



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** April 27, 2001

**In reply refer to:** A-01-09

Honorable Jane F. Garvey  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

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### **Background**

According to Federal Aviation Administration (FAA) Order 7110.65, "Air Traffic Control," tower controllers must "establish the sequence of arriving and departing aircraft by requiring them to adjust flight or ground operation, as necessary, to achieve proper spacing." To establish a sequence, controllers must determine aircraft positions primarily by tracking them visually and using position reports by pilots. Terminal radar displays (TRD)<sup>1</sup> may also be used to aid controllers in determining and confirming aircraft positions. However, not all towers are equipped with TRDs. The National Transportation Safety Board has investigated several recent midair collisions involving airplanes that were all in communication with tower controllers who did not have an operational TRD. As further discussed below, these controllers might have been able to prevent the collisions if they had had the benefit of an operational TRD.

### **Waukegan, Illinois**

On February 8, 2000, about 1504 central standard time (CST), a Moravan Z242L, N5ZA, and a Cessna 172P, N99063, collided in flight over a residential area of Zion, Illinois, approximately 2 miles from the approach end of runway 23 at the Waukegan Regional Airport, Waukegan, Illinois. N5ZA impacted the roof of a hospital, and N99063 came to rest on a residential street. Both airplanes were destroyed on impact. The pilot and passenger on board N5ZA were killed. The student pilot of N99063 was also killed. Both flights were operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91 without flight plans. Daytime

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<sup>1</sup> For the purposes of this letter, a TRD refers to any device that displays radar data directly to controllers in a tower cab. These devices include, but are not limited to, Digital Bright Radar Indicator Tower Equipment (D-BRITE), Remote Automated Radar Terminal System (ARTS) Color Displays, Terminal Automated Radar Display and Information Systems (TARDIS), and Standard Terminal Arrival Route System (STARS) Tower Display Workstations (TDW).

visual meteorological conditions (VMC) prevailed at the time of the accident. Reported visibility was 10 miles; however, controllers reported that conditions were hazy with much lower visibility to the northeast, toward Lake Michigan.<sup>2</sup>

At 1455:25 CST, the pilot of N5ZA made his initial call to the Waukegan tower, and, 6 seconds later, he reported that he was 15 miles northeast of the airport. The local controller (LC) acknowledged the call and asked the pilot, “are you coming down the shoreline?”<sup>3</sup> The pilot responded, “that’s affirmative.” The LC instructed the pilot to “report turning final at the shoreline for the straight in [to] runway two three.” The pilot acknowledged. At 1457:42, the pilot of N99063 (who was performing practice takeoff and landings and remaining in the traffic pattern) indicated that she was holding short of runway 23 and was “ready for departure.” At 1458:07 CST, the LC cleared N99063 for takeoff. At 1459:48 CST, the LC asked the pilot of N5ZA for his position. The pilot replied that he was “just about a mile or two off the lake...off the shoreline.”<sup>4</sup> The LC subsequently asked the pilot of N99063 to advise him when she saw “a red<sup>[5]</sup> low wing aircraft [N5ZA].”

At 1501:16 CST, the pilot of N99063 stated, “negative traffic,” and asked the LC to advise her when to turn for her base leg.<sup>6</sup> At 1501:41 CST, the LC asked the pilot of N5ZA how far out he was; the pilot responded that he was “just crossing the shoreline.”<sup>7</sup> At 1502:09, the LC asked the pilot of N99063 if she saw N5ZA yet. The pilot responded, “negative.” At 1502:12 CST, the LC asked the pilot of N99063, “have you passed the shoreline?” The pilot replied, “gettin there.”<sup>8</sup> The LC then instructed N99063 to “start your base leg now,” intending to line up N99063 behind N5ZA.<sup>9</sup> At 1502:18, the pilot acknowledged; radar data showed that N5ZA crossed the shoreline about the same time, 4 miles from the approach end of the runway 23. As the pilot of N99063 turned onto base leg, then final approach, the airplane was slightly in front of N5ZA.<sup>10</sup> At 1503:19 CST, the pilot of N5ZA reported, “negative contact with the Cessna in front of us.” At 1503:40, the pilot of N99063 reported that she was on final approach. At

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<sup>2</sup> The accident description for CHI00MA066A/B can be found at [www.nts.gov/NTSB/query.asp](http://www.nts.gov/NTSB/query.asp).

<sup>3</sup> The shoreline is oriented north-south. Runway 23 is oriented northeast-southwest. The approach end of runway 23 is 4 miles southwest of the shoreline.

<sup>4</sup> Radar data provided by the FAA from its Chicago and Milwaukee terminal radar sites, which cover the traffic pattern altitude at Waukegan Regional Airport (1,300 feet mean sea level), revealed that N5ZA was actually 3.75 miles northeast of the shore along the runway 23 extended centerline. After the initial contact, the airplane performed a gradual arc from a southerly course to a southwesterly course, intercepting the extended centerline.

<sup>5</sup> At 1500:57, the LC corrected this instruction and advised N99063 that “it’ll be a white low wing aircraft.”

<sup>6</sup> A standard traffic pattern consists of (1) a downwind leg (parallel to the runway in a direction opposite to the intended landing direction), (2) a 90° turn to the base leg (in the direction of the runway), and (3) a final approach (along the extended runway centerline, to the point of touchdown).

<sup>7</sup> If N5ZA had just crossed the shoreline, the airplane would have been 4 miles northeast of the runway; however, FAA radar revealed that N5ZA was actually about 5 miles from the runway.

<sup>8</sup> The FAA radar revealed that N99063 was actually about 1.6 miles southwest of the shore along her extended downwind leg.

<sup>9</sup> In postaccident interviews, the LC acknowledged that he did not have visual contact with the airplanes at this time. Therefore, he had no firm information on which to make the turn instruction for N99063.

<sup>10</sup> Although it was not the LC’s intent to position N99063 in front of N5ZA, his instruction for N99063 to turn base resulted in it turning to the final approach leg ahead of N5ZA.

1503:53, the LC asked the pilot of N5ZA, “do you see a Cessna in front of you?” At 1504:00, the pilot responded, “[N5ZA] just had a midair.”

The Waukegan tower was not equipped with a TRD.<sup>11</sup> Therefore, because the LC did not see the airplanes, his erroneous estimate of N99063’s progress since losing visual contact and the pilots’ imprecise position reports<sup>12</sup> were the only information that he had with which to judge the proper sequence of the airplanes. His initial decision to sequence N5ZA first was apparently based on his incorrect belief that N5ZA was closer to the airport than it actually was. Subsequent communications between the LC and the pilot of N5ZA confirm that the airplane was not nearing the runway as quickly as the sequencing plan would require; however, the LC did not amend the sequence. Preliminary findings indicate that if the Waukegan tower had been equipped with a TRD at the time of the accident, the LC could have confirmed the pilot’s position reports and established a more effective sequencing plan, thereby preventing the accident. Additionally, the LC would not have had to contact the aircraft as frequently to determine their positions and to confirm their sighting of other traffic, thereby keeping the communications frequency open.

### **Palm Springs, California**

On February 15, 2000, about 1727 Pacific standard time (PST), a Cessna 172N, N6479D, and a Piper PA-28-140, N84PB, collided while entering the downwind leg of the traffic pattern at Palm Springs Regional Airport (PSP), Palm Springs, California. The certified flight instructor and two students on board N6479D sustained minor injuries, and the airplane was substantially damaged. The certified flight instructor and the student on board N84PB were not injured; however, the airplane sustained minor damage. Both airplanes were being operated as instructional flights without flight plans under the provisions of 14 CFR Part 91. Daylight VMC prevailed at the time of the accident. Reported visibility was 10 miles. Controllers reported that the sun was low in the sky and that the mountains to the west were casting long shadows over the area.<sup>13</sup>

At 1724:22 PST, the pilot of N84PB made his first contact with the PSP LC when he was approximately 5.5 miles from the center of the field. The LC acknowledged and instructed the pilot of N84PB to “make right traffic runway three one right report two miles out on the forty five.” The pilot of N84PB replied, “three one right report two miles out, papa bravo.” Despite the LC’s instructions, the pilot of N84PB made a 30° intercept to the downwind leg and did not provide the requested position report.<sup>14</sup> At 1725:21 PST, N6479D was cleared for takeoff to

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<sup>11</sup> After the accident, the FAA installed a TARDIS in the Waukegan tower.

<sup>12</sup> For example, the pilot of N99063’s response, “gettin there,” when the LC asked, “have you passed the shoreline?”

<sup>13</sup> The accident description for LAX00FA101A/B can be found at [www.nts.gov/NTSB/query.asp](http://www.nts.gov/NTSB/query.asp).

<sup>14</sup> In postaccident interviews, the LC stated that, although the pilot did not exactly follow his instructions, it is quite common for arriving aircraft to make this alternate turn and that he believed that the pilot’s position reports would keep him adequately apprised of the airplane’s position. Further, the LC acknowledged that the instruction he issued to N84PB (“report two miles out”) is commonly interpreted in different ways by different pilots. Safety Board investigators asked the instructor and student aboard N84PB if they had made the report, the instructor stated that he was “familiar with the area and the requested report” and that he believed that the student had made the report. However, the student did not recall making a report.

perform touch-and-go landings on runway 31R. At 1725:39 PST, the LC transmitted to N84PB that there were “two cessnas in the right closed traffic pattern,” and, a few seconds later, he advised N6479D of “traffic inbound from the northwest for right traffic, a Cherokee.” Both pilots acknowledged the advisories and indicated that they were “looking.” At 1727:20 PST, the pilot of N6479D reported that he had hit another airplane.

The PSP tower is equipped with D-BRITE displays. However, because of technical problems with the PSP Airport Surveillance Radar/ARTS, the D-BRITE displays were not available at the time of the accident.<sup>15</sup> This prevented the LC from monitoring the progress of N84PB; if he had been able to monitor its progress, he would likely have noted that N84PB had turned early and passed the 2-mile point. Preliminary findings indicate that if the D-BRITE (or other TRD) had been operational, the LC could have provided more accurate traffic advisories and possibly prevented the collision.

### **Stuart, Florida**

On March 14, 2000, about 1435 eastern standard time (EST), a Beechcraft A-36 Bonanza, N51ML, and a C-310D Twin Cessna, N6744T, collided on final approach for runway 7 at Witham Field, Stuart, Florida. No injuries were sustained by the pilot of N6744T or by the pilot and passenger on board N51ML. Both flights were being operated by private pilots under the provisions of 14 CFR Part 91 as personal flights. N51ML was on an instrument flight rules flight plan and had requested a practice global position system approach to runway 12.<sup>16</sup> N6744T was inbound operating under a visual flight rules (VFR) flight plan. Daytime VMC prevailed at the time of the accident. Reported visibility was 10 miles with scattered clouds.<sup>17</sup>

At 1421:40 EST, the radar controller at the West Palm Beach Terminal Radar Approach Control (TRACON) coordinated N51ML’s requested approach with the Witham tower and then was relieved from position. The replacement radar controller then cleared N51ML for a visual approach to the airport; however, he did not specify which runway the pilot should use. The replacement controller did not advise the Witham tower controllers of the change in the approach procedure, as required by FAA Order 7110.65.<sup>18</sup> At 1431:06 EST, the radar controller confirmed that the pilot of N51ML had the airport in sight and instructed him to contact the Witham LC,

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<sup>15</sup> Safety Board staff learned that the PSP ASR radar had not been operational for over 2 months.

<sup>16</sup> This procedure would result in the airplane flying a course of about 120°.

<sup>17</sup> The accident description for MIA00FA107A/B can be found at [www.nts.gov/NTSB/query.asp](http://www.nts.gov/NTSB/query.asp).

<sup>18</sup> FAA Order 7110.65, Section 2-1-14, “Coordinate Use of Airspace,” states the following:

a. Ensure that the necessary coordination has been accomplished before you allow an aircraft under your control to enter another controller’s area of jurisdiction.

b. Before you issue control instructions directly or relay through another source to an aircraft which is within another controller’s area of jurisdiction that will change that aircraft’s heading, route, speed, or altitude, ensure that coordination has been accomplished with each of the controllers listed below whose area of jurisdiction is affected by those instructions unless otherwise specified by a letter of agreement or a facility directive:

1. The controller within whose area of jurisdiction the control instructions will be issued.
2. The controller receiving the transfer of control.

which the pilot did at 1433:00 stating, “five mile straight in for seven.”<sup>19</sup> Flying the straight in approach to runway 7 caused the pilot of N51ML to fly a path farther to the south than that coordinated by the original radar controller and conflict with N6744T’s traffic pattern. In response to the LC’s question, “who said straight in for seven,” the pilot restated his position as “over the interstate.” About 4 seconds later, the pilot of N6744T reported that he was on a 4-mile base leg.<sup>20</sup> About 5 seconds later, the airplanes collided. Although the replacement radar controller should have advised the LC of the change in N51ML’s flightpath, preliminary findings indicate that a TRD would have allowed the LC to see the conflict developing and issue amended instructions to one or both aircraft, possibly preventing the accident.

### **Fort Pierce, Florida**

On September 11, 2000, at 1246 EST, a Piper PA-28 Cherokee, N9208N, and a Piper PA-23 Aztec, N54235, collided on final approach to runway 9 at the St. Lucie International Airport, Fort Pierce, Florida. N9208N was being operated as a solo training flight by a Flight Safety International student, and N54235 was being operated under the provisions of 14 CFR Part 91. Neither pilot had filed flight plans. The pilots of both airplanes were killed, and both airplanes were destroyed. Daytime VMC prevailed at the time of the accident. Reported visibility was 10 miles with scattered clouds.<sup>21</sup>

At the time of the accident, both pilots were in radio communication with the LC. N9208N was conducting practice touch-and-go landings while remaining in a left traffic pattern for runway 9. At 1242:06 EST, N54235 reported 10 miles west inbound to the airport; the LC instructed him to proceed straight in for runway 9 and to report over the interstate highway, located about 3 miles west of the airport. At 1245:24 EST, N54235 reported over the interstate, as instructed; he was then instructed to follow N9208N, which was turning base to a 3-mile final to runway 9. The pilot reported, “we’re looking for the Cherokee.”<sup>22</sup> About 20 seconds later, the LC asked the pilot of N54235, “do you have a Cherokee off your left wing?” The pilot replied, “no contact.” The pilot of another airplane advised the LC that he had just witnessed a midair collision 3 miles from the end of runway 9. In this accident, the LC instructed a faster airplane (N54235) to follow a slower airplane (N9208N) along final approach. Preliminary findings indicate that a TRD would have allowed the LC to see N54235 overtaking the traffic, enabling him to provide more effective traffic advisories or amended instructions.

## **Discussion**

### **Terminal Radar Displays**

These accidents demonstrate the need for the installation of TRDs at VFR facilities that currently do not have such equipment installed. Radar coverage to traffic pattern altitude from

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<sup>19</sup> This procedure would result in the aircraft flying a course of about 70°.

<sup>20</sup> The LC had instructed the pilot of N6744T to report on 4-mile right base for runway 7.

<sup>21</sup> The accident description for ATL00FA091A/B can be found at [www.nts.gov/NTSB/query.asp](http://www.nts.gov/NTSB/query.asp).

<sup>22</sup> Approach speeds for Aztecs are typically about 20 knots faster than those for Cherokees.

nearby radar sites existed at each of the airports involved in the collisions. However, the LCs could not benefit from the available radar information because they lacked operational TRDs.

Because of concerns raised by these accidents, Safety Board investigators requested a briefing from the FAA on its plans for the procurement and installation of TRDs. On May 11, 2000, the FAA's Manager of Air Traffic Planning and Procedures presented a briefing to the Board that explained the staff-proposed, long-term plan for installing TRDs. He stated that the plan proposed to provide STARS TDWs in eligible towers and that staff had formulated the criteria<sup>23</sup> to identify those towers. However, the manager acknowledged that the STARS program was not fully funded and had experienced delays that were preventing tower display needs from being met and, therefore, that staff had formulated an interim plan to meet these needs.

In an August 31, 2000, followup briefing, managers of the FAA's Air Traffic Procedures and Terminal Automation Divisions presented a briefing on the initial interim plan to Safety Board staff. They stated that the proposed interim plan called for the installation of TRDs in 42 of the 87 eligible towers by fiscal year (FY) 2003 and at least 56 of these towers by FY 2008 and that the proposed interim plan relied on the completion of other programs planned by the FAA to free up existing TRDs (primarily D-BRITEs).<sup>24</sup> However, they indicated that this proposed interim plan also lacked funding. Further, Safety Board staff is concerned that even if the interim plan were fully funded, relying on the completion of other programs to free up assets to implement the interim plan will likely introduce additional unwanted delays. Additionally, the proposed interim plan will not meet the goal of equipping all 87 towers that were determined to be eligible to receive TRDs.

The Safety Board is pleased that TARDIS equipment has been installed at the Waukegan tower and that the FAA's budget for FY 2001 includes funding to install TRDs at the airports in Gainesville and Boca Raton, Florida, and at six additional towers still to be determined. The Board is also pleased that FAA staff has developed an interim plan that attempts to maximize the radar capabilities of lower-volume towers with minimal resources. However, the Safety Board concludes that the installation and implementation of TRDs are already seriously behind schedule and must not be delayed further. As general aviation and regional airline traffic continues to increase, and to ensure a higher level of safety, the need for TRDs at airport towers not currently so equipped will also increase.<sup>25</sup> Therefore, the Safety Board believes that the FAA should install TRDs at all towered airports where radar coverage exists at traffic pattern altitude.

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<sup>23</sup> The following criteria were established by the FAA: "An FAA VFR control tower at an airport [that] is a satellite of the primary airport of a radar approach control facility is a candidate for a remote radar display scope in the tower cab when: at least 30,000 annual itinerant operations are recorded; and operationally adequate low coverage is assured at the satellite airport." (Each of the accidents discussed in this letter occurred at an airport with at least 30,000 annual itinerant operations.) The FAA identified 87 towers that were eligible to receive TRDs.

<sup>24</sup> They acknowledged that the FAA did not have enough TRDs in its inventory to fulfill the interim plan and that production of D-BRITEs had ceased in anticipation of STARS deployment. Therefore, the FAA's interim plan relies on the completion of other programs (for example, the completion of new TRACON facilities in Northern California; Atlanta, Georgia; and Washington, D.C.), which would free up D-BRITEs (or other TRDs) to be redeployed to the towers identified in the interim plan.

<sup>25</sup> According to FAA forecasts, regional and commuter revenue passenger miles and general aviation turboprop and jet activity are expected to increase 5.3 percent and 7 percent annually through FY 2011, respectively.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Install terminal radar displays at all towered airports where radar coverage exists at traffic pattern altitude. (A-01-09)

Acting Chairman CARMODY and Members HAMMERSCHMIDT, BLACK, and GOGLIA concurred with this recommendation.

*[original signed]*

By: Carol J. Carmody  
Acting Chairman