Attachment 6: BNA ATCT Facility Administration
- Attachment 7: Personnel Background Worksheets
- Attachment 8: ZME ARTCC Facility Administration
- Attachment 9: FAA AJW-1435 Report

Submitted by:

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Air Traffic Control Investigator