Party Submission

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I. INTRODUCTION

A. Synopsis

On August 16, 2015, about 1103 Pacific Daylight time, a Cessna 172M, N1285U ("Cessna 85U"), and an experimental Sabreliner, NA265-60SC, N442RM, ("Sabreliner") collided midair approximately 1 mile northeast of Brown Field Municipal Airport ("SDM" or "Brown Field"), San Diego, California. Both aircraft were under control of the SDM airport traffic control tower ("ATCT" or "Brown Field") at the time of the accident. The ATCT functions were being performed on the day of the accident by employees of Serco, Inc. ("Serco"), a contractor that provides such services to the Federal Aviation Administration ("FAA"). Cessna 85U was owned by Brent McAleese and operated by Plus One Flyers, Inc., of San Diego, California, under the provisions of 14 Code of Federal Regulations Part 91 as a local flight. BAE Systems Technology Solutions & Services, Inc., ("BAE Systems") owned and operated the Sabreliner. During the accident flight, BAE Systems was operating the Sabreliner as a public aircraft as defined by 49 U.S.C. § 40102 under a contract for the Department of Defense. The pilot of Cessna 85U and the two pilots and two mission specialists of the Sabreliner were fatally injured. Both aircraft were substantially destroyed by impact forces and post-crash fire. Visual meteorological conditions prevailed.

B. Executive Summary

As discussed in greater detail below, the cause of this accident is that the contract air traffic controller (an employee of Serco) permitted a traffic conflict to develop between the Sabreliner and Cessna 85U; gave instructions to the wrong aircraft, instead of Cessna 85U, in an attempt to provide separation for the aircraft; failed to confirm the maneuver was properly executed; and then directed the Sabreliner to turn base leg and cleared it to land, thus turning the Sabreliner directly into Cessna 85U. In doing so, the Serco controller failed to meet his obligations as a tower controller.

The pilots of the Sabreliner and Cessna 85U did not observe the other aircraft in time to avoid the collision, while the Brown Field Tower controller clearly observed a potential conflict developing with sufficient time to react. The tower controller-in-charge was busy, distracted by his attempts to coach and train a developmental controller, and allowed conditions in the traffic pattern to deteriorate to a point where he had to step in to try to resolve the situation. The tower controller then not only failed to successfully resolve the conflict – or advise the two aircraft of the developing collision hazard – but instead unsuccessfully attempted to direct a separation maneuver, failed to confirm the maneuver was properly executed, and then directed the Sabreliner to turn directly into Cessna 85U – actions that directly precipitated the accident. These actions by the tower controller were therefore the most direct cause of the accident.

The BAE Systems Sabreliner contacted the Brown Field tower nine miles from the airport as he entered Class D airspace, and complied with all tower controller instructions, including the last direction from tower for the Sabreliner to turn base. The pilots of the Sabreliner were highly experienced and skilled, and the factual record reflects both had ample opportunity for recuperative sleep and were not under the influence of drugs or alcohol. Even at the end of the accident flight, the Cockpit Voice Recording transcript confirms that both were alert, attentive,

making efforts to clear for traffic, and fully aware of the mid-air risk in the Visual Flight Rules ("VFR") pattern. However, Cessna 85U made no radio calls from the time the Sabreliner entered the pattern that might have alerted the Sabreliner pilots to Cessna 85U's location in the pattern, before Cessna 85U acknowledged a single call from tower just seconds before accident impact. In addition, Cessna 85U was at a lower altitude than the Sabreliner, at some distance, and likely was obscured from view among the clutter of the background terrain features below the pattern.

In light of the facts developed in the NTSB's investigative record, BAE Systems respectfully recommends the following findings:

- The flight crew of the Sabreliner were qualified to operate the airplane, and the use of alcohol or drugs, fatigue, and medical conditions were not factors in the flight crew's performance.

- The Sabreliner was airworthy in all respects.

- The flight crew of the Sabreliner were familiar with the VFR pattern at San Diego Brown Field Municipal Airport.

- The flight crew of the Sabreliner were actively clearing for conflicting aircraft, but did not see Cessna 85U prior to impact, likely because the aircraft was obscured among the cluttered background of surface features on the terrain below and were not otherwise alerted to Cessna 85U's presence.

- The pilot of Cessna 85U did not observe the Sabreliner prior to impact likely because he did not recognize the significance of pattern entry and downwind radio calls from and to the Sabreliner or the Brown Field Tower controller's radio instructions to the Sabreliner to turn base and land, and because the Cessna's left wing and wing strut likely obscured his line of sight.

- The Brown Field Tower controller controlling both accident aircraft at the time of the accident observed a mid-air collision hazard developing between the accident aircraft.

- The Brown Field Tower controller mistakenly provided separation instructions to the wrong aircraft (another Cessna that had just departed the pattern, Cessna N6ZP) before directing the Sabreliner to begin its turn from downwind to base leg and clearing the Sabreliner to land.

- Because the Brown Field Tower controller used the wrong call sign for Cessna 85U, he failed to direct Cessna 85U to perform a 360 degree maneuver to downwind, and thus failed to achieve separation between Cessna 85U and the Sabreliner, as intended, before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

- The Brown Field Tower controller failed to visually observe if Cessna 85U, located on the "inside" downwind, executed the 360 degree maneuver the controller intended Cessna

85U to execute before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

- The Brown Field Tower controller assumed the duty to provide separation and responsibility to direct the aircraft in a competent and safe manner.

- The Brown Field Tower controller unsuccessfully attempted to provide separation between the Sabreliner and Cessna 85U and subsequently directed the Sabreliner to turn base leg and cleared it to land, thus turning the Sabreliner directly into Cessna 85U.

- The Brown Field Tower controller directed the Sabreliner to turn base leg and cleared the Sabreliner to land.

- The Brown Field Tower controller's instructions to the Sabreliner placed the Sabreliner on a collision course with Cessna 85U.

- The Brown Field Tower controller did not issue an immediate safety alert or directions to the Sabreliner that might have avoided the accident in the final seconds of the sequence, nor did he issue any traffic alerts.

- The public aircraft mission of the Sabreliner did not contribute to the accident.

II. FACTUAL INFORMATION

The Sabreliner was registered to BAE Systems Technology Solution & Services, Inc. d/b/a BAE Systems and was operating under a 14 Code of Federal Regulations Part 21 Special Airworthiness Certificate, Experimental Category. The flight involved classified support to the U.S. Navy, and under U.S. law and Federal Aviation Administration regulations, constituted a "public aircraft operation." Title 49 United States Code § 40102(a)(41), in pertinent part, defines a public aircraft as one "used only for the United States Government." When used in that manner for a particular flight, the flight becomes a public aircraft operation. The determination is made on a flight-by-flight basis.

The aircraft and crewmembers were participating in a multi-day mission temporarily relocated away from the Sabreliner's home base of operations at Mojave, California. The aircraft was thus operating temporarily out of Brown Field for purposes of the mission. On the day of the accident, the Sabreliner took off from Brown Field and was returning to land at the same airport. The collision occurred in the VFR pattern for the airfield.

Plus One Flyers managed Cessna 85U as a rental aircraft for its club members, and the aircraft was believed to have been operated by the pilot as a personal flight under 14 Code of Federal Regulations Part 91. Cessna 85U's pilot was reportedly practicing touch-and-go landings at Brown Field at the time of the accident.

Serco, Inc., a large contractor with the Federal Aviation Administration, operated the air traffic control tower at Brown Field and provided all air traffic control services. Both aircraft were in radio contact with the control tower at the time of the accident. According to witnesses, neither airplane appeared to maneuver to avoid the collision in the final seconds preceding the accident.

As will be discussed in further detail later in this Submission, the Brown Field Tower did not issue either aircraft any safety alert or collision avoidance instructions. Instead, Brown Field Tower mistook Cessna 85U for a different Cessna 172 aircraft (Cessna N6ZP) and instructed Cessna 6ZP to make a 360 degree turn and rejoin the downwind pattern. Cessna 6ZP, which Brown Tower earlier had cleared for departure, had already departed the pattern and was likely at least a mile from the pattern, acknowledged and complied with the instruction, at least in part, without questioning the instructions.

When the aircraft collided, the Sabreliner was in the traffic pattern turning from the downwind leg (parallel flight path, proceeding opposite direction to the landing runway) to base leg (90-degree leg to runway before the turn to final), and descending from the previously assigned altitude of 2,000 feet Mean Sea Level ("MSL"). Prior to the Sabreliner commencing its turn from the downwind to base leg, the Brown Field Tower controller instructed Cessna 6ZP to make a 360 degree turn. Cessna 6ZP acknowledged and began to comply. Brown Tower then instructed the Sabreliner to turn base and cleared it to land on Runway 26 Right. The Sabreliner acknowledged the instructions and began its descending turn. Cessna 85U, which had made no calls in the pattern from the time he stated his intention to perform a touch and go to Runway 26 Left from the right downwind, was also in the VFR pattern on its downwind leg. It was at roughly 1,500 feet MSL, approximately 500 feet lower in altitude than the Sabreliner's downwind altitude, and nearer the runways. Essentially, Cessna 85U was on an "inside" right downwind while the Sabreliner was on an "outside" right downwind.

The accident resulted in two primary debris fields. The Cessna 85U debris field was located 400 feet northeast of the Sabreliner's debris field, was about 1,200 feet in length, and contained parts from the Sabreliner. The Sabreliner's right wing was found in Cessna 85U's debris field. The Sabreliner's debris field was contained within a radius of approximately 100 feet. A cockpit voice recording was located for the Sabreliner. There was no Flight Data Recorder ("FDR") on the Sabreliner. No recorders were located for Cessna 85U.

A. Sabreliner Flight Crew

Four BAE Systems crewmembers were aboard the Sabreliner. The deceased Sabreliner crewmembers were identified as:

PIC:	Jeffrey D. Percy, BAE Systems Employee
Age:	41
Title:	Intelligence & Security Head of Flying
Flight hours:	4,480 hours total flight time, of which 3,860 hours were as PIC
Time in make and type:	350 hours

SIC:	James H. Hale, Contractor Pilot
Age:	66
Title:	Contractor Pilot; employed by James H. Hale Aviation
Flight hours:	Est. 7,150 total flight time, of which over 3,300 hours were as PIC
Time in make and type:	120 hours

Crewmember:	Carlos Palos, BAE Systems Employee
Age:	40
Title:	Aircraft Technician

Crewmember:	Jon Kovach, BAE Systems Employee
Age:	34
Title:	Crew Chief

Jeffrey Percy, BAE Systems Intelligence & Security Head of Flying and Chief Pilot, was the Pilot-in-Command and seated in the left seat. James "Dick" Hale, was Second-in-Command and seated in the right seat. Based on information gathered during the NTSB's investigation, it is believed that Mr. Hale was the pilot flying the approach and Mr. Percy was handling the radios at the time of the accident.

Mr. Percy started work at BAE Systems on April 5, 2010. From December 2008 to April 2010, he worked for Epic Aircraft as the chief of flight test and engineering. Prior to that, Mr. Percy served in the U.S. Air Force and flew the F-15 Eagle. In 1997, Mr. Percy entered the Specialized Undergraduate Pilot Training Program. He served in the Air Force until 2008, where he held a number of positions, including instructor pilot. Mr. Percy held an airline transport pilot certificate and was instrument rated for single-engine land and multiengine land aircraft, and was rated for glider aircraft. He had type ratings for B737, DC-9, and N-265 aircraft; the military also qualified him to fly various combat aircraft. He also held instructor ratings for single-engine and multiengine land aircraft, as well as instrument and glider aircraft. His total flight time in all aircraft was 4,480 hours, of which 3,860 hours were as PIC.

James H. Hale returned to BAE Systems to work as a contractor pilot[1] on October 6, 2009, after working for BAE Systems as a Site Manager, Operations Officer, and F-4D pilot from September 1994 to December 2002. In the time between working for BAE Systems, approximately May 2004 to October 2009, Mr. Hale worked for AirUSA as an Air Operations Officer/Pilot, Safety Officer, Flight Scheduler, and Instructor Pilot for the Alpha Jet, L-59, and L-39. From January 1993 to September 1994, Mr. Hale was a member of the Civil Air Patrol. Prior to this, Mr. Hale served in the U.S. Air Force from June 1972 to July 1992 when he retired as a Lieutenant Colonel. Mr. Hale held a number of positions in the Air Force including instructor pilot and flew various aircraft, primarily the F-4G. Mr. Hale held an airline transport pilot certificate and was instrument rated for single-engine land and multiengine land aircraft. He held type ratings for B737 and N-265 aircraft. His total flight time in all aircraft was 7,150 hours, of which over 3,300 hours were as Pilot-in-Command.

Jonathan Kovach began working for BAE Systems in July 2004 as an aircraft mechanic. Prior to joining BAE Systems, he joined the Marine Corps in June 1999 shortly after graduating from high school. In the Marine Corps, he was a member of the Marine Air Logistics Squadron and held the positions of Crewleader/Collateral Duty Inspector and Jet Engine Inspector. He also

[1] BAE Systems' pilot workforce includes its Head of Flying and a number of contract pilots. The contract pilots are extremely experienced pilots, all with prior military flight experience, who fly missions for the company on a project-by-project basis. Mr. Hale was a former full-time pilot employee of BAE Systems.

completed various engine and machinist training courses while in the Marine Corps. In June 2004, Mr. Kovach left the Marine Corps as an E-4 Corporal and joined BAE Systems.

Carlos Palos was hired to work for BAE Systems in March 1997. He maintained various positions while working for BAE Systems, including AC Electrical Technician and Production Master. In June 2007, Mr. Palos left BAE Systems for a brief time to pursue a career in law enforcement. He later returned to BAE Systems and was rehired in September 2008 as an Aircraft Mechanic and was later promoted to AC Electrical Master Mechanic and Master Production Operator.

Post-accident test results revealed no evidence of drugs or alcohol that could have contributed to the accident. The assessment by the Human Performance Group found more than sufficient opportunity for crew rest and restful sleep in the days leading up to the accident and no evidence that personal electronic devices were misused at the expense of crew rest prior to the accident flight.

Proposed Finding: The flight crew of the Sabreliner were qualified to operate the airplane, and the use of alcohol or drugs, fatigue, and medical conditions were not factors in the flight crew's performance.

B. Cessna 85U Pilot

The deceased pilot of the Cessna 172 was identified as:

Pilot:	Michael A. Copeland
Age:	55
Title/Employer:	Senior Marketing Manager, Qualcomm
Pilot License:	Obtained in 1997

BAE Systems understands that Mr. Copeland had approximately 280 hours of flying time and was practicing touch-and-go landings in the SDM pattern on the day of the accident. Mr. Copeland had logged 11.6 hours in the 6 months preceding the accident, 2.8 hours of which were in the most recent 30 days.

C. Aircraft Information

Sabreliner

The Sabreliner, N442RM, was a North American Rockwell NA265-60SC, serial number 306-073, manufactured in 1974. It was an IFR-equipped and certified aircraft with a 14 Code of Federal Regulations Part 21 Special Airworthiness Certificate, Experimental Category.

BAE Systems purchased the Sabreliner in 2007. The aircraft's wings were modified in 1980 to adopt a Sabreliner 65 wing configuration by including a super critical airfoil, fixed leading edges, and Fowler flaps, which extended the wings by 6 feet, and a larger horizontal stabilizer that was used on the Sabreliner 65 model. The Sabreliner was powered by two Pratt and Whitney JT12A-8 engines with total times of approximately 8,160 and 9,470, hours,

respectively. The Sabreliner was on a Continuous Aircraft Maintenance Program (CAMP) and last inspected on July 20, 2015, at which time the airframe had approximately 13,420 hours.

There were no deficiencies noted for the Sabreliner prior to the accident that could have contributed to the accident. Furthermore, the nature of the accident indicates that no defect or malfunction of the aircraft is likely to have contributed to the accident.

Proposed Finding: The Sabreliner was airworthy in all respects.

Cessna 172M (85U)

The Cessna 172M Skyhawk, N1285U, was registered to Brent McAleese of San Diego, California. The pilot rented the aircraft through Plus One Flyers for that day's flight.

BAE Systems is aware of no deficiencies noted for Cessna 85U prior to the accident that could have contributed to the accident. Furthermore, the nature of the accident indicates that no defect or malfunction of the aircraft is likely to have contributed to the accident.

D. Meteorological Information

The weather at Brown Field on the morning of August 16, 2015 was clear and there was no ceiling and no precipitation. Around the time of crash, approximately 1100, the temperature was 91 degrees Fahrenheit (33 degrees Celsius). Winds were negligible (6 knots from the west) and not gusting. Visibility exceeded 10 miles and visual meteorological conditions prevailed.

E. Airport Information

San Diego's Brown Field Municipal Airport is located 1.5 miles north of the U.S.-Mexico border in the Otay Mesa community of the City of San Diego. The Federal Aviation Administration classifies Brown Field as a reliever airport for San Diego International, Lindberg Field. Brown Field is 13 miles southeast of Lindberg Field. Tijuana International Airport (TIJ), in Tijuana, Baja California, Mexico, is located in the Tijuana's Otay Centenario borough, just immediately south of the U.S. border. The close proximity of TIJ to Brown Field and the dividing international border cause the majority of Brown Field's VFR traffic to remain in the VFR pattern north of the runways. It appears common for Brown Field traffic using Runway 26 Left to operate as right hand traffic, crossing final and departure tracks for Runway 26 Right.

Brown Field is a busy general aviation airport. The types of general aviation aircraft that operate at Brown Field include private, corporate, charter, air ambulance, law enforcement, fire rescue, flight training, cargo, skydiving, banner towing, and airships. Military aircraft also operate regularly at Brown Field, practicing approaches and VFR patterns. In the twelve months preceding March 31, 2015, an average of 246 aircraft per day operated out of Brown Field. Of those, 56 percent were local general aviation operations, 26 percent were transient general aviation operations, 14 percent were military operations, and 3 percent were air taxis.

A para-jumping zone lies three miles east of Brown Field, and there is high terrain (3,566 ft. MSL) 6 miles east of the airport. Additionally, aircraft must avoid direct overflight of the Pio

Pico Energy Center (3 miles east of SDM) at altitudes below 2000 feet above ground level ("AGL").

Brown Field has two parallel runways. Figure 1 presents the Brown Field configuration and runway identification. The runways are oriented nearly east to west. On August 16, 2015, the wind was generally from the west, so all traffic was landing to the west. Correspondingly, aircraft were flying east on any downwind leg of the VFR pattern. Runways 26 Right and 26 Left were therefore the active runways at the time of the accident. Runway 26 Right is a 7,972 foot runway for larger aircraft and 26 Left is a 3,180 foot runway for smaller aircraft. The control tower is staffed daily from 0900 to 1700 and is operated as class D airspace during those hours.

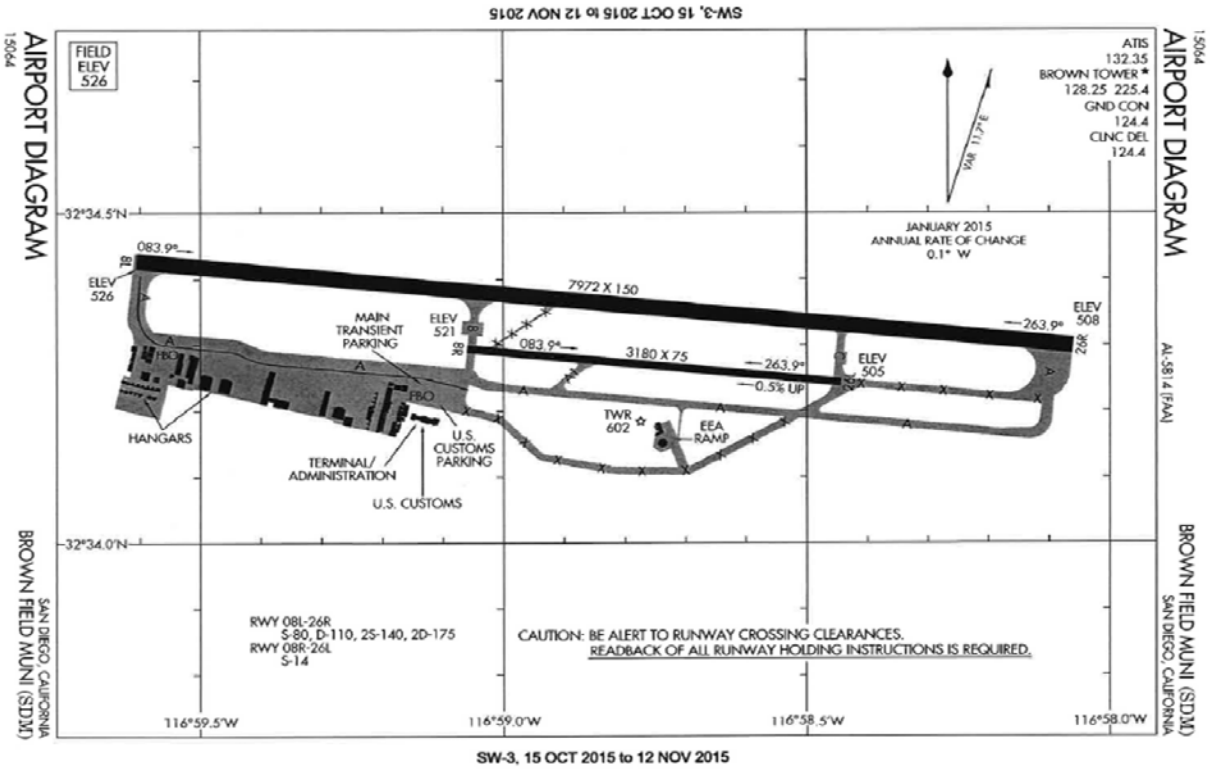

Figure 1

BAE Systems has used Brown Field as a base of operations on public aircraft flights on numerous occasions. The BAE Systems pilots flying the aircraft at the time of the accident were fully qualified to fly the Sabreliner. Both pilots were familiar with Brown Field and had flown multiple missions from the airport. The flight logs show that Mr. Percy operated at Brown Field on 32 occasions over the previous 18 months and that Mr. Hale had operated there on 21 occasions over the previous 18 months.

Proposed Finding: The flight crew of the Sabreliner were familiar with the VFR pattern at San Diego Brown Field Municipal Airport.

F. BAE Systems TSS Organizational Information

BAE Systems TSS is a subsidiary of BAE Systems, Inc. ("Inc. Business"), which is a global aerospace and defense company with over 35,000 employees and more than 50 different affiliates and subsidiaries in the United States and overseas. BAE Systems, Inc. is, in turn, indirectly owned by BAE Systems plc, a United Kingdom company. BAE Systems TSS holds multiple contracts with the U.S. military, including a number for different flight operations. BAE Systems is a company that is dedicated to its mission. Particularly in the context of flight operations, safety of flight is a core value at all levels of the enterprise.

Mr. Percy was emblematic of its safety-first culture. At the time of the accident, Mr. Percy was BAE Systems' Head of Flying and Chief Pilot, and was also a designated Aviation Safety Official for the Mojave Operations. He flew missions on the Sabreliner, QF-4, DC-9, and T-39. BAE Systems first appointed Mr. Percy as Head of Flying on April 15, 2010. He remained as Head of Flying for the business through several corporate reorganizations with his latest appointment letter dated July 1, 2014. His duties included responsibility for, among other things:

- The safe and effective operation of Aircraft, Unmanned Aircraft Systems, airfields, and air traffic services;

- Ensuring that the Aircraft, UAS, airfield operations and air traffic services comply with Applicable Laws and Regulations and [company] Policy;

- The authorization of Flight Crew and Crewmember employees flying (other than as commercial air transport passengers) and non-employees flying as Flight Crew and Crewmembers in Aircraft (other than as commercial air transport passengers) operated by the Inc. Business;

- The approval of personnel engaged by the Inc. Business in Flight Crew, air traffic and airfield roles;

- Ensuring all Inc. Business employees operating Aircraft, UAS, air traffic services and airfields are aware of and instructed to operate in accordance with this policy and any local operating instructions that may be produced by or on behalf of the Head of Flying; and

- The establishment of a flight safety management system that identifies and manages the operating risks associated with the safe preparation of Aircraft and UAS for flight and the safe conduct of flying and airfield operations.

As part of flight safety management system, Mr. Percy reviewed and approved of every flight that was scheduled within the business. He reviewed the mission parameters to ensure safe operation, proposed air crew and the crew qualifications/recent experience, aircraft maintenance status, proposed airfields and potential divert airfields that the aircraft would visit and the support services at the airfields, and expected weather conditions during the mission. His focus was on risk identification and risk reduction and mitigation. Mr. Percy diligently executed his role as Head of Flying for the business. He was regularly audited by the sister business's Head

of Flying and by the Defense Contract Management Agency Government Flight Representatives, with no problems identified since he assumed this role.

In addition to safety of flight, BAE Systems maintains a safety culture within the broader business. BAE Systems maintains policies and procedures that form the basis for its ISO9000 and AS9100 certifications. One of Mr. Percy's roles as Head of Flying was to ensure BAE Systems' safety culture was maintained. As an Aviation Safety Official for the Mojave Operations, Mr. Percy led quarterly Aviation Safety Council Meetings to discuss flight operations and raise and address any safety-related concerns to ensure the continuation of safe flight operations in Mojave. Regular topics of discussion included flight safety, bird/wildlife aircraft strike hazards, mid-air collision avoidance, ground safety, and airfield hazards at the Mojave Airport. Other entities at the Mojave airport were often invited to participate in these Safety Council meetings to review and provide feedback on BAE Systems' programs and safety initiatives.

BAE Systems regularly operates flights that are public aircraft operations as defined by Title 49 of the United States Code, and BAE Systems also regularly operates different flights that are civil aircraft operations under 14 Code of Federal Regulations, Part 91. The work results in review and analysis of BAE Systems' operations, maintenance, and safety by the cognizant military command that grants the interim flight clearances, ISO/AS certifying corporations, and the FAA. BAE Systems and its employees are committed to conducting safe flight operations within this framework.

III. ANALYSIS

A. Accident Sequence

The accident occurred as the Sabreliner was returning to Brown Field following a military training support mission, and after the aircraft had entered the airport's VFR traffic pattern. This section first sets forth an overview and outline chronology of the day of the accident and then discusses the accident in detail.

Overview

As discussed in detail above, August 16, 2015 was sunny and clear with very little wind. Traffic was relatively diverse that morning; it included multiple jets, general aviation aircraft piloted by both students and experienced pilots, a helicopter, and a jump plane. There were three controllers on duty: a supervisor (who had gone on a break at the time of the accident), a Controller-in-Charge, and a developmental controller. Initially in the critical sequence, the developmental controller called traffic, while being instructed by the Controller-in-Charge. As the traffic picked up, first with a call at 1058:55, and then from 1059:36 on, the Controller-in-Charge took over from the developmental controller and began to call traffic himself (all times local; radio calls that are not relevant are omitted).

- 0830 (est.) Eagle 1 departs Brown Field.
- 1030 (est.) Cessna 85U departs Montgomery for Brown Field.
- 1049:44 Cessna 85U contacts Brown Field inbound for touch and go's.
- 1052:57 Cessna 85U cleared touch and go Runway Two Six Right.
- 1054:46 Cessna 85U calls going around on Two Six Right.
- 1056:31 Cessna 85U told to expect Runway Two Six Left.
- 1057:22 Cessna 85U told it is number two behind a Skybolt on left base for Two Six Left; and Cessna 85U acknowledges it will perform a touch and go. This is Cessna 85U's last radio call until immediately preceding the accident.
- 1058:55 The Controller-in-Charge intervenes and clears an aircraft to land and then permits the Developmental Controller to resume calls.
- 1059:04 Eagle 1 first contacts Brown Field Tower.
- 1059:08 The developmental controller gives Eagle 1 at or above two thousand feet and right traffic for Runway Two Six Right.
- 1059:36 The Controller-in-Charge begins to control traffic. (The Tower Controller-in-Charge is exclusively controlling from this point through the accident event.)
- 1059:44 Cessna 6ZP calls, "Brown Tower, Cessna Six Zulu Papa request right downwind departure." This call is not acknowledged by the Tower.
- 1059:50 Eagle 1 is again given at or above two thousand feet and right traffic to Runway Two Six Right, which Eagle 1 acknowledged.
- 1100:46 Cessna 6ZP calls right downwind departure, which is approved by Tower.
- 1102:14 Eagle 1 calls right downwind abeam and traffic left and right in sight.
- 1102:32 Tower directs "Cessna Six Zulu Papa, make a right three sixty, right three sixty; rejoin downwind"; this is nearly two minutes after Cessna 6ZP has departed the downwind pattern.
- 1102:39 Cessna 6ZP acknowledges instructions.
- 1102:42 Tower directs "Eagle One, turn base Two Six Right; clear to land." Eagle 1 acknowledges.
- 1102:56 Tower calls, "Cessna Six Zulu Papa, Tower."

- 1103:00 Cessna 6ZP acknowledges, “Turning, Cessna Six Zulu Papa.”
- 1103:04 Tower calls, “November Eight Five Uniform, Tower.”
- 1103:07 Cessna 85U responds, “Eight Five Uniform.”
- 1103:08 Tower queries Cessna 85U, “Are you still on downwind, sir, right downwind?”
- 1103:10 Approximate time the midair occurs.
- 1103:12 The next call is unintelligible.
- 1103:17 The controller works to clear traffic from SDM, either by bringing aircraft in for landing or clearing them for departure. He also notifies his command center.
- 1107:33 Another controller (noted in the transcript as “BB”) begins to assist with the post-accident procedures.
- 1107:35 The Controller-in Charge states, “Two Six Left and Right in use and available I’ll deal with the mess that I’ve created up there.”
- 11:07:40 Controller BB places a telephone call on hold.
- 1107:43 The Controller-in Charge briefs Controller BB on the status of the traffic that is on the runway.
- 1107:52 Controller BB states “alright.”
- 1107:53 The Controller-in-Charge states “and there’s nothing else I can tell you at the moment.”

As indicated from the sequence above, Cessna 85U was already established in the pattern prior to the Sabreliner’s return to Brown Field. Earlier, Cessna 85U had been cleared by the Brown Field controller for a touch and go on Runway 26 Right, and directed to follow that with entry into “right closed traffic,” meaning to follow the procedures for a right-hand VFR traffic pattern north of the airport.

Cessna 85U did not complete that touch and go landing, and instead called out it was “gonna go around on Two Six Right,” which meant it was going to level off its descent and fly over the runway to the departure end of the runway. The controller acknowledged Cessna 85U’s radio call concerning the go around, and instructed, “roger, you’re following a Cessna mid-right downwind.” The controller was likely referring to Cessna 6ZP. Cessna 85U proceeded to turn right onto the crosswind leg while climbing to his pattern altitude of 1,500 feet. Shortly afterwards, the Tower controller instructed Cessna 85U to expect “a pass” on the “left runway” next. Cessna 85U acknowledged the call, repeating, “expecting left runway.”

Cessna 85U next received clearance from the Tower controller stating, "Cessna Eight Five Uniform, number two behind a Skybolt, left base, Runway Two Six Left. Clear touch and go." Cessna 85U acknowledged the instructions. At this point in the chronology, the Sabreliner was approaching the VFR pattern from the west, after having flown across the shoreline from the waters to the west. The Sabreliner flew just south of the city of San Diego, and then proceeded to a position northwest of Brown Field. The Sabreliner radioed Brown Field Tower, shortly after passing the shoreline stating, "Brown Tower, Eagle One, Nine [miles] west inbound, bravo, full stop." The Tower controller instructed the Sabreliner, "maintain at or above two thousand feet; enter right traffic for Runway Two Six Right." The Sabreliner acknowledged the call.

Following the touch and go on Runway 26 Left, Cessna 85U turned to a right crosswind, crossed the centerline for Runway 26 Right, climbed to its pattern altitude of 1,500 feet, and then turned east onto the downwind leg. Importantly, there were no calls or position reports initiated by Cessna 85U after turning onto the downwind leg. In fact, there are apparently no recorded calls from Cessna 85U from the point the pilot acknowledged the clearance for the touch and go on Runway 26 Left until the collision, except a last-second acknowledgment by Cessna 85U of a call from Tower just prior to impact.

There were a series of radio calls where the developmental controller was becoming rushed and misstated a runway assignment. The operation appeared to become noticeably more challenging for the Tower controller, and the Controller-in-Charge took over for the developmental controller. Shortly thereafter, the Brown Field Tower Controller, by now with the Controller-in-Charge controlling traffic, further instructed the Sabreliner, "Eagle One, right traffic, two thousand, for Two Six Right." Both controllers appeared to use a number of non-standard calls during this timeframe.

The Sabreliner next reported to the Tower controller that, "Eagle One is right downwind abeam. Traffic to the left and right in sight." At this point, Cessna 85U would have been to the south of the Sabreliner, probably abeam or perhaps still slightly "ahead" of the Sabreliner, on Cessna 85U's downwind leg, approximately 500 feet lower. The Sabreliner would have been abeam to slightly behind Cessna 85U, but 500 feet higher and on a wider downwind leg, because of its larger turning radius from the VFR pattern downwind to final approach. The Sabreliner, though, would have been traveling at a higher rate of speed and quickly catching up to and overtaking Cessna 85U before the Sabreliner approached its right turn to base leg.

The Sabreliner would have overtaken Cessna 85U from the rear with approximately one-half to three-quarters of a mile of spacing farther to the north. Cessna 85U would have been to the right of and lower in altitude to the Sabreliner, likely camouflaged by background clutter of the terrain and surface features, and because of the relative positions and closure rates of the two aircraft, there would not have been a dramatic movement of Cessna 85U in the lower part of the windscreen and side cockpit windows of the Sabreliner. Radio calls alone might have provided an opportunity for clearing via radios, but, as mentioned previously, Cessna 85U made no position reports or radio calls from the point of being cleared its previous touch and go landing. The Sabreliner's abeam downwind call apparently did not alert the inexperienced pilot of Cessna 85U that a conflict might be developing.

Proposed Finding: The flight crew of the Sabreliner were actively clearing for conflicting aircraft, but did not see Cessna 85U prior to impact, likely because the aircraft was obscured among the cluttered background of surface features on the terrain below and were not otherwise alerted to Cessna 85U's presence.

Proposed Finding: The pilot of Cessna 85U did not observe the Sabreliner prior to impact likely because he did not recognize the significance of pattern entry and downwind radio calls from and to the Sabreliner or the Brown Field Tower controller's radio instructions to the Sabreliner to turn base and land, and because the Cessna's left wing and wing strut likely obscured his line of sight.

It was at this point in time that the Brown Field Tower Controller-in-Charge attempted to reconcile the looming and obvious conflict between the Sabreliner and Cessna 85U, with each aircraft approaching their respective turns to right base leg at roughly the same time. Based upon an interview of the Tower controller immediately after the accident, he intended to give a spacing right 360 degree turn to the Cessna on the "inside" downwind (which he thought was Cessna 6ZP, but was in fact Cessna 85U), and have it rejoin the inside downwind with greater spacing behind the Sabreliner. The controller further did not instruct that inside Cessna of the controller's intentions, ***i.e.***, that the Cessna would be "Number 2 to follow the Sabreliner," a call that could have alerted both aircraft of the potential conflict.

Proposed Finding: The Brown Field Tower controller controlling both accident aircraft at the time of the accident observed a mid-air collision hazard developing between the accident aircraft.

Instead, the Tower controller, at this point the Controller-in-Charge, instructed as follows: "*Cessna Six Zulu Papa*, make a right three sixty, right three sixty. Rejoin the downwind." This instruction was incongruous. Roughly <u>two</u> minutes and 45 seconds prior to this instruction, Cessna 6ZP had requested to depart the pattern from the right downwind, stating, "Brown Tower, Cessna Six Zulu Papa request right downwind departure." That call was not acknowledged by the Tower controller. Approximately <u>one</u> minute and forty five seconds prior to the erroneous instruction for Cessna 6ZP to make a right three sixty, Cessna 6ZP had called, "Brown Tower, Cessna Six Zulu Papa right downwind departure," and the Tower controller confirmed, "Cessna Six Zulu Papa, right downwind departure approved." As a result, Cessna 6ZP was east-northeast of the airport proceeding in a northeasterly direction at the time of the erroneous call. Even so, Cessna 6ZP responded to the erroneous call with, "Right three sixty, rejoin [the] downwind, Cessna Six Zulu Papa." Clearly, and as the Tower controller admitted following the accident, the Tower controller had confused the call signs of the two Cessna's and given the spacing or deconfliction instruction to the wrong aircraft.

Proposed Finding: The Brown Field Tower controller mistakenly provided separation instructions to the wrong aircraft (another Cessna that had just departed the pattern, Cessna N6ZP) before directing the Sabreliner to begin its turn from downwind to base leg and clearing the Sabreliner to land.

Proposed Finding: Because the Brown Field Tower controller used the wrong call sign for Cessna 85U, he failed to direct Cessna 85U to perform a 360 degree maneuver to downwind, and thus failed to achieve separation between Cessna 85U and the Sabreliner, as intended, before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

The conflict or collision hazard between the Sabreliner and Cessna 85U had thus not been resolved. Cessna 85U did not initiate a spacing turn, because it had received no such instruction. Cessna 85U was not aware of the controller's intention to have it follow the Sabreliner, because no such explicit instructions were given by the controller. The fact Cessna 85U did not initiate a spacing 360 degree turning maneuver would have been instantly observable from Brown Field tower. First, the right downwind to base turn point is close enough to the airport that it is readily observable, even with the naked eye. Second, a right turn initiated by the inside downwind Cessna would have resulted in a right bank and the white tops of the fuselage and wings would have been clearly visible to the Tower at the start of the turn.

But the Tower controller did not visually confirm that the inside downwind Cessna, actually Cessna 85U, was turning before directing the Sabreliner to turn to base. Instead, immediately upon hearing Cessna 6ZP acknowledge the erroneous instruction, and without visually confirming the conflict had been resolved, the Tower controller directed the Sabreliner to turn base, instructing as follows: "Eagle One, turn base Two Six Right, clear to land." The Sabreliner acknowledged, "Eagle One, base, gear, stop, right clear to land," and the pilot flying immediately started a descending turn to final and an intended full stop landing.

Proposed Finding: The Brown Field Tower controller failed to visually observe if Cessna 85U, located on the "inside" downwind, executed the 360 degree maneuver the controller intended Cessna 85U to execute before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

Proposed Finding: The Brown Field Tower controller directed the Sabreliner to turn base leg and cleared the Sabreliner to land.

Although the developmental controller, who was by then observing the Controller-in-Charge, testified that he recognized the incorrect call sign, he was unsure of himself and did not immediately speak up. Then the Tower controller recognized the problem. Instead of immediately issuing a safety alert to the Sabreliner pilots or to Cessna 85U, he proceeded to query Cessna 6ZP at 1802:56, "Cessna Six Zulu Papa, Tower." Cessna 6ZP responded at 1803:00, "Turning, Cessna Six Zulu Papa." There was a slight pause, followed by a critical exchange in the last seconds before the collision. Here is the final sequence of radio calls:

1102:56	Tower	"Cessna Six Zulu Papa, Tower."
1103:00	Cessna 6ZP	"Turning, Cessna Six Zulu Papa."
1103:04	Tower	"November Eight Five Uniform, Tower."
1103:07	Cessna 85U	"Eight Five Uniform."
1103:08	Tower	"Are you still on downwind, sir, right downwind?"

1103:12 Unknown Unintelligible call.

It was too late. The accident occurred during the Sabreliner's base leg turn to final to Runway 26 Right. The Sabreliner was in a descending right turn to final to Runway 26 Right when its flight path intersected that of Cessna 85U's extended downwind leg, presumably still straight and level, at approximately 1500 feet MSL. The controller stated in his interview that, in retrospect, he should have issued a traffic alert; but at the moment he realized that Eagle 1 was turning into Cessna 85U, it was too late to help. The controller likely meant he should have issued a "safety" alert in that situation.

B. Controller's Duties to Pilots Are Governed by the FAA's ATC Manual

14 C.F.R. § 65.45(a) governs the general duties and obligations of an air traffic controller. In pertinent part, it states that: "(a) An air traffic control tower operator shall perform his duties in accordance with the limitations on his certificate and the procedures and practices prescribed in air traffic control manuals of the FAA, to provide for the safe, orderly, and expeditious flow of air traffic." Air Traffic Control ("ATC") Manual version JO 7110.65V was operative at the time of the accident. It prescribes, among others, the duties that a controller owes to pilots in the course of his or her job function.

The Manual provides that the primary purpose of the ATC system is "to prevent a collision between aircraft operating in the system and to organize and expedite the flow of traffic, and to provide support for National Security and Homeland Defense." FAA Order 7110.65 ¶ 2-1-1. A controller's duties and obligations are developed with the intent to further this overarching purpose. As a result, Section 2-1-1 states that a controller is not only permitted, but in fact obligated, to provide additional services to further this effort when capable of doing so.

2−1−1. ATC SERVICE

The primary purpose of the ATC system is to *prevent a collision* between aircraft operating in the system and to organize and expedite the 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.* (Emphasis added.)

SDM is identified as a Class D controlled airspace, which the ATC Manual Pilot/Controller Glossary describes as follows:

> CLASS D− Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless otherwise authorized, each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while in the airspace. No separation services are provided to VFR aircraft.

As the ATC Manual notes, "[n]o separation services are provided to VFR aircraft" in Class D airspace. "Separation" is defined by the ATC Manual Pilot/Controller Glossary as:

> SEPARATION− In air traffic control, the spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off.

Accordingly, "no separation services" as described here solely refers to the absence of a controller's general duty in Class D airspace to provide separation between VFR aircraft operating in that airspace. On the other hand, although a controller is not obligated to provide spatial separation to aircraft arriving or departing or otherwise flying VFR in Class D airspace, the controller is not otherwise exempt from the duty to provide separation services to VFR aircraft as the situation and the controller's workload permit, or to intervene when a collision hazard manifests itself. This language also does not excuse a controller from the responsibility, when providing any instructions to aircraft, to do so in a competent, prudent, and careful manner, whether the aircraft are VFR or not, and whether for separation or other purposes.

C. General Duty to Provide Separation and Issue Safety Alerts

A controller has general responsibility to maintain separation of aircraft and issue safety warnings. Under Section 2-1-1, a controller's first priority must be to separate aircraft and issue safety alerts regardless of whether the aircraft is flying under Visual Flight Rules or Instrument Flight Rules. A controller must rely on good judgment to prioritize separation and issue safety alerts over all other responsibilities. Given the unique circumstances of each scenario, a controller must consider and evaluate each situation he is presented with and take the action that is "most critical from a safety standpoint [] first." FAA Order 7110.65 ¶ 2-1-2a, n. A controller must provide "additional services to the extent possible" to carry out these responsibilities.

> 2−1−2. DUTY PRIORITY
>
> 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.

A controller has a duty to be vigilant of dangerous conditions in the airspace he or she controls. Although the controller may not become immediately aware of every unsafe scenario, the FAA warns that "the controller must remain vigilant for such situations and issue a safety alert when the situation is recognized."

Controllers are obligated to issue two types of warnings to aircraft operating in unsafe situations: a safety alert and a traffic advisory.

The FAA has made "[t]he issuance of a safety alert [] a first priority." FAA Order 7110.65 ¶ 2-1-6, n.1. When a controller becomes aware that an aircraft is at risk because it is in a position or altitude that places it in unsafe proximity to terrain, obstructions, or other aircraft, the controller must issue a safety alert to the pilot. FAA Order 7110.65 ¶ 2-1-6. A controller may issue an aircraft conflict safety alert by instructing the pilot to take an alternative course of action if the controller is aware of an aircraft operating at an altitude that places both aircraft in an unsafe proximity to each other.

The controller may choose to discontinue the issuance of further alerts if the pilot has notified the controller that action has been undertaken to resolve the danger.

> 2−1−6. SAFETY ALERT
>
> 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.
>
> 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.

A controller may also issue a traffic advisory to alert pilots to traffic in close proximity to the position or intended flight route of the aircraft that warrants the pilot's attention. FAA Order 7110.65 ¶ 2-1-21. Controllers are required to issue traffic advisories to aircraft flying under IFR or VFR when the proximity diminishes to less than the applicable separation minima. However, a controller must also provide separation to aircraft whenever its proximity to other aircraft warrants it. This remains true even if the aircraft is operating in airspace where no separation minima applies, such as an aircraft flying VFR in Class D airspace.

2−1−21. TRAFFIC ADVISORIES

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.

D. Serco Controllers Additionally Required to Use Radar

In addition to those duties described in the ATC Manual, Serco controllers are responsible for complying with certain agreed-upon obligations as defined by the August 22, 2013 Letter of Agreement ("LOA") between Serco and Southern California Terminal Radar Approach Control ("TRACON"). This LOA supplements the ATC Manual by setting forth further responsibilities for both Serco and TRACON controllers to help coordinate and control air traffic at Brown Field Municipal Airport while the Tower is in operation.

Most pertinent here, Serco controllers are required to control VFR aircraft within the Tower Class D surface area and obligated to use the Certified Tower Radar Display. According to the LOA, the following applies:

4. RESPONSIBILITIES
   b. Tower is responsible for and must:
      (4) Control VFR aircraft within the Tower Class D Surface Area
      (7) Utilize [Certified Tower Radar Approach Control] procedures when CTRD is operational.

E. Actions of Tower Controller-in-Charge

At issue in this accident is not whether the Brown Field Tower controller recognized a developing loss of separation between the Sabreliner and Cessna 85U and ignored his overarching responsibility to do something about it. The Tower controller recognized the *potential* conflict and actually attempted to reconcile the situation. Instead, this accident was caused by mistakes in the effort to provide separation to the two aircraft. Specifically, the Tower controller failed to verify that the separation maneuver intended for Cessna 85U was successful before turning the Sabreliner onto a base turn and into Cessna 85U. The Tower controller actively attempted to direct the two aircraft to eliminate a risk of collision, but through a series of mistakes, the controller actually precipitated the mid-air accident.

i. Ineffective Efforts to Correct Collision Hazard

As the situation was developing initially, the Controller-in-Charge recognized that the traffic load was increasing for the developmental controller. Complicating matters was that the tower was attempting to control the approach, pattern, and ground traffic simultaneously.

When the Controller-in-Charge replaced the developmental controller and began to control traffic, the circumstances were busy, but still manageable. He addressed and resolved a number of situations. He also attempted to address the looming collision hazard between the Sabreliner and Cessna 85U. His confusion of call signs at that critical point in time was the error that led to the collision threat continuing, a fact he ultimately recognized as the sequence progressed. By using the incorrect call sign to correct the impending collision hazard, the Controller-in-Charge did not achieve the separation between the two aircraft that he was intending. Cessna 85U continued to parallel the flight path of the Sabreliner, at least until the Sabreliner was directed to turn and descend across Cessna 85U's flightpath.

Proposed Finding: Because the Brown Field Tower controller used the wrong call sign for Cessna 85U, he failed to direct Cessna 85U to perform a 360 degree maneuver to downwind, and thus failed to achieve separation between Cessna 85U and the Sabreliner, as intended, before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

ii. Failure to Visually Monitor Aircraft at Risk

The primary means of controlling VFR traffic at Brown Field appears to have been by visual observation. The Controller-in-Charge provided an official statement to investigators after the accident that the radar available in the tower was flawed and unreliable. The Controller-in-Charge added that he did not use or rarely used the radar system to perform his controller function. Recorded radar imagery collected after the accident would seem to confirm the accuracy of this statement. The clear implication is that the controller as a matter of practice, and at the time of the accident, was controlling aircraft visually.

Visits to the accident site afterwards by the BAE Systems team indicated that there were no obstructions between the tower and the point of the accident at 1500 feet MSL, approximately 1 mile northeast of the runway. Even had the distance somehow been a problem, tower controllers may, and are encouraged to use, binoculars when needed for visual observation.

Perhaps further complicating the controller's ability to visually monitor the accident aircraft was his apparent selection of Position 3 in the tower for his work station on the day of the accident. Position 3 is on the opposite side of the tower from the position that would look out on the approach end of the active Runways the day of the accident, Runways 26 Right and 26 Left.

Regardless, it appears it would have been a simple matter for the Tower controller to verify that the separation maneuver he was attempting to issue to the Cessna on the "inside" downwind was in fact being followed and in fact effective. From the sequence of radio calls, the fact the Tower controller turned the Sabreliner into Cessna 85U, and the delay in recognizing the hazard on the part of the controller, it is clear that the tower controller did not effectively monitor the aircraft visually before issuing the instruction for the Sabreliner to turn base.

Proposed Finding: The Brown Field Tower controller failed to visually observe if aircraft Cessna 85U, located on the "inside" downwind, executed the 360 degree maneuver the controller intended Cessna 85U to execute before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

iii. Issuance of Erroneous Separation Instruction

Before the controller mistakenly provided a separation instruction (a right 360 degree turn) to Cessna 6ZP instead of Cessna 85U, there was still no immediate collision risk between the two aircraft. The two aircraft were still on their own downwinds, separated by some distance and altitude, and moving in parallel. The faster Sabreliner was abeam to slightly ahead of Cessna 85U proceeding in a common direction of travel. The Sabreliner had not yet been cleared to turn from downwind to base. And lastly, the two aircraft were still separated by approximately 500 feet in altitude.

The controller has stated that he had concerns with the Sabreliner's downwind extending into and posing a hazard to that day's active parachute jump area to the northeast of the airport. Aircraft 5161U (the jump plane) reported "jumpers away" approximately five minutes before the instruction to the Sabreliner to turn final. The typical parachute jump places the jumper under a parachute for 4 to 6 minutes, so the controller may legitimately have had some concerns about the drop zone. It was this perception of another threat that appears to have rushed the controller's decision-making process. On the other hand, a turn to base was not the only possible recourse. The Sabreliner could always have been directed to leave the pattern and re-enter downwind, while directing Cessna 85U to turn base.

Although there were other options available to the controller beyond an immediate turn to final for the Sabreliner, a sense of urgency, a faulty mental picture, and a failure to verify that the conflict had been resolved led to the final link in the chain of events being put in place. The controller's actions can only be explained as an incorrect mental picture that the collision threat between the Sabreliner and Cessna 85U had been resolved and no longer existed. Not recognizing that his mental picture was even then contradicted by the actual location and flight path of Cessna 85U, the controller turned the Sabreliner to final and cleared it to land. It was this last instruction that actually precipitated the collision by placing the Sabreliner on its collision course with that of Cessna 85U. It was the controller's failure to visually confirm that intended 360 degree maneuver was actually started by the inside downwind Cessna before he directed the Sabreliner to turn that created the loss of separation.

Proposed Finding: The Brown Field Tower assumed the duty to provide separation and responsibility to direct the aircraft in a competent and safe manner.

Proposed Finding: The Brown Field Tower controller attempted to provide separation between the Sabreliner and Cessna 85U and subsequently directed the Sabreliner to turn base leg and cleared it to land, thus turning the Sabreliner directly into Cessna 85U.

Proposed Finding: The Brown Field Tower controller's instructions to the Sabreliner placed the Sabreliner on a collision course with Cessna 85U.

iv. Misplaced Prioritization and Absence of Safety Alert

Instead of fully resolving the situation of a converging midair collision threat, the controller instructed the Sabreliner to turn right base and allowed his attention to be immediately distracted by a call to an aircraft on the ground before returning to the previously-recognized collision threat between the Sabreliner and Cessna 85U.

The controller had mentally concluded the threat was resolved, but upon returning to visually observe the Sabreliner's turn to final, observed a problem – the Cessna on the inside downwind was still there and now in the likely path of the Sabreliner. Then, instead of issuing an immediate safety alert, he began efforts to resolve why the aircraft on inside downwind was still an obvious collision risk with the Sabreliner, wasting valuable seconds, first calling Cessna 6ZP and then Cessna 85U. No immediate safety alert was issued, even though the Controller-in-Charge and the developmental controller had apparently by then recognized that the aircraft on the inside downwind had never executed the intended separation maneuver.

Proposed Finding: The Brown Field Tower controller did not issue an immediate safety alert or directions to the Sabreliner that might have avoided the accident in the final seconds of the sequence, nor did he issue any traffic alerts.

F. Tower and Controller Conditions

i. Training of Controllers by Serco and Oversight by the FAA

As a party to the NTSB accident investigation, BAE Systems has had limited access to the training materials used by Serco to train its tower controllers at Brown Field. Attachment 1 to the ATC Group Factual Report contains what the Group Chairperson deemed to be relevant training excerpts from copies of training materials submitted to the NTSB over the course of the NTSB investigation.

The Air Traffic Control Group Factual Report also documents discussions with the tower controllers on duty at the time of the accident as well as Serco supervisors and FAA oversight personnel about the training received and documented by controllers. Based upon what BAE Systems has learned in this investigation, it is not clear to us how much oversight and supervision the FAA exerted over Brown Tower.

ii. Lack of Emphasis on Visual Observation

The training slides covering visual observation of aircraft within the pattern and under the control of the tower controller appear to have been quite limited. There appear to be two from the totality of the training materials, and these two slides were part of a 20-slide training program. On these two slides, there appears to be one "bullet" that could potentially be instructive to the tower controller to verify that instructions given to eliminate a collision risk are actually followed. That bullet reads, "Aircraft receiving the control instructions," and falls under a heading titled "Visual Elements."

The implication is that a controller should observe aircraft receiving instructions for compliance. There appears to have been no further instruction emphasizing the need to visually ensure a collision risk is mitigated or eliminated before leaving that task. In brief, training on the importance of visual observation appears to have been quite limited.

iii. Lack of Training on New Radar

Although Serco surely informs its controllers that they are required to use radar in its normal operations, pursuant to the LOA, Serco apparently does not provide radar training as part of its formal training program. *See* SERCO, Training Program, Section 1-07.

The ATC Group Factual Report documents that the Controller-in-Charge at the time of the accident, the controller actually controlling both the Sabreliner and Cessna 85U, failed to receive any training on the STARS or FUSION radar system, and had completed only 30 percent of the STARS computer-based instruction module before the accident.

Within the training materials previously mentioned, there appear to be few materials instructing Serco controllers about how to use the radar systems at their disposal. On one slide under the heading of "Visual Elements," there is a bullet which reads "CTRD/ASDE." Implying that radar displays can in some sense contribute to better visual observation or situational awareness.

The ATC Group Factual Report documents guidance from FAA JO 7110.65, Air Traffic Control, paragraph 3-1-9(b), "Use of Tower Radar Displays." The pertinent provisions include that "Local controllers *may* use certified tower radar displays for the following purposes . . . ." (emphasis added) Those purposes include, "To determine an aircraft's identification, exact location, or spatial relationship to other aircraft." In the following note, however, the instructions provide, ". . . local controllers at non-approach control towers *must* devote the majority of their time to visually scanning the runways and local area; an assurance of continued positive radar identification could place distracting and operationally inefficient requirements upon the controller." (emphasis added)

The Tower controller revealed after the accident that the radar system was so unreliable that he did not use the STARS or FUSION systems. It is clear from the accident sequence that not only did the tower controller not overly rely on the radar system, he did not use it even for the basic purpose of determining an aircraft's proper identification when providing instruction to an aircraft or use it to maintain better situational awareness. In none of the Serco training materials are expectations set out any more precisely.

iv. OJT Training Standards and Conditions Issued by Serco

Serco guidance materials appear to approve of a single controller being allowed, under light traffic conditions, to be in charge of all positions in the tower *and* provide instructional training to a developmental controller.

The ATC Group Factual Report documents the guidance for certain combined controller duties. The Report provides that guidance consolidating positions at SDM ATC were defined in the Serco standard operating procedure, Training Program, Appendix 4, "Training on Consolidated Positions," paragraph B, which stated in part:

> B. Local control, ground control, and flight data positions are combined during various situations. Training may be conducted on consolidated positions at local control, only during *light* traffic, at the discretion of the on the job-training

instructor (OJTI). The OJTI will take into consideration the developmental's progress in training prior to making this decision. (Emphasis added.)

Read literally, this instruction provided almost unfettered discretion to a controller to determine under what conditions in the pattern he or she could continue to instruct a developmental controller. This may have been unwise considering the additional burdens that instruction places on the Controller-in-Charge.

v. Maximum Pattern Saturation

There appears to be no definition of what light traffic might be under the preceding guidance, and certainly the controller's response to questioning following the accident seemed to indicate he was guided only by his rough sense of his own capabilities when determining how long to continue instructing during the pattern operations. This appears to have contributed to the Controller-in-Charge allowing the pattern situation with the developmental controller to deteriorate too far before intervening.

Regardless, it appears that the Controller-in-Charge continued the developmental controller's training under the Controller-in-Charge's sole oversight even after, by the Controller-in-Charge's own admission, the pattern had become at least moderately busy ("He recalled that Mr. Price had not moved either airplane [N1285U or N6ZP] over to runway 26L and thought that the situation was getting interesting. At that point, Mr. Hill described the traffic volume and complexity as 'moderate'.")

vi. Maximum Age of Controllers

BAE Systems noted during the course of the accident investigation that the FAA imposes a mandatory retirement age for controllers actually controlling aircraft. That age limit is 56 years of age.

The Controller-in-Charge was apparently retired from the Federal Aviation Administration and over the age of 56. BAE Systems can find no specific policy guidance or regulations that addresses the age limit for contract controllers, but the practice observed here would appear to be inconsistent with the FAA's own mandatory age limits.

vii. Medical Condition of Controller

BAE Systems found insufficient documentation in the record to determine whether there were health or medication issues that might place in question the issuance of the Controller-in-Charge's medical certificate.

IV. CONCLUSIONS

A. Proposed Findings

1. The flight crew of the Sabreliner were qualified to operate the airplane, and the use of alcohol or drugs, fatigue, and medical conditions were not factors in the flight crew's performance.

2. The Sabreliner was airworthy in all respects.

3. The flight crew of the Sabreliner were familiar with the VFR pattern at San Diego Brown Field Municipal Airport.

4. The flight crew of the Sabreliner were actively clearing for conflicting aircraft, but did not see Cessna 85U prior to impact, likely because the aircraft was obscured among the cluttered background of surface features on the terrain below and were not otherwise alerted to Cessna 85U's presence.

5. The pilot of Cessna 85U did not observe the Sabreliner prior to impact likely because he did not recognize the significance of pattern entry and downwind radio calls from and to the Sabreliner or the Brown Field Tower controller's radio instructions to the Sabreliner to turn base and land, and because the Cessna's left wing and wing strut likely obscured his line of sight.

6. The Brown Field Tower controller controlling both accident aircraft at the time of the accident observed a mid-air collision hazard developing between the accident aircraft.

7. The Brown Field Tower controller mistakenly provided separation instructions to the wrong aircraft (another Cessna that had just departed the pattern, Cessna N6ZP) before directing the Sabreliner to begin its turn from downwind to base leg and clearing the Sabreliner to land.

8. Because the Brown Field Tower controller used the wrong call sign for Cessna 85U, he failed to direct Cessna 85U to perform a 360 degree maneuver to downwind, and thus failed to achieve separation between Cessna 85U and the Sabreliner, as intended, before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

9. The Brown Field Tower controller failed to visually observe if Cessna 85U, located on the "inside" downwind, executed the 360 degree maneuver the controller intended Cessna 85U to execute before directing the Sabreliner to turn from downwind to base leg and clearing the Sabreliner to land.

10. The Brown Field Tower controller assumed the duty to provide separation and responsibility to direct the aircraft in a competent and safe manner.

11. The Brown Field Tower controller unsuccessfully attempted to provide separation between the Sabreliner and Cessna 85U and subsequently directed the Sabreliner to turn base leg and cleared it to land, thus turning the Sabreliner directly into Cessna 85U.

12. The Brown Field Tower controller directed the Sabreliner to turn base leg and cleared the Sabreliner to land.

13. The Brown Field Tower controller's instructions to the Sabreliner placed the Sabreliner on a collision course with Cessna 85U.

14. The Brown Field Tower controller did not issue an immediate safety alert or directions to the Sabreliner that might have avoided the accident in the final seconds of the sequence, nor did he issue any traffic alerts.

15. The public aircraft mission of the Sabreliner did not contribute to the accident.

B. Proposed Probable Cause

[redacted] probable cause of this accident was the Brown Field Tower controller's ineffective efforts to resolve a collision hazard between the Sabreliner and Cessna 85U, because the controller (1) used the incorrect call sign for Cessna 85U when attempting to resolve a developing collision hazard between the Sabreliner and Cessna 85U; (2) failed to observe whether the separation maneuver the controller intended for Cessna 85U was actually accomplished by Cessna 85U; and (3) failed to ensure the conflict was resolved before instructing the Sabreliner to turn base and clearing the Sabreliner to land, thereby placing the Sabreliner on a direct collision course with Cessna 85U.

C. Proposed Recommendations

To Serco

1. Set clear training policies that ensure an on-the-job training instructor is not the sole qualified controller in the Tower when giving training to a developmental controller during even moderately busy traffic periods.

2. Revamp controller training to address position selection within the tower to maximize visibility of aircraft being controlled.

3. Revamp controller training to emphasize visual observation of aircraft in the pattern when directing such aircraft in the VFR pattern, and emphasize the use of safety alerts for collision avoidance.

4. Revamp controller training on the use of tower radar.

To the FAA

1. Revisit the flow-down of FAA regulations to contractor-operated towers, including the use of controllers in contractor-operated towers who exceed the FAA mandatory retirement age of 56.

2. Revisit procedures to ensure proper oversight and training of controllers in contractor-operated towers.

ABBREVIATIONS & ACRONYMS

AGL	Above Ground Level
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
CTRD	Certified Tower Radar Display
FDR	Flight Data Recorder
IFR	Instrument Flight Rules
ISO/AS	International Organization for Standardization/Aviation, Space and Defense
LOA	Letter of Agreement
MSL	Mean Sea Level
OJTI	On-the-Job Training Instructor
PIC	Pilot-in-Command
SDM	San Diego Brown Field Municipal Airport
SIC	Second-in-Command
STARS	Standard Terminal Automation Replacement System (also, Standard Terminal Arrival Routes)
TIJ	Tijuana International Airport, Mexico
TRACON	Terminal Radar Approach Control
UAS	Unmanned Aircraft Systems
VFR	Visual Flight Rules