NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

October 31, 2016

Group Chairman's Factual Report

AIR TRAFFIC CONTROL

ERA15MA259AB

A. AIRCRAFT INCIDENT

Location:	Moncks Corner, South Carolina
Date:	July 7, 2015
Time:	1101 eastern daylight time (EDT) / 1501 Coordinated Universal Time (UTC)[1]
Aircraft:	Death 41, Lockheed Martin F-16CM
	N3601V, Cessna 150M

[1]All times are expressed in eastern daylight time (EDT) unless otherwise noted.

B. AIR TRAFFIC CONTROL GROUP

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C. SUMMARY

On July 7, 2015, at 1101 eastern daylight time, a Cessna 150M, N3601V, and a Lockheed-Martin F-16CM, operated by the US Air Force (USAF), collided in midair near Moncks Corner, South Carolina. The Cessna was destroyed during the collision, and both the private pilot and passenger were fatally injured. The damaged F-16 continued to fly for an additional 3 minutes until the pilot activated the airplane's ejection system. The F-16 was destroyed following the subsequent collision with terrain and post-impact fire, while the pilot landed safely and was uninjured. Visual meteorological conditions prevailed, and no flight plan was filed for the Cessna, while the F-16 was operating on an instrument flight rules (IFR) flight plan. The Cessna departed from Berkley County Airport (MKS), Moncks Corner, South Carolina, at 1057, and was destined for Grand Strand Airport (CRE), North Myrtle Beach, South Carolina; the personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. The F-16 had departed from Shaw Air Force Base (SSC), Sumter, South Carolina about 1020.

According to the USAF, after departing from SSC, the F-16 proceeded to Myrtle Beach International Airport (MYR), Myrtle Beach, South Carolina, where the pilot conducted two practice instrument approaches before continuing the flight to Charleston Air Force Base/International Airport (CHS), Charleston, South Carolina. According to preliminary air traffic control (ATC) radar and voice communication data provided by the FAA, the F-16 pilot contacted the approach controller at CHS about 1052 and requested to perform a practice tactical air navigation system (TACAN) instrument approach to runway 15. The controller subsequently instructed the F-16 pilot to fly a heading of 260 degrees to intercept the final approach course. At 1055, the controller instructed the F-16 pilot to descend from his present altitude of 6,000 feet[2] to 1,600 feet. About that time, the F-16 was located about 34 nautical miles northeast of CHS.

[2] All altitudes are expressed in feet above mean sea level (msl) unless otherwise noted.

At 1057:41, a radar target displaying a visual flight rules (VFR) transponder code of 1200, and later correlated to be the accident Cessna, appeared in the vicinity of the departure end of runway 23 at MKS, at an indicated altitude of 200 feet. The Cessna continued its climb, and began tracking generally southeast over the next 3 minutes. For the duration of its flight, the pilot of the Cessna did not contact CHS approach control, nor was he required to do so. At 1100:16, the controller advised the pilot of the F-16, "traffic 12 o'clock, 2 miles, opposite direction, 1,200 [feet altitude] indicated, type unknown." The F-16 pilot responded and advised the controller that he was "looking" for the traffic. At 1100:26, the controller advised the F-16 pilot, "turn left heading 180 if you don't have that traffic in sight." The pilot responded by asking, "confirm 2 miles?"
According to analysis of the flight track data obtained from the F-16 flight data recorder, the pilot had begun a turn to the left however, the controller, observing a radar presentation depicting a range of 80 to 100 miles, was not able to visually detect the turn.

Eight seconds later, the controller stated, "if you don't have that traffic in sight turn left heading 180 immediately." Over the next 18 seconds, the controller observed the track of the F-16 began turning southerly.

At 1100:49, the radar target of the F-16 was located 1/2 nautical mile northeast of the Cessna, at an indicated altitude of 1,500 feet, and was on an approximate track of 215 degrees. At that time, the Cessna reported an indicated altitude of 1,400 feet, and was established on an approximate track of 110 degrees. At 1100:52 the controller advised the F-16 pilot, "traffic passing below you 1,400 feet." At 1100:54, the radar reported altitude of the F-16 remained at 1,500 feet and no valid altitude information was returned for the radar target associated with the Cessna. At that point the targets were laterally separated by about 1,000 feet. No further radar targets were received from the Cessna, and the next radar target for the F-16 was not received until 1101:13. At 1101:19, the F-16 pilot transmitted a distress call, and no subsequent transmissions were received. Air traffic control radar continued to track the F-16 as it proceeded on a roughly southerly track, and after descending to an indicated altitude of 300 feet, radar contact was lost at 1103:17 in the vicinity of the F-16 crash site.

D. DETAILS OF THE INVESTIGATION

The group convened at the air traffic control (ATC) facility located at CHS on July 8, 2015, to review data and interview the controllers and staff. The group met with and was provided an in-brief by Ms. Stephanie Faison, the air traffic manager (ATM).

According to the ATM, Death 41 was radar transferred to CHS from Myrtle Beach air traffic control for two approaches, one TACAN and one instrument landing system (ILS) approach. The TACAN approach was to be the first of the two approaches for Death 41, after which the pilot intended to return to SSC. The Cessna 150 departed MKS, probably from runway 23 and did not communicate with CHS ATC. The radar approach controller observed the Cessna 150 at 1,200 feet southeast of MKS. Traffic was issued to the F16 at 2 miles. F16s usually have radar and will identify the traffic. Death 41 had descended to 1,600 feet and the Cessna 150 was climbing out of 1,200 feet. Death 41 was heading 260 degrees and was advised that if he did not have traffic

in sight to turn left heading 180 degrees. Death 41 declared a mayday[3] and no further transmissions were heard from the F-16.
The ATM added that the 260 degree vector for aircraft arriving from the northeast for operations to runway 15 at CHS was designed to avoid overflying general aviation airports such as MKS.

1. History of Flight

After completing several approaches at MYR, Death 41 proceeded to CHS at 6,000 feet to conduct two approaches and return to SSC via an aerial refueling (AR) track at flight level 240. Death 41 checked in with the CHS terminal radar approach controller at 1052:34, reported level at 6,000 [feet] and was issued the altimeter setting of 30.16. Death 41 was told to expect radar vectors for a TACAN runway 15 approach, and after completing the approach to fly runway heading, maintain 2,000 feet and return to the current approach control frequency. Death 41 acknowledged with "Death four one copies runway heading two thousand this freq". (See figure 1).

The radar controllers at CHS described the ATC workload as light and routine.

At 1053:24 Death 41 was issued a radar vector heading of 260 degrees to the final approach course for runway 15 at CHS. Death 41 acknowledged with "Death four one right two six zero vectors".

At 1054:39 the approach controller asked Death 41 to "say intentions on the go", meaning what would the pilot like to do after he completed his TACAN approach. Death 41 responded that he would "…like to climb out to vectors ILS runway 15." The controller followed up with "Death four one are you gonna be full stopping at Charleston eventually or you gonna need climb out." Death 41 responded that he" will be rtb [return to base] to Shaw not full stop." The approach controller asked "at ten thousand [feet]." Death 41 responded with "Death four one requesting 24,000 [feet] going to the AR track."

At 1055:24 the approach controller directed Death 41 to descend and maintain 1,600 feet. Death responded with "Death four one down to one thousand six hundred." (See figure 2).

[3] ***Mayday***− The international radiotelephony distress signal. When repeated three times, it indicates imminent and grave danger and that immediate assistance is requested.

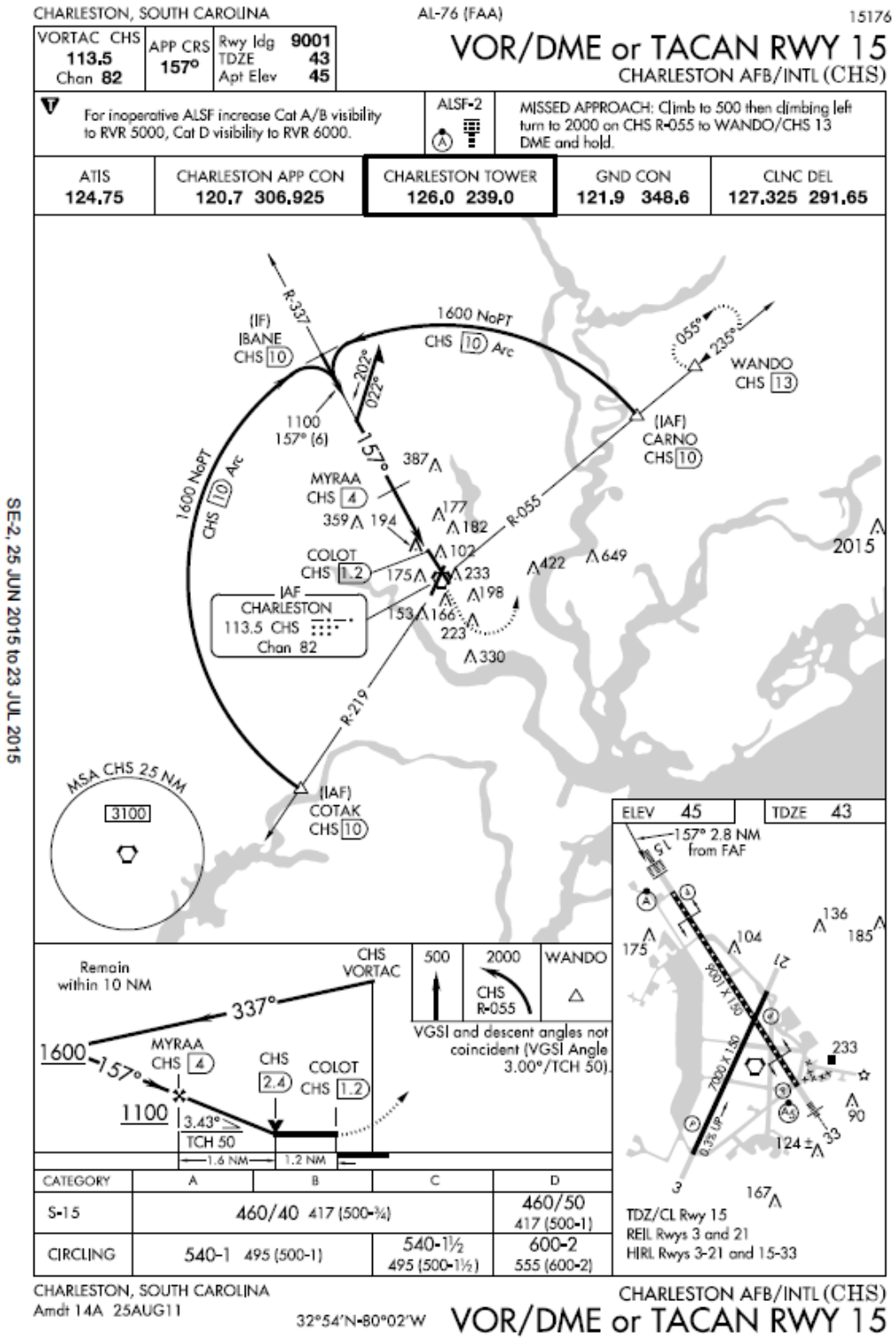

Figure 1 – The VOR/DME or TACAN runway 15 approach procedure at CHS

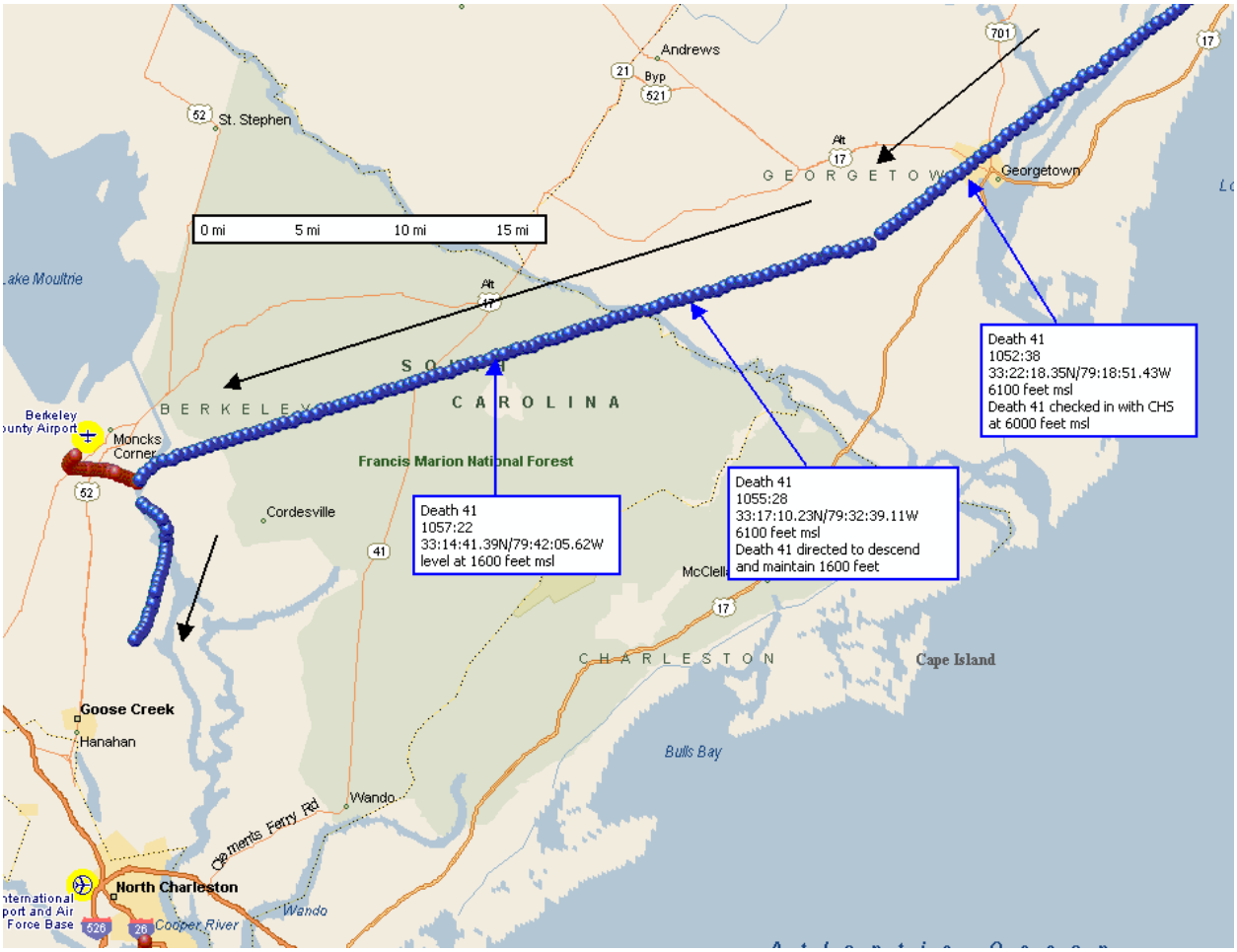

Figure 2 – Radar flight tracks of Death 41 and N3601V. Death 41 radar track is indicated by blue dots. N3601V radar track is indicated by red dots. Death 41's direction of flight is indicated by black arrows. MKS and CHS are highlighted in yellow.

The minimum vectoring altitude (MVA)[4] in the vicinity of CHS and along the flight track of Death 41 was 1,600 feet. This altitude also kept aircraft that were receiving radar vectors from CHS ATC from conflicting with aircraft in the local VFR airport tower traffic patterns such as MKS.

At 1057:40 the first radar return was recorded for the aircraft later identified as N3601V. The aircraft appeared to have departed from runway 23 at MKS and was indicating an altitude of 200 feet. The aircraft flew runway heading for 23 seconds to an indicated altitude of 300 feet before beginning a left turn to an easterly heading while continuing to climb. N3601V did not nor was required to communicate with CHS ATC. (See figure 3)

[4] MVA - (Minimum Vectoring Altitude) - The lowest msl altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures, and missed approaches. The altitude meets IFR obstacle clearance criteria.

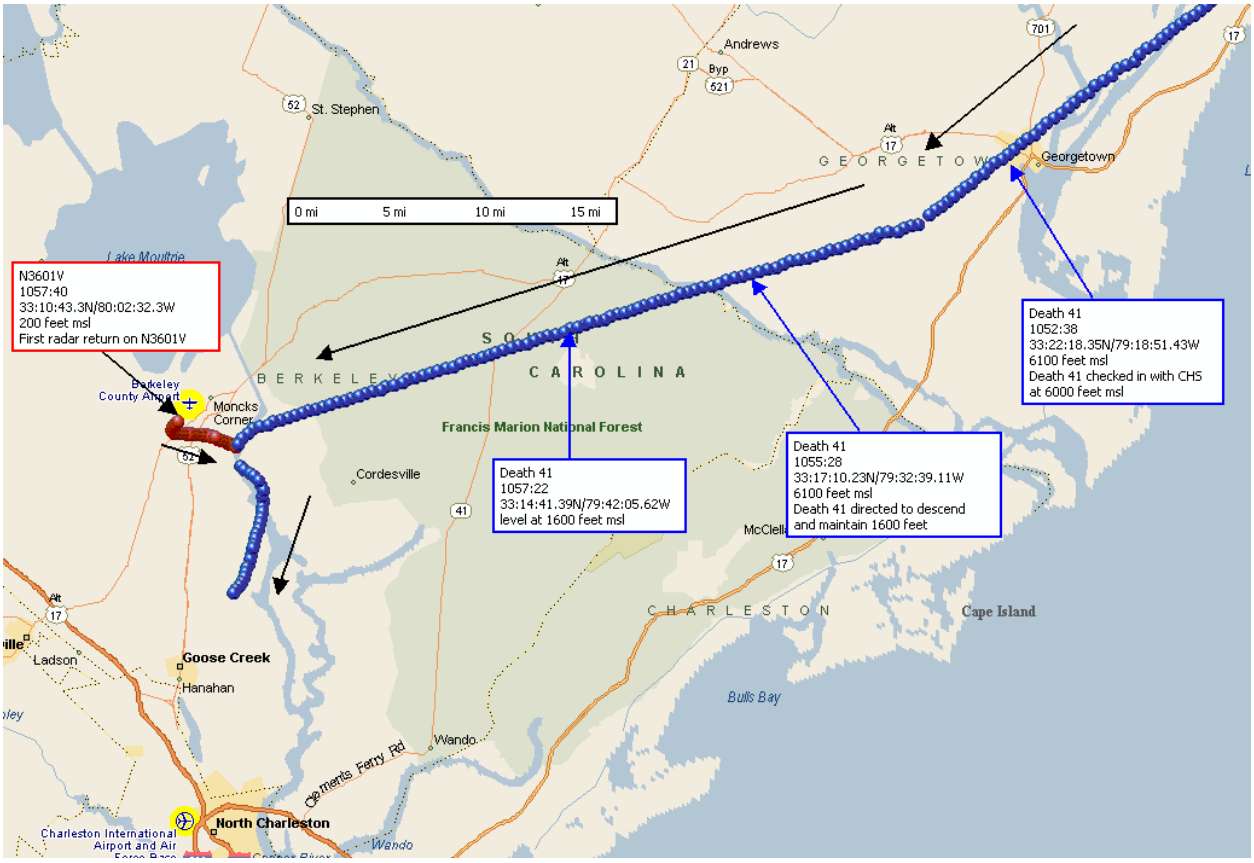

Figure 3 – Radar flight tracks of Death 41 and N3601V. Death 41 radar track is indicated by blue dots. N3601V radar track is indicated by red dots. Direction of flight is indicated by black arrows.

At 1059:48 the approach controller transmitted "information tango current at Charleston altimeter is three zero one six."

According to controller interviews, the CHS approach controller noticed traffic depart MKS and initially thought the aircraft at MKS was in the local VFR traffic pattern. Pattern traffic at MKS was rare and typically stayed below 1000 feet. The controller observed that the aircraft that had departed MKS was climbing above 1000 feet. Radar data indicates that N3601V passed 1,000 feet at 1059:49.

The radar system data indicated that the ARTS IIE conflict alert (CA)[5] system alarmed at 1100:13, advising the controller of a conflict between Death 41 and the unidentified target that had departed MKS. While the controller did not recall seeing or hearing the CA, she transmitted "Death four one traffic twelve o'clock two miles opposite direction one thousand two hundred indicated type unknown", at 1100:16. (See figure 4)

[5] CA – Conflict Alert – See section 3.5

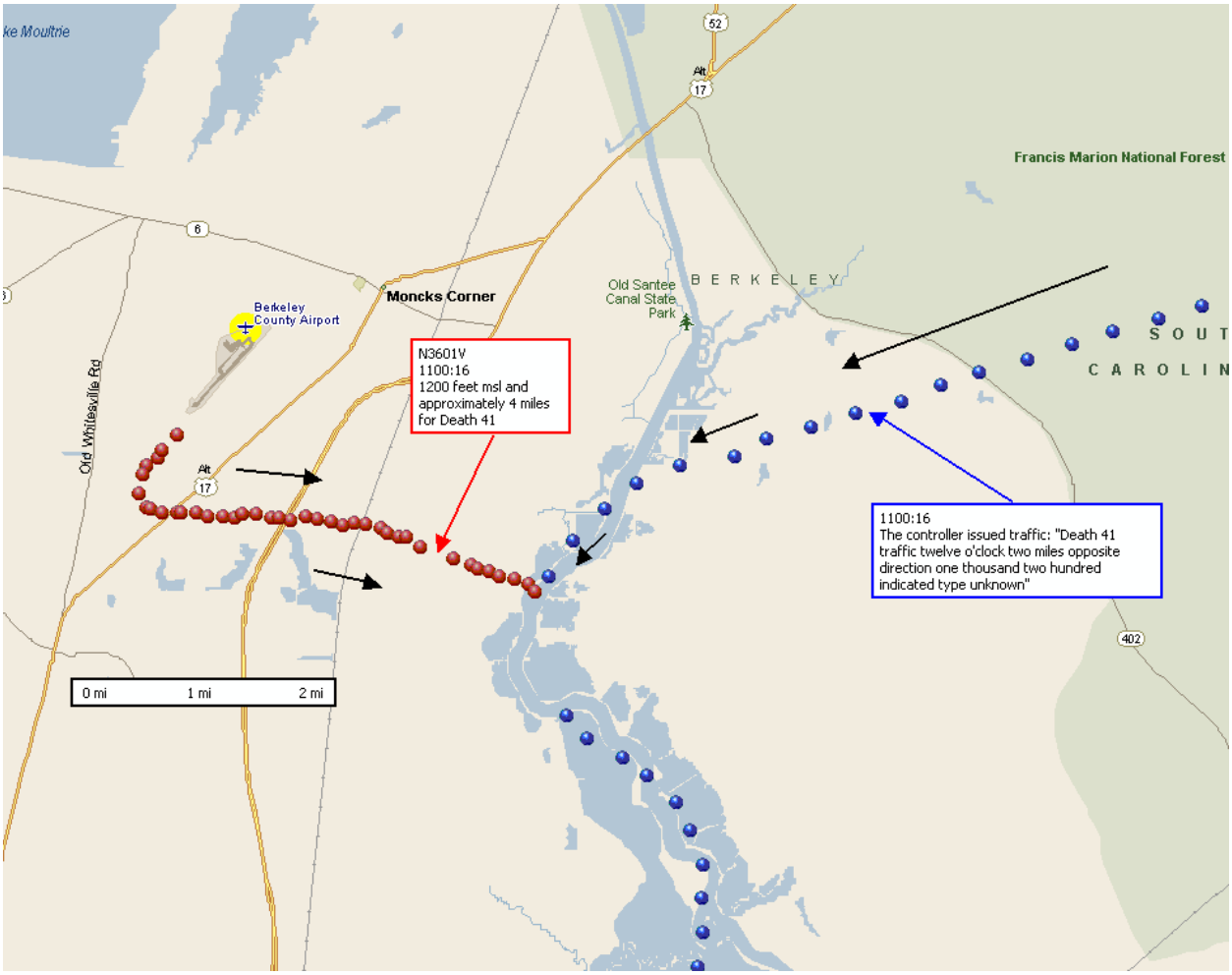

Figure 4 – Radar flight tracks of Death 41 and N3601V displaying proximity to each other at 1100:16. Death 41 radar track is indicated by blue dots. N3601V radar track is indicated by red dots. Direction of flight is indicated by black arrows.

The pilot of Death 41 responded at 1100:24 with "Death four one looking." Two seconds later at 1100:26, the approach controller advised Death 41 "four one turn left heading one eight zero if you don't have that traffic in sight."

The pilot of Death 41 asked "confirm two miles?" At 1100:34, the approach controller transmitted "Death four one if you don't have that traffic in sight turn left heading one eight zero immediately." The pilot of Death 41 responded but the transmission was garbled and unreadable. (See figure 5)

Death 41's ground track indicated that Death 41 began a gradual turn to the south. Twenty seconds after the pilot was directed to turn left heading 180 immediately; Death 41 was passing through a ground track of 199 degrees just prior to the collision.

As the aircraft approached each other, Death 41's radar data block indicated 1,500 feet and N3601V's radar data block indicated 1,400 feet. (See figure 6)

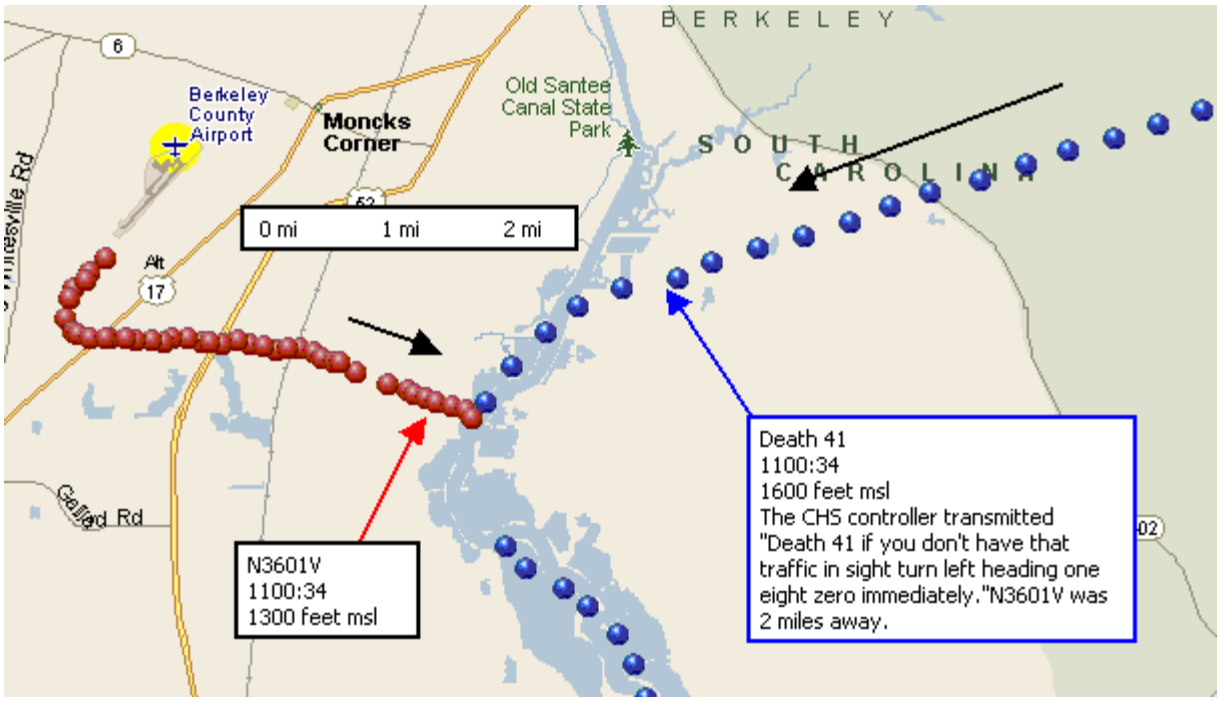

Figure 5 – Radar flight track of Death 41 and N3601V displaying proximity to each other at 1100:34. Death 41 radar track is indicated by blue dots. N3601V radar track is indicated by red dots. Direction of flight is indicated by black arrows.

At 1100:52 the approach controller transmitted "Death four one traffic passing below you one thousand four hundred [feet]." Death 41 responded with a broken transmission, "Death four one (unintelligible) that traffic is uh (unintelligible)." At 1101:09 the approach controller replied "Death four one unable to read you say again."

Ten seconds later, at 1101:19, Death 41 transmitted "Death four one mayday mayday mayday." The approach controller responded with "Death four one Charleston" and repeated the transmission "Death four one Charleston" at 1101:45. There was no response from the pilot of Death 41 and no further communications between Death 41 and the approach controller.

The F-16 flew for approximately 10 miles before the pilot ejected and the aircraft impacted the ground.

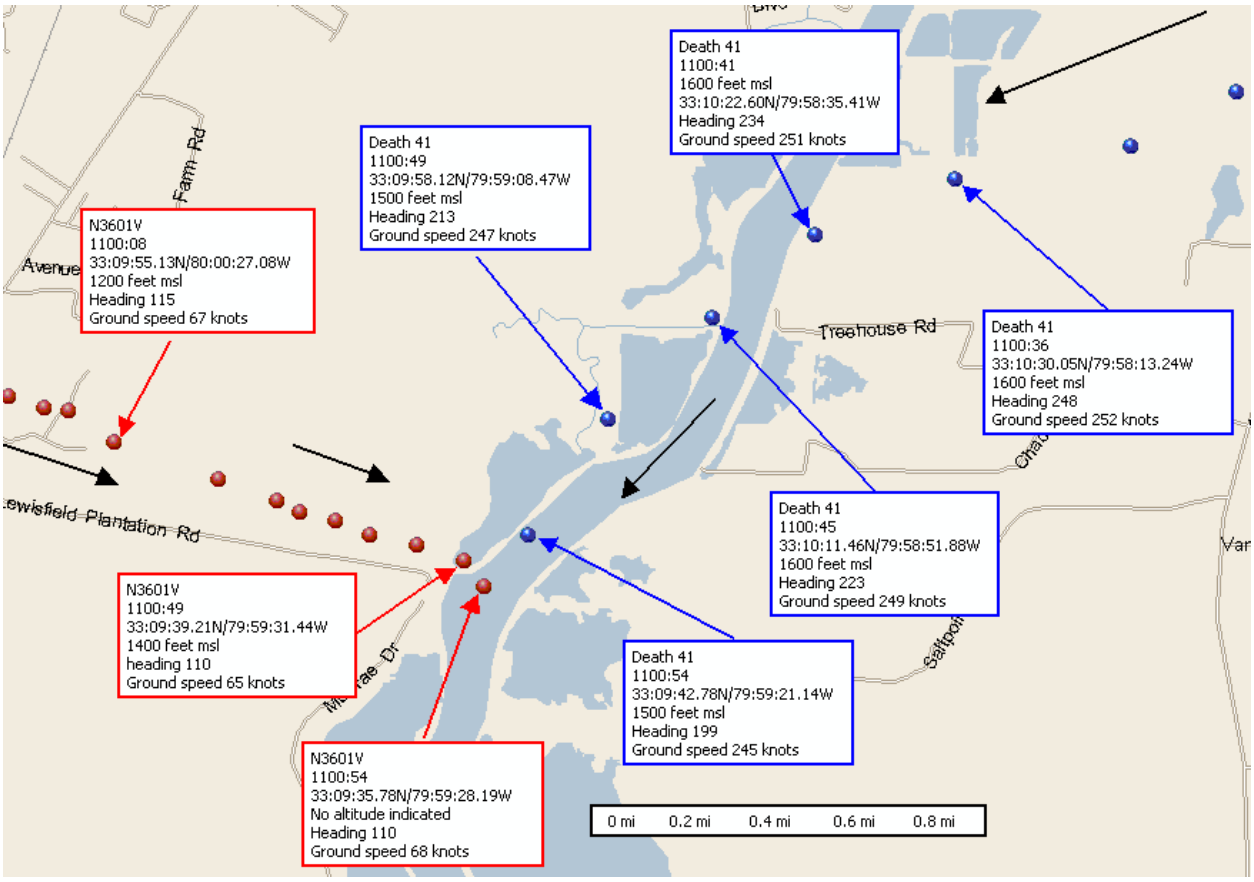

Figure 6 – Radar flight track of Death 41 and N3601V just prior to the collision. Death 41 flight track indicated by blue dots. N3601V flight track indicated by red dots. Route of flight is indicated by black arrows.

2. Weather Information

The 1055 Aviation Routine Weather Report (METAR) observation for MKS was wind calm, visibility 10 statute miles. Scattered clouds at 2,600 feet above ground level (agl). Temperature 30 degrees Celsius (C), dew point 22 degrees C, altimeter 30.15 inches of mercury.

The 1056 METAR observation for Charleston Air Force Base (CHS) was wind 220 degrees at seven knots, visibility 10 statute miles. Scattered clouds at 4,000 agl. Temperature 30 degrees C, dew point 22 degrees C, altimeter 30.15 inches of mercury.

3. Air Traffic Control

3.1 CHS ATCT

The CHS ATCT was a combined tower and terminal radar approach control (TRACON) facility known as an up/down facility and was open 7 days a week, 24 hours a day. The CHS terminal area approach control area of jurisdiction extended approximately 40 miles radius from CHS from the surface up to 10,000 feet. CHS radar data was displayed via automated radar

terminal system (ARTS IIE) with the radar feed from the airport surveillance radar (ASR-9), located at CHS.

CHS was surrounded by Class C airspace defined as that airspace extending upward from the surface to and including 4,000 feet within a 5-mile radius of CHS; and that airspace extending upward from 1,200 feet to and including 4,000 feet within a 10-mile radius of CHS. (See figure 7)

There is no specific pilot certification required to operate in Class C airspace, however, aircraft are to be equipped with a two-way radio and, unless otherwise authorized by ATC, must be equipped with an operable radar beacon transponder with automatic altitude reporting equipment.

Two-way radio communication must be established with the ATC facility providing ATC services prior to entry and thereafter maintain those communications while in Class C airspace. Pilots of arriving aircraft should contact the Class C airspace ATC facility on the publicized frequency and give their position, altitude, radar beacon code, destination, and request Class C service. Radio contact should be initiated far enough from the Class C airspace boundary to preclude entering Class C airspace before two-way radio communications are established.

MKS was located outside the CHS Class C airspace. Neither accident aircraft were in or had been in CHS Class C airspace prior to or at the time of the collision.

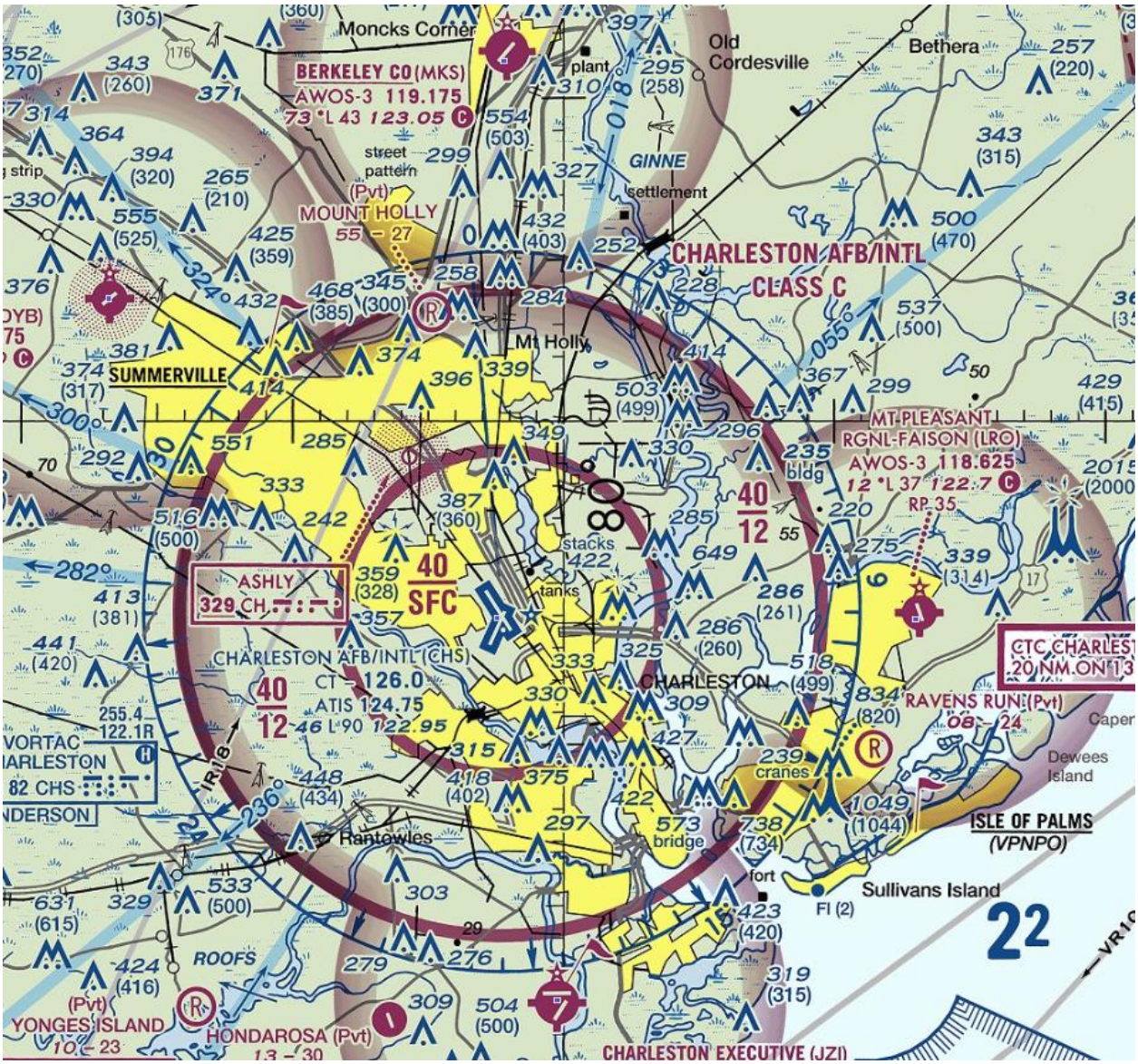

Figure 7 - CHS Class C airspace

3.2 Federal Aviation Administration Order (FAAO) 7110.65, *Air Traffic Control*

FAAO 7110.65, *Air Traffic Control*, prescribes air traffic control procedures and phraseology for use by personnel providing air traffic control services. Controllers are required to be familiar with the provisions of this order that pertain to their operational responsibilities and to exercise their best judgment if they encounter situations not covered by it.

Paragraph 2-1-1, ATC Service, states in part:

> The primary purpose of the ATC system is to prevent a collision between aircraft operating in the system and to provide a safe, orderly and expeditious flow of traffic, and to provide support for National Security and Homeland Defense. In

addition to its primary function, the ATC system has the capability to provide, with certain limitations**,** additional services. The ability to provide additional services is limited by many factors, such as the volume of traffic, frequency congestion, quality of radar, controller workload, higher priority duties, and the pure physical inability to scan and detect those situations that fall in this category. It is recognized that these services cannot be provided in cases in which the provision of services is precluded by the above factors. Consistent with the aforementioned conditions, controllers must provide additional service procedures to the extent permitted by higher priority duties and other circumstances. The provision of additional services is not optional on the part of the controller, but rather is required when the work situation permits. Provide air traffic control service in accordance with the procedures and minima in this order.

Paragraph 2-1-2, Duty Priority, states in part:

a. Give first priority to separating aircraft and issuing safety alerts as required in this order. Good judgment must be used in prioritizing all other provisions of this order based on the requirements of the situation at hand.

NOTE−
Because there are many variables involved, it is virtually impossible to develop a standard list of duty priorities that would apply uniformly to every conceivable situation. Each set of circumstances must be evaluated on its own merit, and when more than one action is required, controllers must exercise their best judgment based on the facts and circumstances known to them. That action which is most critical from a safety standpoint is performed first.

c. Provide additional services to the extent possible, contingent only upon higher priority duties and other factors including limitations of radar, volume of traffic, frequency congestion, and workload.

Paragraph 2-1-5, Expeditious Compliance, states in part:

…that controllers will use the word "immediately" only when expeditious compliance is required to avoid an imminent situation. If time permits, include a reason for this action.

Paragraph 2-1-6, Safety Alerts, states in part:

Issue a safety alert to an aircraft if you are aware the aircraft is in a position/altitude that, in your judgment, places it in unsafe proximity to terrain, obstructions, or other aircraft. Once the pilot informs you action is being taken to resolve the situation, you may discontinue the issuance of further alerts. Do not assume that because someone else has responsibility for the aircraft that the unsafe

situation has been observed and the safety alert issued; inform the appropriate controller.

NOTE−
1. *The issuance of a safety alert is a first priority (see para 2−1−2, Duty Priority) once the controller observes and recognizes a situation of unsafe aircraft proximity to terrain, obstacles, or other aircraft. Conditions, such as workload, traffic volume, the quality/limitations of the radar system, and the available lead time to react are factors in determining whether it is reasonable for the controller to observe and recognize such situations. While a controller cannot see immediately the development of every situation where a safety alert must be issued, the controller must remain vigilant for such situations and issue a safety alert when the situation is recognized.*

2. *Recognition of situations of unsafe proximity may result from MSAW/E−MSAW, automatic altitude readouts, Conflict/Mode C Intruder Alert, observations on a PAR scope, or pilot reports.*

3. *Once the alert is issued, it is solely the pilot's prerogative to determine what course of action, if any, will be taken.*

b. Aircraft Conflict/Mode C Intruder Alert. Immediately issue/initiate an alert to an aircraft if you are aware of another aircraft at an altitude that you believe places them in unsafe proximity. If feasible, offer the pilot an alternate course of action. When an alternate course of action is given, end the transmission with the word "immediately."

PHRASEOLOGY−
TRAFFIC ALERT (call sign) (position of aircraft) ADVISE YOU TURN LEFT/RIGHT (heading), and/or CLIMB/DESCEND (specific altitude if appropriate) IMMEDIATELY.

EXAMPLE−
"Traffic Alert, Cessna Three Four Juliet, 12'o clock, 1 mile advise you turn left immediately."
Or "Traffic Alert, Cessna Three-Four Juliet, 12'o clock, 1 mile advise you turn left and climb immediately."

Paragraph 2-1-21, Traffic Advisories, states:

Unless an aircraft is operating within Class A airspace or omission is requested by the pilot, issue traffic advisories to all aircraft (IFR or VFR) on your frequency when, in your judgment, their proximity may diminish to less than the applicable separation minima. Where no separation minima applies, such as for VFR aircraft outside of Class B/Class C airspace, or a TRSA, issue traffic advisories to those

aircraft on your frequency when in your judgment their proximity warrants it. Provide this service as follows:

a. To radar identified aircraft:

1. Azimuth from aircraft in terms of the 12−hour clock, or

2. When rapidly maneuvering aircraft prevent accurate issuance of traffic as in 1 above, specify the direction from an aircraft's position in terms of the eight cardinal compass points (N, NE, E, SE, S, SW, W, and NW). This method must be terminated at the pilot's request.

3. Distance from aircraft in miles.

4. Direction in which traffic is proceeding and/or relative movement of traffic.

NOTE−

Relative movement includes closing, converging, parallel same direction, opposite direction, diverging, overtaking, crossing left to right, crossing right to left.

5. If known, type of aircraft and altitude.

PHRASEOLOGY−

TRAFFIC, (number) O'CLOCK, or when appropriate, (direction) (number) MILES, (direction)−BOUND and/or (relative movement), and if known, (type of aircraft and altitude). Or When appropriate, (type of aircraft and relative position), (number of feet) FEET ABOVE/BELOW YOU. If altitude is unknown, ALTITUDE UNKNOWN.

EXAMPLE−

"Traffic, eleven o'clock, one zero miles, southbound, converging, Boeing Seven Twenty Seven, one seven thousand." "Traffic, twelve o'clock, one five miles, opposite direction, altitude unknown." "Traffic, ten o'clock, one two miles, southeast bound, one thousand feet below you."

6. When requested by the pilot, issue radar vectors to assist in avoiding the traffic, provided the aircraft to be vectored is within your area of jurisdiction or coordination has been effected with the sector/facility in whose area the aircraft is operating.

7. If unable to provide vector service, inform the pilot.

8. Inform the pilot of the following when traffic you have issued is not reported in sight:

(a) The traffic is no factor.

(b) The traffic is no longer depicted on radar.

PHRASEOLOGY−

TRAFFIC NO FACTOR/NO LONGER OBSERVED, or (number) O'CLOCK TRAFFIC NO FACTOR/NO LONGER OBSERVED, or (direction) TRAFFIC NO FACTOR/NO LONGER OBSERVED.

b. To aircraft that are not radar identified:

1. Distance and direction from fix.

2. Direction in which traffic is proceeding.

3. If known, type of aircraft and altitude.

4. ETA over the fix the aircraft is approaching, if appropriate.

PHRASEOLOGY−

TRAFFIC, (number) MILES/MINUTES (direction) OF (airport or fix), (direction)−BOUND, and if known, (type of aircraft and altitude), ESTIMATED (fix) (time), or TRAFFIC, NUMEROUS AIRCRAFT VICINITY (location). If altitude is unknown, ALTITUDE UNKNOWN.

EXAMPLE−

"Traffic, one zero miles east of Forsythe V−O−R, Southbound, M−D Eighty, descending to one six thousand." "Traffic, reported one zero miles west of Downey V−O−R, northbound, Apache, altitude unknown, estimated Joliet V−O−R one three one five." "Traffic, eight minutes west of Chicago Heights V−O−R, westbound, Mooney, eight thousand, estimated Joliet V−O−R two zero three five." "Traffic, numerous aircraft, vicinity of Delia airport."

c. For aircraft displaying Mode C, not radar identified, issue indicated altitude.

EXAMPLE−

"Traffic, one o'clock, six miles, eastbound, altitude indicates six thousand five hundred."

The FAA's Pilot-Controller Glossary defines "additional services" as advisory information provided by ATC which includes, but is not limited to the following:

a. Traffic advisories.
b. Vectors, when requested by the pilot, to assist aircraft receiving traffic advisories to avoid observed traffic.
c. Altitude deviation information of 300 feet or more from an assigned altitude as observed on a verified (reading correctly) automatic altitude readout (Mode C).
d. Advisories that traffic is no longer a factor.
e. Weather and chaff information.
f. Weather assistance.
g. Bird activity information.
h Holding pattern surveillance.

Additional services are provided to the extent possible contingent only upon the controller's capability to fit them into the performance of higher priority duties and on the basis of limitations of the radar, volume of traffic, frequency congestion, and controller workload. The controller has complete discretion for determining if he/she is able to provide or continue to provide a service in a particular case. The controller's reason not to provide or continue to provide a service in a particular case is not subject to question by the pilot and need not be made known to him/her.

The FAA's Pilot-Controller Glossary defines traffic advisories as advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant their attention. Such advisories may be based on:

a. Visual observation.

b. Observation of radar identified and non-identified aircraft targets on an ATC radar display, or
c. Verbal reports from pilots or other facilities.

Note 1: The word "traffic" followed by additional information, if known, is used to provide such advisories; e.g., "Traffic, 2 o'clock, one zero miles, southbound, eight thousand."
Note 2: Traffic advisory service will be provided to the extent possible depending on higher priority duties of the controller or other limitations; e.g., radar limitations, volume of traffic, frequency congestion, or controller workload. Radar/ non-radar traffic advisories do not relieve the pilot of his/her responsibility to see and avoid other aircraft. Pilots are cautioned that there are many times when the controller is not able to give traffic advisories concerning all traffic in the aircraft's proximity; in other words, when a pilot requests or is receiving traffic advisories, he/she should not assume that all traffic will be issued.

The FAA's Pilot-Controller Glossary defines "immediately" as a term used by ATC or pilots when such action compliance is required to avoid an imminent situation.

3.3 Aeronautical Information Manual (AIM) Basic Flight Information and ATC Procedures

The non-regulatory AIM is designed to provide the aviation community with basic flight information and ATC procedures for use in the National Airspace System (NAS) of the United States. The manual contains the fundamentals required in order to fly in the United States NAS. It also contains items of interest to pilots concerning health and medical facts, factors affecting flight safety, a pilot/controller glossary of terms used in the ATC System, and information on safety, accident, and hazard reporting.

Paragraph 4−1−16, Safety Alert, states in part:

A safety alert will be issued to pilots of aircraft being controlled by ATC if the controller is aware the aircraft is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain, obstructions or other aircraft. The provision of this service is contingent upon the capability of the controller to have an awareness of a situation involving unsafe proximity to terrain, obstructions and uncontrolled aircraft. The issuance of a safety alert cannot be mandated, but it can be expected on a reasonable, though intermittent basis. Once the alert is issued, it is solely the pilot's prerogative to determine what course of action, if any, to take. This procedure is intended for use in time critical situations where aircraft safety is in question. Noncritical situations should be handled via the normal traffic alert procedures.

Controllers will immediately issue an alert to the pilot of an aircraft under their control if they are aware of another aircraft which is not under their control, at

an altitude which, in the controller's judgment, places both aircraft in unsafe proximity to each other. With the alert, when feasible, the controller will offer the pilot the position of the traffic if time permits and an alternate course(s) of action.

Any alternate course(s) of action the controller may recommend to the pilot will be predicated only on other traffic being worked by the controller.
EXAMPLE−
American Three, traffic alert, (position of traffic, if time permits), advise you turn right/left heading (degrees) and/or climb/descend to (altitude) immediately.

Paragraph 5−5−10, Traffic Advisories (Traffic Information) states:

a. Pilot.
1. Acknowledges receipt of traffic advisories.
2. Informs controller if traffic in sight.
3. Advises ATC if a vector to avoid traffic is desired.
4. Does not expect to receive radar traffic advisories on all traffic. Some aircraft may not appear on the radar display. Be aware that the controller may be occupied with higher priority duties and unable to issue traffic information for a variety of reasons.
5. Advises controller if service is not desired.

b. Controller.
1. Issues radar traffic to the maximum extent consistent with higher priority duties except in Class A airspace.
2. Provides vectors to assist aircraft to avoid observed traffic when requested by the pilot.
3. Issues traffic information to aircraft in the Class B, Class C, and Class D surface areas for sequencing purposes.
4. Controllers are required to issue to each aircraft operating on intersecting or nonintersecting converging runways where projected flight paths will cross.

The AIM Pilot-Controller Glossary defines traffic advisories as advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant their attention. Such advisories may be based on:

a. Visual observation.
b. Observation of radar identified and non-identified aircraft targets on an ATC radar display, or
c. Verbal reports from pilots or other facilities.
Note 1: The word "traffic" followed by additional information, if known, is used to provide such advisories; e.g., "Traffic, 2 o'clock, one zero miles, southbound, eight thousand."
Note 2: Traffic advisory service will be provided to the extent possible depending on higher priority duties of the controller or other limitations; e.g., radar limitations, volume of traffic, frequency congestion, or controller workload.

> Radar/ non-radar traffic advisories do not relieve the pilot of his/her responsibility to see and avoid other aircraft. Pilots are cautioned that there are many times when the controller is not able to give traffic advisories concerning all traffic in the aircraft's proximity; in other words, when a pilot requests or is receiving traffic advisories, he/she should not assume that all traffic will be issued.

The AIM Pilot-Controller Glossary defines "immediately" as a term used by ATC or pilots when such action compliance is required to avoid an imminent situation.

Paragraph 4−4−10. Adherence to Clearance, states in part:

> a. When air traffic clearance has been obtained under either visual or instrument flight rules, the pilot−in−command of the aircraft must not deviate from the provisions thereof unless an amended clearance is obtained. When ATC issues a clearance or instruction, pilots are expected to execute its provisions upon receipt. ATC, in certain situations, will include the word "IMMEDIATELY" in a clearance or instruction to impress urgency of an imminent situation and expeditious compliance by the pilot is expected and necessary for safety. The addition of a VFR or other restriction; i.e., climb or descent point or time, crossing altitude, etc., does not authorize a pilot to deviate from the route of flight or any other provision of the ATC clearance.
>
> b. When a heading is assigned or a turn is requested by ATC, pilots are expected to promptly initiate the turn, to complete the turn, and maintain the new heading unless issued additional instructions.

3.4 ATC Radar Displays

At the time of the accident, there were two radar display systems in use for terminal area surveillance in the NAS. These were the Automated Radar Terminal System (ARTS) and the Standard Terminal Automation Replacement System (STARS). The FAA is in the process of replacing all of the ARTS with STARS.

There were two major types of ARTS models in use at FAA facilities, ARTS models IIE and IIIE. Current versions of the ARTS were referred to as Common ARTS or CARTS due to the common national software. The ARTS IIIE version was designed to support 15 sensors, 10,000 simultaneous tracks, and over 200 displays. ARTS-IIIEs are operational at 8 large TRACONs. ARTS IIE versions, such as the version at CHS, were designed to support one or two sensors and up to 22 displays in two different configurations that can process 256 simultaneous tracks per sensor. The CARTS systems have been a reliable part of the Terminal domain for over 30 years.

The STARS is currently being used in many TRACONs around the United States by the FAA and Department of Defense. STARS is scheduled to replace ARTS throughout the NAS by 2020. In addition to the TRACON upgrade with STARS, tower radar displays such as the digital bright radar indicator tower equipment (DBRITE), in use at CHS, are being replaced with STARS

tower display workstations (TDW) that provide enhanced presentation and functionality. The STARS is capable of receiving input from multiple sensors and provides enhanced tracking capabilities when compared to ARTS. Some of these enhancements include a crisper video presentation resulting from digitized data, an adjustable radar target trail history function that allows for variable target display intensity and trail length, and enhanced weather display. The STARS contains tools that, if used and adequate time allowed, could provide the controller with methods to ascertain aircraft radar track data faster and more efficiently. These tools are the minimum separation (MIN SEP) function, predicted track lines (PTL) function, and terminal proximity alerts (TPA) function.

The MIN SEP function provides the controller enhanced information on the projected or predicted tracks of two aircraft involved in a potential conflict. It provides planning information to the controller on whether or not the flight tracks will or will not cross, providing information on how far apart or how close the two targets will be in the future. This is a predictive tool used to determine future conflict potential.

PTL's are used to check and verify the track of radar targets.

TPA's are visual cones, displayed in mileage, which can be placed over a radar target and are used with maneuvering aircraft to provide a quick recognition of the direction of flight. When used with other tools can aid in timely de-confliction between aircraft.

The radar display system in use at CHS at the time of this accident was ARTS IIE. According to the ATM, the CHS TRACON is scheduled to be decommissioned due to irreparable structural issues dealing with seismic safety. The TRACON function will be transferred to an adjacent TRACON. Accordingly, CHS is not scheduled to receive a STARS installation.

At the time of the accident, there were no known or reported equipment discrepancies with the ARTS IIE detrimental to providing ATC services.

3.5 Conflict Alert (CA)/Mode C Intruder (MCI)

The ARTS IIE had numerous capabilities and functions to assist the controller with strategic and tactical decision making. One of these functions is the conflict alert (CA)/mode C intruder (MCI).

CA/MCI provides the controller visual and aural warnings for aircraft that are or will be in dangerous proximity to each other. The CA/MCI was not designed to and does not detect a loss required minimum required separation, however, a conflict alert and a loss of minimum required separation may be coincidental.

The system processes potential conflicts between aircraft radar track pairs. These aircraft radar tracks, consisting of full radar data blocks or partial data blocks, are considered associated tracks. Aircraft radar tracks that do not have full or partial data blocks, such as an aircraft on a mode 3 transponder of 1200 and have not been radar identified, are considered unassociated tracks. Associated radar track conflicts will generate a CA. Unassociated radar tracks conflicts will

generate a MCI alert. The CA/MCI conflict detection system detects and provides a warning to the controller when associated versus associated or associated versus non-associated targets are developing a potential conflict. Future references to CA will include MCI.

A CA alert provides a visual presentation on the radar scope associated with the developing conflict aircraft and an aural alarm when conditions warrant. These variable conditions are based on vertical and horizontal parameters established for the environment the aircraft are operating in. For example, in the en-route environment where aircraft are faster and higher, the parameters will be more sensitive than an airport environment where aircraft operate closer to each other.

For a predicted alert, the ARTS IIE evaluates a developing conflict for two of three consecutive radar sweeps. The average radar sweep of an airport surveillance radar (ASR), such as the radar at CHS, i.e a 360 degree scan, takes approximately 5 seconds. Accordingly, the CHS ARTS IIE sensed the conflict between Death 41 and N3601V at 1059:59. According to recorded radar data, the CA was presented on the radar scope and aurally alarmed at 1100:13, when Death 41 and N3601V were separated laterally by 4.07 miles and vertically by 400 feet. Recorded radar data indicated that the ARTS IIE continued to provide a CA to the controller until 1101:00, six seconds after the radar targets merged.

The controller did not recall seeing or hearing the CA but her initial traffic call to Death 41 at 1100:16 was 3 seconds after the CA alarmed. (See figure 8)

There were no discrepancies noted with the CA system at CHS.

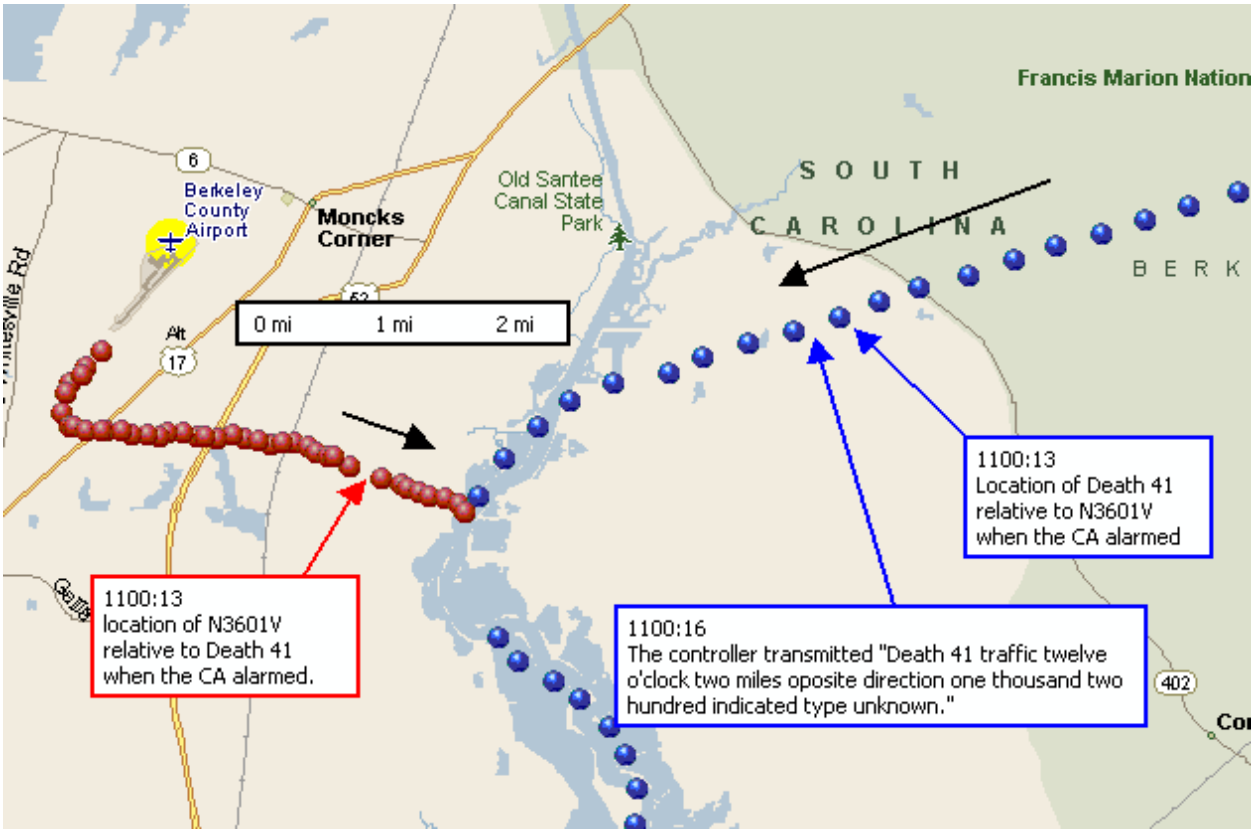

Figure 8 - Radar flight track of Death 41 and N3601V. Death 41 flight track indicated by blue dots. N3601V flight track indicated by red dots. Route of flight indicated by black arrows. The figure illustrates the relative positions of Death 41 and N3601V when the CA alarmed and when the controller issued the initial traffic advisory to Death 41.

3.6 ATC Transcript

This transcription covers the CHS ATCT approach control position for the time period from July 7, 2015 at 10:52 to July 7, 2015 at 11:02.

Agencies Making Transmissions	Abbreviations
Death 41	Death 41
CHS approach controller	CHS
Sneky 91	Sneky 91

1052:34	Death 41	approach death four one level six thousand
1052:38	CHS	death four one charleston approach altimeter is three zero one six
1052:46	Death 41	death four one sierra three zero one six requesting vectors for the tacan runway one five option radar
1052:55	CHS	death four one expect vectors tacan runway one five approach

		climb out instructions fly runway heading maintain two thousand return this frequency
1053:06	Death 41	death four one copies runway heading two thousand this freq
1053:24	CHS	death four one fly heading two six zero vectors to final
1053:29	Death 41	death four one right two six zero vectors
1054:39	CHS	death four one say intentions on the go
1054:43	Death 41	death four one like climb out to vectors ils runway one five
1054:52	CHS	death four one are you gonna be full stop at Charleston eventually or you gonna need climb out
1054:56	Death 41	death four one will be ah rtb to shaw today not full stop
1455:02	CHS	at ten thousand
1055:04	Death 41	death four one requesting twenty four thousand going to the ar track
1055:24	CHS	death four one descend and maintain one thousand six hundred
1055:28	Death 41	death four one down to one thousand six hundred
1059:48	CHS	information tango current at charleston altimeter is three zero one six
1100:16	CHS	death four one traffic twelve o'clock two miles opposite direction one thousand two hundred indicated type unknown
1100:24	Death 41	death four one looking
1100:26	CHS	death four one turn left heading one eight zero if you don't have that traffic in sight
1100:28	Death 41	confirm two miles
1100:33	CHS	death four one if you don't have that traffic in sight turn left heading one eight zero immediately
1100:37	Death 41	death four one (unintelligible)
1100:53	CHS	death four one traffic passing below you one thousand four hundred
1100:58	Death 41	death four one (unintelligible) that aircraft is uh (unintelligible)
1101:08	CHS	death four one ah unable to read you say again
1101:19	Death 41	death four one mayday mayday mayday
1101:22	CHS	death four one Charleston
1101:39	CHS	sneky nine one turn right heading zero niner zero
1101:42	Death 41	death four one
1101:43	Sneky 91	(unintelligible) for sneky nine one
1101:45	CHS	death four one charleston
1101:50	Sneky 91	approach sneky nine one confirm heading zero niner zero
1101:53	CHS	sneky niner one affirmative
1101:55	Sneky 91	sneky niner one heading zero niner zero and ah we will be with chase
1101:58	CHS	sneky niner one roger understand flight of two
1102:10	CHS	sneky niner one maintain three thousand and ah expect holding instructions
1102:15	Sneky 91	sneky niner one
1102:20	CHS	sneky niner one ah we've got a mayday going on can i send you back to shaw

1102:26 Sneky 91 yeah that's affirm we can do that

3.7 Airport/Facility Directory (A/FD) - MKS

The Airport/Facility Directory (A/FD) is a Civil Flight Information Publication published and distributed every eight weeks by the U.S. Department of Transportation, Federal Aviation Administration, Aeronautical Information Services, http://www.faa.gov/go/ais. It is designed for use with Aeronautical Charts covering the conterminous United States, Puerto Rico and the Virgin Islands. This directory contains all public–use airports, seaplane bases and heliports, military facilities, and selected private use facilities specifically requested by the Department of Defense (DoD) for which a DoD Instrument Approach Procedure has been published in the U.S. Terminal Procedures Publication. Additionally, this directory contains communications data, navigational facilities and certain special notices and procedures. Military data contained within this publication is provided by the National Geospatial–Intelligence Agency and is intended to provide reference data for military and/or joint use airports. Not all military data contained in this publication is applicable to civil users.

The A/FD is used by pilots for current airport information and is designed to be used in conjunction with aeronautical charts. The A/FD does not address the proximity to CHS or the intensive heavy military jet and other miscellaneous aircraft executing numerous cargo and personnel drops, high speed low–level military formation flights and the miscellaneous air to ground military operations that occur at and in the vicinity of CHS. (See figure 9)

MKS was a non-towered airport but was attended daily from 0900 to 1900. The MKS local traffic pattern altitude and dimensions are not defined however, according to the AIM, at most airports and military air bases, traffic pattern altitudes for propeller−driven aircraft generally extend from 600 feet to as high as 1,500 feet above the ground. According to the controller interviews, pattern work, i.e. touch and go aircraft remaining in the tower pattern, was not a common occurrence at MKS.

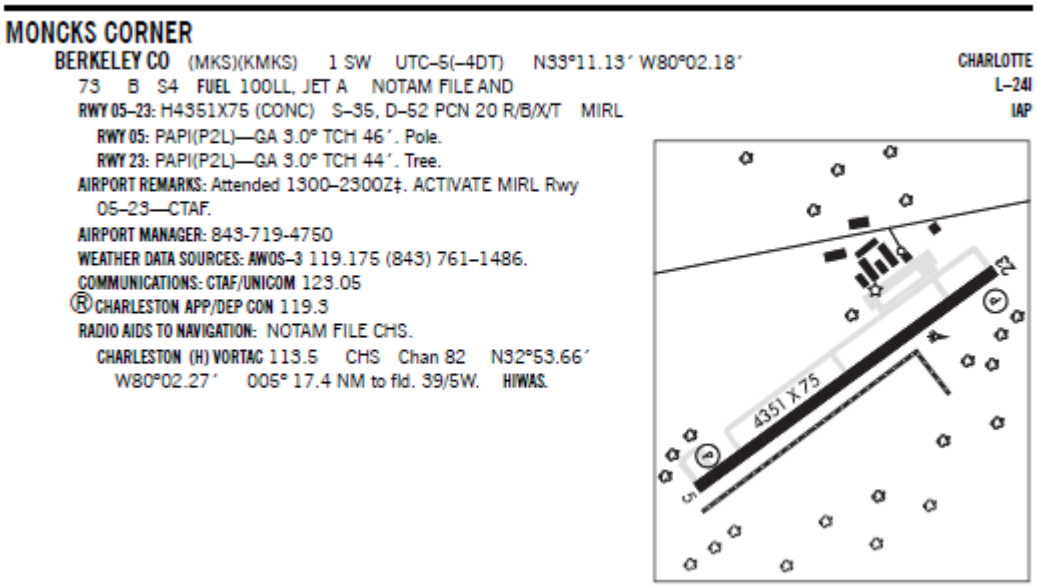
MONCKS CORNER
BERKELEY CO (MKS)(KMKS) 1 SW UTC–5(–4DT) N33°11.13′ W80°02.18′ CHARLOTTE
73 B S4 FUEL 100LL, JET A NOTAM FILE AND L–24I
RWY 05–23: H4351X75 (CONC) S–35, D–52 PCN 20 R/B/X/T MIRL IAP
RWY 05: PAPI(P2L)—GA 3.0° TCH 46′. Pole.
RWY 23: PAPI(P2L)—GA 3.0° TCH 44′. Tree.
AIRPORT REMARKS: Attended 1300–2300Z‡. ACTIVATE MIRL Rwy 05–23—CTAF.
AIRPORT MANAGER: 843-719-4750
WEATHER DATA SOURCES: AWOS–3 119.175 (843) 761–1486.
COMMUNICATIONS: CTAF/UNICOM 123.05
® CHARLESTON APP/DEP CON 119.3
RADIO AIDS TO NAVIGATION: NOTAM FILE CHS.
CHARLESTON (H) VORTAC 113.5 CHS Chan 82 N32°53.66′ W80°02.27′ 005° 17.4 NM to fld. 39/5W. HIWAS.
4351 X 75

Figure 9 – MKS A/FD

3.8 ATC Interviews

3.8.1 Patricia Covert - Radar - West Controller

The group interviewed Ms. Covert on July 9, 2015. Ms. Covert was represented by Ms. Nichole Vitale, NATCA labor relations attorney. In response to questions presented by the group Ms. Covert provided the following information:

Ms. Covert started her career with the FAA in August of 2006 attending the FAA academy in Oklahoma City and then at the Oakland air route traffic control center. She resigned from the FAA in September 2007 and was rehired in February 2008. She has worked at CHS since her rehire. She was an air traffic controller in the US Air Force at McGuire AFB from 1998 to 2000.

Ms. Covert was qualified and current on all operating positions at CHS. She had no other FAA certifications. Her supervisor for the last several years was Kali Young. Her operating initials were TC.

Her class 2 medical certificate was current with a requirement to wear glasses while providing ATC services. She was wearing her glasses on July 7th. Her work schedule consisted of an 8 hour shift from 1300, 1445 or 1600 on Saturdays, 1300 to 2100 on Sundays and Mondays, 0600 or 0700 to 1500 or 1600 on Tuesdays, and 0600 to 1400 or the mid shift starting at 2230 on Wednesdays. Her regular days off (RDO) were Thursday and Friday.

When asked to describe the event, Ms. Covert stated that she was working a regularly scheduled 0700 to 1500 shift on July 7, 2015. At the time of the accident she was working the radar west position combined with the radar east position, which was the normal radar configuration at CHS. The radar assistant position called radar handoff was staffed. Radar handoff was normally staffed from about 0900 to 2000 daily as part of the normal radar configuration. At 1100, when the accident occurred, she had been on position for 1 to 2 hours. Typical time on position was 1 ½ hours on position followed by a 45 minute break. Radar staffing traditionally comprised of a 3 person crew with the position rotation being radar handoff to a break to radar west to a break.

Traffic was routine with light traffic. There was nothing out of the ordinary. Shaw AFB fighters were making approaches when Death 41 entered the airspace from the northeast and requested a TACAN approach. Ms. Covert told the pilot to expect a TACAN runway 15 approach and provided climb-out instructions after completing the approach. She issued a radar vector to Death 41 heading 260 degrees to intercept the 10 to 15 mile final approach course for the TACAN runway 15 approach. This vector would keep Death 41 south of and avoid overflying MKS. There was an unwritten practice at CHS to avoid overflying GA airports such as MKS. She then directed Death 41 to descend and maintain 1,600 feet and was pretty much done with him while she worked other traffic including a flight of 2 F-16s, call-sign Sneky 91. She had descended Death 41 to 1,600 because that was the minimum vectoring altitude at CHS and getting aircraft to their final altitude quickly allowed her more efficient use of her time. This was her technique.

Ms. Covert noticed an aircraft depart from MKS and initially thought the aircraft at MKS was in the local VFR traffic pattern. Pattern traffic at MKS was rare and typically stayed below 1,000 feet. She descended the Sneaky flight to sequence behind Death 41 and to get around other traffic. She asked the Sneaky flight to expedite his descent to 3,000 feet. She noticed that the aircraft that had departed MKS was climbing above 1,000 feet. She called traffic to Death 41 hoping he would get a visual on the traffic but the pilot did not report the traffic in sight. She issued a second traffic call and advised the pilot to turn left heading 180 if he did not have the traffic in sight. This allowed the pilot to continue on his heading of 260 without additional handling if he had the traffic in sight. As the radar targets were merging, she directed Death 41 that if the traffic was not in sight to turn left heading 180 immediately. The 180 heading assignment was preferred over a turn to the north because the turn was quicker and the fighters could turn on a dime. She did not recall seeing or hearing a conflict alert.

She stated that her action/reaction when she received a conflict alert was to call traffic and direct a turn to the aircraft if needed. She stated that she could also use vertical separation to address a conflict alert but in the case of Death 41, the VFR, mode 3 code 1200, target altitude was unverified so a climb or descent was not an option because she did not know the true altitude of the conflict and did not want to climb or descend into possible conflicting altitudes exacerbating the situation.

Ms. Covert stated that fighter aircraft and airliners would typically advise they have observed issued traffic via on board radar but when calling traffic, Ms. Covert wanted pilots to visually identify the traffic with or without aircraft on board radar.

Ms. Covert advised Death 41 that the traffic had passed below him and thought the two aircraft were clear of each other until she saw the VFR target disappear followed by Death 41 declaring a MAYDAY. She transmitted "Death 41 Charleston" and turned to the radar handoff controller and told him "I don't know what to do". The radar handoff controller advised her to "separate what you've got" and the radar handoff controller started making notification calls as the radar controller-in-charge (CIC).

She sent the Sneaky flight of F16s back to Shaw AFB and had no control actions pending as she was relived from position by Mr. Thomas who had just entered the radar room with the ATM. Once off position, she spoke with the ATM who directed her to the quiet room, a room for controller breaks, and eventually came and talked to her. The ATM had the secretary, Janet, drive Ms. Covert home.

3.8.2 John Karafa - Radar Handoff/CIC

The group interviewed Mr. Karafa on July 9, 2015. Mr. Karafa was represented by Ms. Nichole Vitale, NATCA labor relations attorney. In response to questions presented by the group, Mr. Karafa provided the following information:

Mr. Karafa started his career with the FAA in May of 1983 at Atlanta ARTCC where he worked until 1987. He was a controller at CHS from 1987 to 1990 after which he transferred to Columbus Tower (CSG) until 2002. He was a controller at Atlanta TRACON from 2002 to 2005 and returned to CHS in 2005 where he has worked since. He was qualified and current on all operating positions at CHS as well as a CIC and on the job training instructor (OJTI). Prior ATC

experience included four years in the US Navy from 1978 to 1982 as a controller at Naval Air Station Chase Field and aboard USS Forrestal, CV59. He did not hold any additional FAA certifications. His supervisor for the last several months had been Todd Krablchek. His operating initials were JK.

His class 2 medical certificate was current with a requirement to have corrective lenses in his possession when providing ATC services. He had his glasses in his possession on July 7.

His work schedule consisted of 1445 to 2245 on Sundays, 1300 to 2100 on Mondays, 0700 to 1500 on Tuesdays, 0600 or 0700 to 1400 or 1500 on Wednesdays, and 0600 to 1400 or a 2230 mid shift Wednesday evenings. His RDO's were Friday and Saturday.

On July 7th, Mr. Karafa was assigned in radar for the whole work shift and was working west handoff combined with the radar CIC. He and the west radar controller were the only 2 personnel in the radar room. He was on position for approximately 20 minutes when the accident occurred.

In describing the events leading up to the accident Mr. Karafa stated that the traffic was pretty light and just starting to pick up. Death 41 was approaching from the east requesting vectors for the TACAN runway 15 approach. The west radar controller descended Death 41 to 1,600 feet and issued a vector to the TACAN approach. Mr. Karafa stated that about the time west radar made the initial traffic call to Death 41, he was issuing an IFR clearance to an aircraft at Charleston Executive airport. When he returned his attention to the west radar position the midair had already occurred. He determined that Death 41 was going down and that the other aircraft was probably already down and promptly notified the front line manager (FLM) in the tower. He then noticed that the ATM was in the TRACON and let her know what was going on. He stated that the data tag for Death 41 made it appear that the pilot was trying to make it to CHS. The west radar controller asked for direction and he told her to mark the last known position of each aircraft so search and rescue personnel would know where to look. Mr. Karafa did not know if the radar controller marked the accident aircraft locations but he marked one that he thought was the Cessna 150. He then assisted west radar in reducing her traffic workload so she could concentrate on the problem. Once that was complete, he began coordinating but did not recall all of the details. Mr. Karafa discussed the situation with Pauli Thomas, a certified professional controller who had recently returned to the radar room, and directed him to relieve the west radar position.

Describing workload management, Mr. Karafa stated keystroke sequences are shared while working the handoff position. As workload for west radar increases the radar handoff position will perform many of the keyboard entries.

When asked if he would have done anything differently, Mr. Karafa stated the he would have initially descended Death 41 to 3,000 feet to give room for departures from satellite airports. He would then step down as traffic allows. If there was nothing going on, i.e., satellite airport departures, he may have performed the same as the west radar controller did.

Mr. Karafa stated that he didn't really notice the Cessna 150 at first, and that nothing appeared out of the ordinary. After hearing the traffic call, he might have climbed instead of turning Death

41. He had no reason to think that the Cessna 150 was at any other altitude than what was shown. His experience is that military aircraft can climb very rapidly. If he had known about the VFR aircraft he probably would've stopped the F16 at 3,000 feet until seeing what the VFR target was doing. But since he was on handoff he didn't pay much attention.

When asked about possible mitigations Mr. Karafa stated the facility could restrict aircraft to 3,000 feet over MKS or until just prior to crossing MKS if traffic allowed. He wouldn't want to make it mandatory because it is sometimes necessary to descend aircraft earlier.

Mr. Karafa stated that MKS is pretty slow with not much traffic. Most aircraft depart to the SW or NNE, but this particular departure wasn't really unusual. He also stated that CHS controllers try not to allow heavy aircraft to fly over satellite airports below 3000 feet due to wake turbulence. It probably would help to also include high performance aircraft in that.

Mr. Karafa mentioned that equipment may be an issue. He said that the range rings on the radar displays are crooked/warped, they were not circular; everything was old; CHS didn't have many of the advantages that bigger facilities have. When asked if there was anything specific that could contribute to the accident, he stated that the history trail is not as pronounced in the TRACON as it is with the DBRITE in the tower resulting in difficulty in predicting the radar track of a slow moving aircraft. He also added that there are a lot of nuisance low altitude warnings at CHS but he was not sure how the low altitude warning radar mapping was configured.

Regarding other items at CHS, Mr. Karafa said that the carryover item in the daily record of facility operation concerning the ASR-9, SC/com in alarm since 8/15/13, referred to something on the ASR-9 control panel that was in alarm mode but he could not recall what is was without taking a look at it. He also stated that staffing could be improved. He was on the handoff and CIC position for almost 2 hours before during and after the accident. He stated that he thought there should have been someone in on overtime. He stated that there were no CIC duties that were contributory, but if there had been adequate staffing there would have been no reason to combine CIC with the handoff position.

3.8.3 Pauli Thomas – Certified Professional Controller (CPC)

The ATC group interviewed Mr. Pauli Thomas on July 9, 2015. Mr. Thomas was represented by Ms. Nichole Vitale; NATCA labor relations attorney. In response to questions presented by the group Mr. Thomas provided the following information:

Mr. Thomas began his career with the FAA at CHS ATCT in December of 1991. He was qualified on all operating positions at CHS, a CIC and OJTI qualified. He was the local NATCA president. He had no other FAA certifications. Prior to the FAA, Mr. Thomas was a navigator in the USAF from 1984 until 1991. His entire FAA and ATC experience had been at CHS. His Class 2 medical certificate was current with a restriction to be in possession of reading glasses. He had reading glasses in his possession on July 7. Mr. Chris Mason had been his supervisor for several years. His operating initials were PT.

Mr. Thomas's work schedule consisted of RDO on Friday and Saturday, Sunday from 1445 to 2245, Monday from 1300 to 2100, Tuesday from 1000 to 1800 or 0700 to 1500, Wednesday

from occurred on Tuesday July 7 and he was working his regularly scheduled shift. Mr. Thomas stated that he rarely works overtime but was recently held over for an hour. He stated that staffing was inadequate and that he'd like to see an increase in staffing to be able to have the second radar position open more often and to be able to meet contractual requirements.

On the day of the accident, Mr. Thomas was working a 0845 to 1645 shift and was assigned to the radar room. He stated that unless there are staffing concerns, assignments are typically for either the radar or tower for the entire shift.

Mr. Thomas stated that he was not in the radar room at the time of the accident. He had been speaking with the ATM about realignment meetings and had walked into the TRACON immediately after the accident occurred. He stated that John Karafa was working handoff and informed him that an aircraft or maybe 2 had gone down. He stated that he stood behind Ms. Covert and saw the coast[6] data tag of Death 41 which eventually disappeared and dropped off the scope completely. After a brief discussion with Mr. Karafa he relieved Ms. Covert from the west radar position. Ms. Covert appeared to be visibly shaken. He stated that upon assuming the west radar position there were only a couple of aircraft left and only limited routine duties to perform.

Mr. Thomas stated that he was not aware of the VFR aircraft though Mr. Karafa had electronically marked the approximate position where he believed the aircraft had gone down. He could not accurately remember how long Mr. Karafa had remained on the handoff/CIC position after the accident and estimated it to be about 30 minutes.

When asked about search and rescue activities, Mr. Thomas stated that the FLM was in the back of the radar room making phone calls. He also stated that he was probably on position for about 25 minutes or so when a civilian medical helicopter, N452MT, departed CHS. He asked the medevac about his destination. The medevac pilot responded that he was on the way to the Cessna 150 crash site, the only site the helicopter pilot was aware of. Mr. Thomas informed the medevac pilot of the possible location of the second aircraft. He stated that he remained on the west radar position for about 2 hours until one of the 1300 shift controllers came in.

Around the same time that the medevac helicopter found the F16 accident site, Spitfire 01, a flight of 4 F-16's coming in from the Warning area, was handed off to CHS from Sealord or Doubleshot. The flight lead requested to go the site to see if they could help. Three of the aircraft stayed at 10,000 feet and the lead aircraft descended to at or above 1,600 feet with clearance to orbit in the area. Around this time a Coast Guard helicopter, C6562, arrived to conduct a river patrol and Mr. Thomas requested that C6562 assist in the search and rescue. About this time the Spitfire 01 pilot transmitted some better coordinates to pass to the helicopter. The Spitfire 01 lead who was operating at 1,600 feet made radio contact with the pilot of Death 41, who reported that he was okay and on the ground. It was then reported that the pilot of Death 41 was making his way to a larger clearing in order to be rescued by the helicopter but was ultimately rescued by ground personnel. Mr. Thomas then assisted 2 of the 3 F16's orbiting in returning to Shaw due to fuel concerns.

[6] Coast – ARTS data tags go into coast status, indicated as CST on the controllers presentation, when the radar system loses contact with a previously tracked target.

When asked how he would normally work arriving F-16's, Mr. Thomas stated that he would normally give the descent to 1,600 feet at "pilot's discretion". He also stated that he probably would've use a similar 260 heading for the aiming point on the final. He re-iterated that the only thing he would have done differently than Ms. Covert would have been to make the descent at pilot's discretion.

Mr. Thomas stated that MKS is the least busy airport in the area and there was very little observed traffic. He further stated that it is common to descend to 1,600 feet and that this practice dates back many years when a "calm wind runway" was utilized. He also stated that 1,600 feet is the intercept for approaches to all runways except for runway 33 which is 2,000 feet due to a higher MVA in that area.

When asked about local restrictions for heavy military in the area, he stated that this most likely was due to issues at JZI which sits between the approaches to runways 33 and 3. A normal downwind would take an aircraft over JZI and if heavy aircraft are too low it could create a wake turbulence issue at JZI.

Mr. Thomas stated that he does not know how often the CA speaker volume is checked. He stated that the F-16's usually arrive a little farther north than Death 41 did. They are ordinarily handed off exiting from one of the MOA's instead of coming from MYR. When asked how he would mitigate the accident, Mr. Thomas stated that the best thing would be to restrict descents over satellite airports. There are no jets operating out of MKS and most of the traffic operating there are slow climbing. He further stated that the use of 3,000 feet would not typically impact other operations, though during times of peak traffic a lower altitude could be more advantageous.

Mr. Thomas stated that the local safety council is comprised of 2 front line managers and 3 active NATCA members. If someone sees an issue it goes to the NATCA VP or one of the front line managers and will subsequently be presented to the ATM and facility NATCA representative for discussion.

Mr. Thomas informed the group that approximately one month earlier he had been contacted by Bruce Landsberg, ex-president of the AOPA Air Safety Foundation, about starting an advocacy program in the area.

3.8.4 Kali Young – Front Line Manager (FLM)

The ATC group interviewed Mr. Young on July 9, 2015. Mr. Young was represented by Mark Tomicich, FAA legal counsel from the office of AGC-400. In response to questions presented by the group, Mr. Young provided the following information:

Mr. Young started his career with the FAA in October 1998 at Oakland ARTCC as a direct hire from the US Navy. He worked at ZOA until 2003 when he transferred to Miami ARTCC until 2008 and then spent 10 months as a ATC safety inspector in the FAA regional office in Atlanta. He transferred to CHS as a FLM in November 2008 and has been at CHS ever since. Additional

ATC experience included 5 years with the US Navy as controller at Naval Air Station Fallon, NV where he was a facility watch supervisor. He held no other FAA certifications.

He was qualified and current on all operating positions at CHS. His currency requirements as an FLM required 4 hours on a radar position plus one hour at the radar handoff position per month and 4 hours in the tower with a minimum of 1 hour on each position per month. The FLMs at CHS self-monitor their currency. His class 2 medical certificate was current with no restrictions or waivers. His supervisor since 2008 had been Stephanie Faison. His operating initials were KY.

Mr. Young's work schedule consisted of an 8 hour shift starting at 1300 on Sunday and Monday, 1000 on Tuesday, and 0700 on Wednesday and Thursday. His RDOs were Friday and Saturday. On July 7, he worked a 0700 to 1500 shift versus his regularly scheduled shift of 1000 to 1800 to cover for one the 3 FLMS at CHS who was on leave.

When asked to describe events surrounding the accident, Mr Young stated he was working at the ground control position in the tower providing a skills certification check to another controller. The tower local control positon was combined with the tower CIC position and the ground control position was combined with flight data/clearance delivery. The radar room was supervised by a radar CIC.

Mr. Young received a call from the radar handoff/radar CIC controller advising the "I think he's going down". Mr. Young did not know what he was talking about but observed the radar data track of Death 41 on the tower DBRITE indicating that Death 41 was descending through 1,000 feet. He observed the data block drop off the radar scope when the altitude of Death 41 indicated 300 feet, followed by a large plume of smoke about 11 miles away. There were a few clouds in the area but no obstructions to visibility that prevented him from seeing the smoke from the accident location. Mr. Young did not visually acquire Death 41 while it was airborne. He was not aware of the 2nd accident aircraft, N3601V, a Cessna 150, until after he left the tower.

He called for relief and stopped operations on the airfield in the event Death 41 was going to try to land at CHS. Mr. Thomas rang the crash phone and attempted to provide accurate location information to the crash crew and the 911 operator using the DBRITE radar map and advised the accident location for the F-16 was east of highway 52, midway between CHS and MKS.

After leaving the tower he went to the TRACON. Mr Karafa was on the radar handoff position and Mr. Luiz was making emergency notifications from the supervisor's desk. Mr. Young assumed the notification duties from Mr. Luiz. He continued making notifications and coordinating with the airport manager at MKS. He finally got through after several busy signals and relayed information to the Berkeley County Sheriff's office. The MKS airport manager, Stacy Thomas, advised that she received a call from a local citizen claiming that a bomb had been dropped in her yard. Ms. Thomas was concerned that a Cessna 150 that had recently departed, piloted by Mr. Johnson, and the bomb report were related, but did not explicitly say so.

Mr. Young reviewed the audio and the National Offload Program (NOP) replay after the accident, but did not develop an opinion then or since regarding culpability in the accident.

Mr. Young stated that most departures from MKS depart to the north.

Mr. Young stated that keeping arrival aircraft at 3000 feet as a mitigation to this accident would hinder efficient operations because runway 15 and 21 would require a longer final and CHS did not have the airspace to support it.

Mr. Young advised that the CA aural alarm was tested daily via a press to test button above the radar supervisor's desk.

4. USAF Mid-Air Collison Avoidance (MACA) Program

The USAF at CHS had produced a MACA pamphlet, dated August 2014, to address mid-air collision potential in the airspace surrounding CHS. This pamphlet was developed to promote flying safety and to minimize the potential for midair and near midair collisions in the vicinity of Joint Base Charleston, Charleston International Airport and all airports in the local area. The pamphlet included numerous safety tips and techniques for avoiding a mid-air collision. Numerous area airports are listed, including MKS. Included in the pamphlet are telephone numbers for the airspace manager and the flight safety office. (See attachment 1)

5. Outreach/Advocacy

Since this midair collision, the CHS ATCT and an Aircraft Owners and Pilots Association (AOPA) associate, Mr. Bruce Landsberg, have established an advocacy and outreach program at CHS to brief local pilots on CHS operations. This outreach includes pilot briefings at the ATCT, pilot observations of radar room operations and planning for controllers to ride along in locally based general aviation aircraft for local airspace and procedures familiarity from the pilot to controller perspective.

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AS-30