



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

June 13, 2022

### **Group Chairman's Factual Report**

# **OPERATIONAL FACTORS**

WPR21FA286

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## **A. ACCIDENT**

Location: Truckee, California

Date: July 26, 2021

Time: 1318 Pacific daylight time<sup>1</sup>  
2018 UTC

Airplane: Bombardier Inc. CL-600-2B16, N605TR

## **B. OPERATIONAL FACTORS GROUP**

|                |                                                                                 |
|----------------|---------------------------------------------------------------------------------|
| Group Chairman | David Lawrence<br>National Transportation Safety Board (NTSB)<br>Washington, DC |
|----------------|---------------------------------------------------------------------------------|

|              |                                                                        |
|--------------|------------------------------------------------------------------------|
| Group Member | Todd Gentry<br>Federal Aviation Administration (FAA)<br>Washington, DC |
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<sup>1</sup> All times for this Factual Report will be Pacific daylight time (PDT) unless otherwise noted.

Group Member                      Etienne Côté  
Bombardier Aviation  
Dorval, Canada

## **C. SUMMARY**

On July 26, 2021, about 1318 Pacific daylight time, a Bombardier Inc., CL-600-2B16<sup>2</sup> airplane, N605TR, was destroyed when it was involved in an accident near Truckee, California. The pilot, co-pilot and 4 passengers were fatally injured. The airplane was operated as a Title *14 Code of Federal Regulations (CFR)* Part 91 personal flight.

## **D. DETAILS OF THE INVESTIGATION**

The Operations (Ops) Group Chairman did not launch for this accident. At the request of the NTSB Investigator-in-Charge (IIC), data from the FAA and operator was collected on the pilots and accident airplane.

On August 16, 2021, the Ops Group Chairman traveled to Washington, DC to audition the Cockpit Voice Recorder (CVR) for this accident.

Between August 30, 2021 and September 2, 2021, the Ops Group participated in interviews of Aeolis Air Charter, Inc. management personnel and pilots in Van Nuys, California.

Between September 23-24, 2021 conducted interviews of the co-pilot's CAE simulator instructors and conducted simulator observation work in Dallas, Texas.

On October 8, 2021 conducted telephone interviews of the captain's most recent FlightSafety instructors.

## **E. FACTUAL INFORMATION**

### **1.0 History of Flight**

The accident flight was the first flight of the day for the captain, co-pilot and four passengers.<sup>3</sup> It was scheduled for a one hour and 32-minute flight from Coeur d'Alene

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<sup>2</sup> The "Challenger 605" name is a marketing designation that is applicable to the Model CL-600-2B16, Aircraft serial No. 5701 to 6049. The designation "CL-605" and "Challenger 605" will be used interchangeably in this Factual Report to describe the CL-600-2B16 airplane.

<sup>3</sup> Source: July 27, 2021 FAA Aviation Safety memo from the Division Manager of AFG-200 to the director of AFG-1. The flight release provided by Aeolus Air Charter, Inc. indicated two (2) passengers were planned to be onboard the airplane. See Attachment 3 - Flight Release Information.

Airport - Pappy Boyington Field (COE), Coeur d'Alene, Idaho to Truckee-Tahoe Airport (TRK), Truckee, California. According to security camera footage from the StanCraft Jet Center Fixed Base Operator (FBO) at COE, the captain arrived at the FBO reception desk about 1016 carrying a cell phone and a personal electronic device (PED).<sup>4</sup> After making several phone calls and signing the fuel slip, the captain left the reception desk and walked out of the FBO about 1020. The co-pilot was observed at the FBO reception desk between 1117 and 1120 before exiting the FBO and walking to the accident airplane .

The four passengers and two dogs were seen arriving by car to the airplane about 1121 and baggage was loaded onto the airplane. The four passengers and two dogs were then seen in the FBO lobby between 1124 and 1129. The captain was seen meeting the passengers at 1127, and then exiting the FBO about a minute later. The four passengers and two dogs were then observed leaving the FBO and entering the airplane about 1130. The airplane door was seen closing about 1131, and the airplane began taxiing about 1137.

According to automatic dependent surveillance-broadcast (ADS-B)<sup>5</sup> data and air traffic control (ATC) audio from the FAA, the airplane departed COE about 1145 and made a left turn to the south. According to recorded data, the captain was the pilot flying (PF) and the co-pilot was the pilot monitoring (PM) on the accident flight. There were no issues noted in the initial departure and climb. According to ADS-B data, the airplane leveled off at a barometric altitude of 37,000 feet above mean sea level (msl) about 1203.

About 1238 ATC cleared the airplane direct to the Truckee airport. TRK reported the following METAR at 1245:

METAR KTRK 261945Z AUTO 09005KT 04SM BKN023 32/06 A3014 FU RMK VIS 3 1/2/V5 FU BKN023<sup>6</sup>

As the airplane was passing over northwestern Nevada, ATC began issuing descent instructions for the airplane's approach into TRK.<sup>7</sup> About 1255, the flight crew requested and was cleared direct to the ALANT waypoint.<sup>8</sup>

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<sup>4</sup> Event times depicted on the security video were about 3 minutes earlier than similar event times noted on the Flight Data Recorder (FDR). Event times from the FBO security video have been adjusted in this Factual Report to approximate the FDR times.

<sup>5</sup> Automatic Dependent Surveillance-Broadcast (ADS-B) is an advanced surveillance technology that combines an aircraft's positioning source, aircraft avionics, and a ground infrastructure to create an accurate surveillance interface between aircraft and ATC.

<sup>6</sup> The "FU" designation in the METAR refers to smoke. For detailed weather information for this accident, see the Meteorology Group Chairman's Factual Report in the Docket for this investigation.

<sup>7</sup> TRK was listed on the airport chart as 5,904 ft above msl. See Section 8.2 TRK Airport Chart.

<sup>8</sup> The ALANT waypoint was an initial approach fix (IAF) for the RNAV (GPS) runway 11 approach at TRK. An IAF is a fix that marks the beginning of the initial segment and the end of the arrival segment, if

About 1258 ATC advised the flight crew to expect the RNAV (GPS) Runway 20 approach<sup>9</sup> at TRK and cleared the airplane direct to the AWEGA waypoint.<sup>10</sup> About 1300 the flight crew responded to ATC that runway 20 would be too short to land on and requested a circle-to-land on runway 11.<sup>11</sup> After coordinating with the TRK tower, about 1302 the controller informed the flight crew that they would be number two for TRK and could expect some delays.

About 1305 ATC cleared the airplane to hold north of the ALVAA waypoint,<sup>12</sup> and about 1311 the flight crew reported established in the holding pattern. Shortly afterwards, ATC cleared the airplane to fly direct to the AWEGA waypoint, and then cleared them for the RNAV approach to runway 20 at TRK.

About 1314 the flight crew established contact with the TRK tower controller as they passed over the LUMMO waypoint.<sup>13</sup> The tower controller offered the flight crew the option of crossing over the field to enter the left downwind leg for runway 29 or to enter a downwind leg for runway 11. At 1314:42 when the airplane was at 9,925 feet, the CVR recording captured the co-pilot making a comment about a path capture.<sup>14</sup> At 1315:05 the co-pilot made a comment suggesting gear down and flaps 30° when the airplane was at 9,276 feet.

FDR data indicated the flap lever position at 45° (full flaps) at 1316:21 when the airplane was descending through 7,350 feet above msl and crossing the YAKYU waypoint.<sup>15</sup> About 1316:28 the flight crew advised the tower controller that they were

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applicable. For additional information, see Section 8.4 TRK RNAV (GPS) Runway 11 Approach Chart of this Factual Report.

<sup>9</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), area navigation (RNAV) allows a pilot to fly a selected course to a predetermined point without the need to overfly ground-based navigation facilities, by using waypoints.

<sup>10</sup> The AWEGA waypoint was an intermediate fix (IF) for the RNAV (GPS) runway 20 approach at TRK. It was located about 18 miles to the north of TRK on the approach to runway 20. An IF is a fix that marks the end of an initial segment and the beginning of the intermediate segment. For additional information, see Section 8.3 TRK RNAV (GPS) Runway 20 Approach Chart of this Factual Report.

<sup>11</sup> The terms "circle-to-land" and "circling" approaches are synonymous and used interchangeably in this Factual Report. For more information, see Section 9.0 Circling Approach in this Factual Report.

<sup>12</sup> The ALVAA waypoint was an IAF for the RNAV (GPS) runway 20 approach at TRK.

<sup>13</sup> The LUMMO waypoint was the final approach fix (FAF) for the RNAV (GPS) runway 20 approach at TRK and located 9.6 miles from the end of runway 20. The FAF was a fix from which the final approach (IFR) to an airport is executed and which identifies the beginning of the final approach segment. It is designated in the profile view of Jeppesen Terminal charts by the Maltese Cross symbol for non-precision approaches and by the glide slope/path intercept point on precision approaches.

<sup>14</sup> NTSB-approved paraphrased comments from the CVR were provided to the Parties to this investigation. For additional paraphrased comments, see Performance Study in the Docket for this investigation. For a detailed transcription of the CVR, see the Cockpit Voice Recorder Group Chairman's Factual Report in the Docket for this investigation.

<sup>15</sup> The minimum descent altitude (MDA) for the RNAV (GPS) runway 20 approach (Category C) was 7,700 feet above msl. YAKYU waypoint was about 3.4 miles from the end of runway 20. See Section 9.1 Circling

making a right turn and had runway 11 in sight. ADS-B data indicated the airplane began maneuvering to the runway at an altitude of about 7,200 feet.

The tower controller cleared the airplane to land on runway 11 about 1316 and advised that the winds were calm. The flight crew acknowledged the clearance, which was their final radio communication. The FDR recorded that the autopilot disconnected at 1316:51 and the auto throttles disconnected at 1317:03.

According to the tower controller's interview, she did not have visual contact with the airplane when the flight crew advised they were making the right turn to enter the left downwind for runway 11. When she visually acquired the airplane on its the downwind leg, she said "it appeared to be a little tight for something as big as him." When the airplane was turning a left base leg, she said the airplane appeared "close" and "can he get stable out of that?"<sup>16</sup>

At 1317:48 the CVR recording captured the co-pilot making a comment about control of the airplane to the captain when the airplane was at an altitude of 6,780 feet above msl. At 1318:01 the FDR recorded the spoilers being deployed when the airplane was at an indicated altitude of about 6,400 feet (about 500 feet above the airport field elevation of 5,904 feet above msl).<sup>17</sup> The spoilers remained deployed for the remainder of the flight. The CVR recording captured the co-pilot making a comment about altitude at 1318:03.

At 1318:06 the FDR recorded the simultaneous activation of the stick shaker and the Ground Proximity Warning System (GPWS) "Pull Up" warning.<sup>18</sup> The FDR recorded the stick pusher activating about a second later. About 2 seconds later the CVR recording captured the co-pilot making a comment about control prior to the impact at 1318:13. The TRK tower controller and ground controller both observed the airplane drop below the tree line and the ensuing post-crash fire. The two pilots, four passengers and two dogs were fatally injured.

## **2.0 Flight Crew Information**

The accident flight crew consisted of the captain and co-pilot.

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Approach Minimums in this Factual Report. For the normal Bombardier CL-605 Circle Approach profile, see Section 11.2.1 Circle Approach in this Factual Report. For additional FDR information, see the Flight Data Recorder Specialist Report in the Docket for this investigation.

<sup>16</sup> For additional information, see the Air Traffic Control Group Chairman's Factual Report in the Docket for this investigation.

<sup>17</sup> See Section 8.2 TRK Airport Chart in this Factual Report and Performance Study in the Docket for this investigation. For operational limitations on spoiler use for the CL-605, see Section 4.2.3 Flight Controls of this Factual Report.

<sup>18</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), the GPWS is a system designed to determine an aircraft's clearance above the Earth and provides limited predictability about aircraft position relative to rising terrain.

## 2.1 The Captain

The captain was 43 years old and resided in Mexico City, Mexico. According to interviews, he was not an employee of Aeolus Air Charter, Inc. at the time of the accident and was operating the accident flight as a contract pilot under Part 91. The captain had applied to the company online and was interviewed via Zoom by the Aeolus Air Charter, Inc. chief executive officer (CEO) and director of operations (DO). According to the DO, the company was in the process of hiring the captain at the time of the accident but "because of him being of Mexico - - or didn't have a visa or a Social Security Number we could not hire him" and "could only contract him."<sup>19</sup> The DO further stated that a Pilot Records Improvement Act of 1996 (PRIA)<sup>20</sup> background check had been done for the captain.<sup>21</sup> According to the Aeolus Air Charter, Inc. CEO, the company hired the captain as a "contractor under 135 because we had trained him" and "we didn't want to lose the investment."<sup>22</sup>

The captain's resume stated that he held a "USA Visa" with an expiration date of February 6, 2028.<sup>23</sup> The NTSB contacted the Federal Bureau of Investigation (FBI), who received a response from the Customs Border Patrol (CBP) that the captain possessed a B1/B2 United States (U.S.) visitor's visa which would not permit operating a flight for compensation in the U.S.<sup>24</sup>

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<sup>19</sup> On July 14, 2021 the captain was enrolled online for basic indoctrination training at Aeolis Air Charter, Inc. The captain had signed an employment contract with Aeolis Air Charter on June 25, 2021. On July 26, 2021 the captain was added to the Aeolis Air Charter insurance policy with Aviation Specialty Insurance.

<sup>20</sup> The "Pilot Records Improvement Act of 1996" (PRIA), as amended, was enacted to ensure that air carriers and air operators adequately investigate a pilot's background before allowing that pilot to conduct commercial air carrier flights. Under PRIA, a hiring employer cannot place a pilot into service until the employer obtains and reviews the last 5 years of the pilot's background and other safety-related records, as specified in PRIA. PRIA required that a hiring air carrier under 14 *CFR* Parts 121 and 135, or a hiring air operator under 14 *CFR* Part 125, request, receive, and evaluate certain information concerning a pilot/applicant's training, experience, qualification, and safety background, before allowing that individual to begin service as a pilot with their company. The Pilot Records Database (PRD) was used to facilitate the sharing of pilot records among air carriers in a clearinghouse managed by the FAA. All Part 119 certificate holders and fractional ownerships can register to access the PRD and evaluate the available FAA data for each individual pilot candidate prior to making a hiring decision. Air carriers must begin using the PRD for FAA record evaluations no later than Dec. 7, 2021, and for all other records no later than June 10, 2022. Guidance for compliance with PRIA and PRD was in FAA Advisory Circular (AC) 120-68J Pilot Records Improvement Act and the Pilot Records Database, dated June 28, 2021.

<sup>21</sup> Aeolus Air Charter, Inc. did not provide the investigation documentation related to a PRIA background check on the captain. Aeolus Air Charter, Inc. provided the NTSB a copy of the captain's FAA certification information via an online search that was dated August 11, 2021. See Attachment 10 - Captain Information.

<sup>22</sup> See Attachment 1 - Interview Transcripts.

<sup>23</sup> See Attachment 10 - Captain Information.

<sup>24</sup> Source: Email from the FBI to the NTSB dated November 22, 2021.

According to his resume, the captain was previously employed on a 4-month contract flying in the Middle East with Starship One, LLC flying a Challenger 601-3R from October 2020 to February 2021. In September 2020 he flew a CL-601 on contract in Egypt for Armer Group. During 2019 and 2020 he flew a CL-605 for SF Consulting LLC. Between 2014 and 2018 he flew a G-200 Gulfstream in Mexico for Aerolineas Marcos SA de CV. Between 2010 and 2014 he flew a CL-601 in Mexico for Aero Util SA de CV. Between 2005 and 2009 he flew a Boeing 737 as second-in-command (SIC) for Lineas Aereas Azteca and between 2000-2005 he flew a Beechjet 400A in Mexico for Aerolineas Ejecutivas.

The captain's most recent proficiency training occurred between July 12, 2021 and July 16, 2021, when he attended Challenger 605 Part 135 training at FlightSafety in Wilmington, Delaware.<sup>25</sup> FlightSafety instructor comments for the July 13, 2021 simulator session included the captain had good situational awareness but would rush abnormal checklists and needed to slow down and read the checklist requirements. Instructor comments for the July 14, 2021 simulator session included the captain had a good V1 cut but would rush a check list.<sup>26</sup> Instructor comments for the July 15, 2021 simulator session included the captain had good overall situational awareness but needed to set up approach procedures without PM prompts. He received 13 hours of ground training and 12 hours of simulator training (6 hours as PF and 6 hours as pilot-not-flying (PNF)). On July 16, 2021 he was graded satisfactory for pilot competency per 14 *CFR* Part 135.293(a)(2-3) and 135.293(b) and instrument proficiency per 14 *CFR* 135.297. According to FlightSafety records, his check ride on July 16, 2021 included a nonprecision approach,<sup>27</sup> stall prevention, and a go-around/rejected landing.<sup>28</sup>

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<sup>25</sup> Aeolus Air Charter, Inc. paid for the captain's training. According to the FlightSafety training records, the captain's training included Crew Resource Management (CRM) training. According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), CRM was the application of team management concepts in the flight deck environment. It was initially known as cockpit resource management, but as CRM programs evolved to include cabin crews, maintenance personnel, and others, the phrase "crew resource management" was adopted. This includes single pilots, as in most general aviation aircraft. Pilots of small aircraft, as well as crews of larger aircraft, must make effective use of all available resources; human resources, hardware, and information. A current definition includes all groups routinely working with the flight crew who are involved in decisions required to operate a flight safely. These groups include, but are not limited to pilots, dispatchers, cabin crewmembers, maintenance personnel, and air traffic controllers. CRM is one way of addressing the challenge of optimizing the human/machine interface and accompanying interpersonal activities.

<sup>26</sup> According to 14 *CFR* Part 1, V1 means the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance. V1 also means the minimum speed in the takeoff, following a failure of the critical engine at VEF, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.

<sup>27</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), a nonprecision approach was a standard instrument approach procedure in which only horizontal guidance is provided.

<sup>28</sup> FlightSafety records also indicated that the captain was trained on circle-to-land approaches.

Between July 6, 2021 and July 10, 2021 the captain attended Challenger 601 (CL-601) Part 142 Recurrent training at CAE. He received 16 hours of ground training and 10.2 hours of simulator training (8.0 hours as PF and 2.2 hours as PNF). The simulator training included 3 nonprecision approaches and 1 circle-to-land approach. On July 10, 2021 he was graded Pilot-in-Command (PIC) proficient in the CL-601 per 14 *CFR* 61.58<sup>29</sup> and instrument current per 14 *CFR* 61.57(d).

Between June 8, 2020 through June 10, 2020, he attended FlightSafety's Challenger 600 series (CL-600) Part 61.58 Recurrent PIC Course in Houston, Texas for SF Consulting, LLC. He received 15.5 hours of ground training and 12 hours of simulator training (6 hours as PF and 6 hours as PNF). On June 10, 2020, he was graded satisfactory for a 14 *CFR* 61.58 check ride.

The captain had previously attended FlightSafety's CL-605 Part 61.58 Recurrent PIC Course between March 2, 2020 through March 5, 2020 in Wilmington, Delaware while employed with SF Consulting, LLC. Instructor comments for the March 2, 2020 simulator session included the captain had a good attitude and decent flying skills, but needed to improve PM duties, altitude calls on approach, running checklists and unusual attitude recoveries. He received 13 hours of ground training, and 12 hours of simulator training (6 hours as PF and 6 hours of PNF). On March 5, 2020, he was graded satisfactory for a 14 *CFR* 61.58 check ride.

Between July 25, 2019 through August 13, 2019, he attended FlightSafety's CL-605 Part 61.157 Initial Course for SF Consulting, LLC. He received 80 hours of ground training and 24 hours of simulator training (12 hours a PF and 12 hours as PNF). He successfully passed his Challenger CL-605 type rating check ride on August 13, 2019.

A review of the FAA Program Tracking and Reporting Subsystem (PTRS),<sup>30</sup> Accident/Incident Data System (AIDS) and Enforcement Information System (EIS) showed no records or reports of any previous aviation accidents or incidents involving the captain.<sup>31</sup>

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<sup>29</sup> Title 14 *CFR* 61.58 Pilot-in-command proficiency check: Operation of an aircraft that requires more than one pilot flight crewmember or is turbojet-powered.

<sup>30</sup> The Program Tracking and Reporting Subsystem (PTRS) is a comprehensive information management and analysis system used in many Flight Standards Service (AFS) job functions. It provides the means for the collection, storage, retrieval, and analysis of data resulting from the many different job functions performed by Aviation Safety Inspectors (ASIs) in the field, the regions, and headquarters. This system provides FAA managers and inspectors with the current data on airmen, air agencies, air operators, and many other facets of the air transportation system. Source: FAA.

<sup>31</sup> Source: FAA Safety Performance Analysis System (SPAS) Investigation Package.

### **2.1.1 The Captain's Pilot Certification Record<sup>32</sup>**

Private Pilot – Airplane Single Engine Land certificate issued February 20, 1998.<sup>33</sup>

Private Pilot – Airplane Multiengine Land, CL-600 (VFR<sup>34</sup> Only), Limitations: English Proficient certificate issued January 15, 2010.<sup>35</sup>

Airline Transport Pilot – Airplane Multiengine Land, CL-600, Limitations: English Proficient certificate issued January 31, 2012.<sup>36</sup>

Airline Transport Pilot – Airplane Multiengine Land, CL-600, G-200, Limitations: English Proficient certificate issued June 14, 2014.<sup>37</sup>

Airline Transport Pilot – Airplane Multiengine Land, CL-600, G-200, LR-60, Limitations: English Proficient certificate issued July 22, 2019.<sup>38</sup>

Airline Transport Pilot – Airplane Multiengine Land, CL-600, CL-604,<sup>39</sup> G-200, LR-60, Limitations: English Proficient certificate issued August 13, 2019.<sup>40</sup>

### **2.1.2 The Captain's Certificates and Ratings Held at Time of the Accident**

Airline Transport Pilot (certificate issued August 2019)  
Airplane Multiengine Land CL-600, CL-604, G-200, LR-60 type ratings

Medical Certificate First Class (certificate issued June 2, 2021)  
Limitations: None

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<sup>32</sup> Source: FAA.

<sup>33</sup> Certificate was issued on the basis of and valid only when accompanied by Mexico Pilot license No. 650-051. All limitations and restrictions of the Mexico license applied.

<sup>34</sup> Visual Flight Rules.

<sup>35</sup> Certificate was issued on the basis of and valid only when accompanied by Mexico Pilot license No. 650-051. All limitations and restrictions of the Mexico license applied.

<sup>36</sup> According to the FAA Form 8710-1 dated January 31, 2012, the captain completed the CAE Simuflite 14 *CFR* Part 142 CL-601 Upgrade training course at Dallas Ft. Worth International Airport (DFW). At the time of the check ride, the captain held a Mexican ATP Pilot's license.

<sup>37</sup> According to the FAA Form 8710-1 dated June 14, 2014, the captain completed the CAE Simuflite 14 *CFR* Part 142 Initial G-200 training course at Whippany, New Jersey.

<sup>38</sup> According to the FAA Form 8710-1 dated July 22, 2019, the captain completed the FlightSafety International LR-60 type rating course at Wichita, Kansas.

<sup>39</sup> According to the FAA Flight Standardization Board Report (dated May 25, 2012), the pilot type rating for the CL-604 and CL-605 has been established as "CL-604". The Canadair/Bombardier CL-604 and Bombardier CL-605 shares the same Type Certificate Data Sheet (A21EA).

<sup>40</sup> According to FlightSafety records, the captain attended the CL-605 Part 61.157 Initial Course between July 25, 2019 and August 13, 2019 at Wichita, Kansas.

### 2.1.3 The Captain's Training and Proficiency Checks Completed

|                                          |                             |
|------------------------------------------|-----------------------------|
| Aeolus Air Charter Date of Hire          | N/A                         |
| Date of Initial Challenger Type Rating   | August 13, 2019             |
| Date of Most Recent Proficiency Training | July 15, 2021 <sup>41</sup> |
| Date of Most Recent Proficiency Check    | July 16, 2021 <sup>42</sup> |

### 2.1.4 The Captain's Flight Times<sup>43</sup>

|                                   |                     |
|-----------------------------------|---------------------|
| Total pilot flying time           | 5,685 <sup>44</sup> |
| Total Pilot-In-Command (PIC) time | 3,080               |
| Total Challenger flying time      | 235                 |
| Total flying time last 24 hours   | 1.5                 |
| Total flying time last 30 days    | 3.5 <sup>45</sup>   |
| Total flying time last 90 days    | 12.3                |

## 2.2 The Co-pilot

The co-pilot was 56 years old and resided in Lakeville, Minnesota. He began flying on February 3, 1988 at Santa Monica Municipal Airport (SMO) in Santa Monica, California. According to interviews, he was not an employee of Aeolus Air Charter, Inc. at the time of the accident and was operating the accident flight as a contract pilot. According to his resume he had been a contract pilot through his personal company TorqueRoll, LLC since January 2013. According to the Aeolus Air Charter, Inc. CEO, their initial hiring process for the co-pilot as a contract pilot consisted of speaking to the co-pilot on the phone, reviewing his pilot certificate and medical, and doing a Google-search on the co-pilot. The company did not do a PRIA background check on the co-pilot because, according to the CEO, "we typically don't [do] PRIA checks on 91 contractors."<sup>46</sup>

Between October 2009 and December 2012, the co-pilot was the chief pilot for start-up carrier California Pacific Airlines in Carlsbad, California.<sup>47</sup> He received a type

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<sup>41</sup> According to interviews and FlightSafety records, Aeolis Air Charter, Inc. paid for the captain's CL-605 Part 135 recurrent training at Wilmington, Delaware between July 13, 2021 and July 16, 2021.

<sup>42</sup> The proficiency check was for PIC and SIC per 14 *CFR* Part 135.293(a)(2-3) and 135.293(b), and instrument proficiency per 14 *CFR* 135.297. See Attachment 12 - Captain's Training Record.

<sup>43</sup> Flight times derived from a review of the captain's logbooks provided to the NTSB and information contained in the NTSB Form 6120.1 completed by Aeolis Air Charter, Inc. Flight times include the accident flight.

<sup>44</sup> Flight time is based on pilot logbook entries, company records, and FAA information. See Attachment 11 - Captain's Logbook (Excerpts).

<sup>45</sup> Prior to July 21, 2021, the last flight the captain operated was a 2.6-hour flight in a CL-601 on May 24, 2021.

<sup>46</sup> See Attachment 1 - Interview Transcripts. PRIA background checks were not required for Part 91 operations.

<sup>47</sup> On the co-pilot's June 1, 2012, September 13 2011 and June 3, 2010 FAA 8500-8 Medical Application forms, he listed California Pacific Airlines as his employer. California Pacific Airlines suspended all

rating for the E-170 on November 18, 2011.<sup>48</sup> Between May 2008 and February 2009 he stated on his resume that he was a training instructor and examiner for Bombardier on the CL-65 in Montevideo, Uruguay. Between January 2008 and May 2008 he flew the B-757 for EOS Airline based in New York, New York.<sup>49</sup>

Between February 1997 and December 2007, he flew the DO-328 and CL-65 for PSA Airlines (USAirways Express) based in Vandalia, Ohio.

The co-pilot placed second in the Sportsman category at the 1993 U.S. National Aerobatic Championships, flying a Pitts Aerobatic S2B/N846, and according to his resume stated he was an International Standard for Business Aircraft Operations (IS-BAO) Auditor trained in 2019.<sup>50</sup>

The co-pilot's most recent proficiency training occurred between June 14, 2021 and June 18, 2021 at CAE when he attended Challenger 604 Recurrent Training in Dallas, Texas. He received 15 hours of ground training and 8 hours of simulator training (4.0 hours as PF and 4.0 hours as PNF). His training included five nonprecision approaches and one circle-to-land approach. On July 18, 2021 he was graded proficient in the CL-604 per 14 *CFR* 61.58 and instrument current per 14 *CFR* 61.57(d).<sup>51</sup>

On May 27, 2021 the co-pilot paid for a single simulator session at CAE in Dallas, Texas in the CL-604. He flew the simulator for 1.5 hours, conducted 6 takeoffs and landings, and conducted 2 instrument landing system (ILS) approaches, 1 nonprecision approach, and no circle-to-land approaches. No proficiency check was accomplished for this single simulator session.

A review of the FAA PTRS, AIDS and EIS databases showed no records or reports of any previous aviation accidents or incidents involving the co-pilot.<sup>52</sup>

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California operations (except for their Essential Air Services) on December 28, 2018 and ceased all operations in January 2019. The airlines' air operating certificate was terminated in October 2020.

<sup>48</sup> According to the co-pilot's logbooks, he did not log any flight time in the E-170.

<sup>49</sup> According to the co-pilot's resume, he had completed initial operating experience (IOE) on the B-757 as a captain before EOS ceased operations. See Attachment 13 - Co-Pilot Information.

<sup>50</sup> The International Standard for Business Aircraft Operations (IS-BAO) was established by the International Business Aviation Council (IBAC) and its member associations, as a recommended code of best practices designed to help flight departments worldwide achieve high levels of safety and professionalism. IS-BAO is an industry standard built for operators, by operators that provides standards based on the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPS). Source: <https://nbaa.org/flight-department-administration/sms/is-bao/>.

<sup>51</sup> The co-pilot paid for the training through his personal company TorqueRoll LLC. See Attachment 14 - Co-Pilot Training Records. According to CAE training records, the co-pilot's training included CRM training.

<sup>52</sup> Source: FAA SPAS Investigation Package.

### **2.2.1 The Co-Pilot's Pilot Certification Record**

Notice of Disapproval - Private Pilot - Airplane Single Engine Land (oral) issued March 15, 1988. Areas of reexamination: Controlled airspace, airport traffic area, maintenance records.

Private Pilot - Airplane Single Engine Land certificate issued March 18, 1988.

Private Pilot - Airplane Single Engine Land, Instrument Airplane certificate issued May 10, 1988.

Commercial Pilot - Airplane Single Engine Land, Instrument Airplane, Private Privileges Airplane Single Engine Land certificate issued February 16, 1989.

Notice of Disapproval - Flight Instructor - Airplane Single Engine (First Failure) issued April 19, 1989. Areas of reexamination: Entire Practical Test.

Flight Instructor - Airplane Single Engine certificate issued May 30, 1989.

Commercial Pilot - Airplane Single and Multiengine Land, Instrument Airplane, certificate issued June 30, 1989.

Flight Instructor - Airplane Single Engine, Instrument Airplane certificate issued October 17, 1989.

Reissued: October 30, 1991; October 29, 1993; January 25, 2012;<sup>53</sup> January 15, 2014; January 16, 2014; January 27, 2018; January 7, 2020.

Notice of Disapproval - Airline Transport Pilot, Multiengine Land (DO-328) (first failure) issued April 1, 1999.

Areas of reexamination: Inflight maneuvers (stalls), instrument procedures (missed approach)

Airline Transport Pilot - Airplane Multiengine Land, DO-328, Commercial Privileges Airplane Single Engine Land certificate issued April 2, 1999.

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-65 (CL-65 Circle Approach - VMC<sup>54</sup> Only), Commercial Privileges Airplane Single Engine Land certificate issued January 12, 2004.

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-65 (CL-65 Circle Approach - VMC Only), B757/B767 (B757/767 Circle Approach - VMC Only),

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<sup>53</sup> On January 25, 2012, an FAA designated pilot examiner conducted a certified flight instructor (CFI) reinstatement flight check with the co-pilot.

<sup>54</sup> Visual Meteorological Conditions.

Commercial Privileges Airplane Single Engine Land certificate issued February 16, 2008.<sup>55</sup>

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-65, B757/B767 (B757/767 Circle Approach - VMC Only), Commercial Privileges Airplane Single Engine Land certificate issued July 25, 2008.<sup>56</sup>

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-65, B757/B767 (B757/767 Circle Approach - VMC Only), Commercial Privileges Airplane Single Engine Land, Glider, English Proficient certificate issued April 17, 2011.

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-65, B757/B767 (B757/767 Circle Approach - VMC Only), ERJ-170, ERJ-190, Commercial Privileges Airplane Single Engine Land, Glider, English Proficient certificate issued November 18, 2011.<sup>57</sup>

Airline Transport Pilot - Airplane Multiengine Land, DO-328, CL-604, CL-65, B757/B767 (B757/767 Circle Approach - VMC Only), ERJ-170, ERJ-190, Commercial Privileges Airplane Single Engine Land, Glider, English Proficient certificate issued June 22, 2013.<sup>58</sup>

Small Unmanned Aircraft System certificate issued August 5, 2019.

### **2.2.2 The Co-Pilot's Certificates and Ratings Held at Time of the Accident**

Airline Transport Pilot (certificate issued June 22, 2013)

Airplane Multiengine Land DO-328, CL-604, CL-65, B757/B767 (B757/767 Circle Approach - VMC Only), ERJ-170, ERJ-190 type ratings

Small Unmanned Aircraft System (certificate issued August 5, 2019).

Flight Instructor (certificate issued January 7, 2020)

Airplane Single Engine, Instrument Airplane

Medical Certificate - First Class medical (certificate issued January 27, 2021)

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<sup>55</sup> The co-pilot's FAA Form 8710-1, dated February 7, 2008, stated that he had completed EOS Airline's air carrier approved training program .

<sup>56</sup> The co-pilot had the CL-65 circling approach (VMC) restriction removed at the Bombardier Aerospace Training Center in Montreal, Canada.

<sup>57</sup> The co-pilot's FAA Form 8710-1, dated November 7, 2011, stated that he had completed ERJ-170/190 initial training at the USAirways Contract Training and Services in Charlotte, North Carolina.

<sup>58</sup> The co-pilot's FAA Form 8710-1, dated June 22, 2013, the co-pilot listed "Jet-A LLC" for the approved training program completed. The oral exam and practical test for the added CL-604 type rating occurred in Tucson, Arizona.

Limitations – Must wear corrective lenses, possess glasses for near/intermediate vision

### **2.2.3 The Co-Pilot's Training and Proficiency Checks Completed**

|                                          |                             |
|------------------------------------------|-----------------------------|
| Aeolus Air Charter Date of Hire          | N/A                         |
| Date of Initial Challenger Type Rating   | June 22, 2013               |
| Date of Most Recent Proficiency Training | June 17, 2021               |
| Date of Most Recent Proficiency Check    | June 18, 2021 <sup>59</sup> |

### **2.2.4 The Co-Pilot's Flight Times**

|                                     |                        |
|-------------------------------------|------------------------|
| Total pilot flying time             | 14,401.2 <sup>60</sup> |
| Total Pilot-In-Command (PIC) time   | 12,355.1               |
| Total Challenger series flying time | 4,500.0 (estimated)    |
| Total flying time last 24 hours     | 1.3                    |
| Total flying time last 30 days      | 26.2                   |
| Total flying time last 90 days      | 37.9                   |

## **2.3 Pilot Recent History**

### **2.3.1 Captain**

From July 11-16, 2021 the captain attended recurrent simulator training at FlightSafety in Wilmington, Delaware.

On July 20, 2021 he flew from Mexico City Airport (MMMX), Mexico City, Mexico to Los Angeles International Airport (LAX), Los Angeles, California on Aeromexico flight 644, departing MMMX at 1020 central daylight time (CDT) and arriving at LAX at 1215 PDT. He stayed at the Courtyard Los Angeles Sherman Oaks.

On July 21, 2021, the captain and an Aeolus Air Charter, Inc. co-pilot (not the accident co-pilot) departed VNY about 1227 PDT and arrived at TRM about 1313 PDT. The captain and a co-pilot employee of Aeolus Air Charter, Inc. were the only ones on the airplane.

They departed TRM about 1350 PDT with two passengers, and arrived Reno/Tahoe International (RNO) Airport, Reno, Nevada about 1457 PDT. They departed RNO about 1853 PDT and arrived COE about 2000 PDT.<sup>61</sup>

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<sup>59</sup> See Attachment 14 – Co-Pilot Training Records.

<sup>60</sup> Total, PIC and recent flight times are derived from the co-pilot's Jeppesen Style Flight Log and includes the accident flight from COE to TRK. See Attachment 15 – Co-Pilot's Logbook (Excerpts).

<sup>61</sup> See Attachment 5 – Flight Crew Itineraries.

The captain and the Aeolis Air Charter, Inc. co-pilot both checked into the Davenport Tower Hotel in downtown Spokane, Washington about 2219 on July 21, 2021.<sup>62</sup> According to hotel key card swipe information, the captain entered his hotel room about 2222, and exited about 2230.<sup>63</sup> Card swipe information showed the captain reentering his hotel room about 0246 on July 22, 2021. There was no exit information prior to his reentering his room about 1405. The last card swipe information was when the captain reentered his room about 2122.

On July 23, 2021 the captain left his hotel room about 0755. There were multiple entries/exits of the room during the day, and his last entry to the room was about 2045.

On July 24, 2021 he left his hotel room about 0743. There were multiple entry/exits to the room during the day, and his last entry to the room was about 1951.

On July 25, 2021 he left his room about 1226. There were multiple entry/exits to the room during the day, and his last entry to the room was about 2139.

On July 26, 2021, he left his room about 0648. According to hotel records, he checked out of the hotel about 0657.

On July 26, 2021 the captain was scheduled on an Aeromexico flight 649 from LAX to MMMX, departing at 2355 PDT and arriving MMMX at 0545 CDT.

### **2.3.2 Co-Pilot**

On June 8, 2021 he flew a CL-605 as a co-pilot from St Paul Downtown Airport Holman Field (STP), St Paul, Minnesota to Grand Junction Regional Airport (GJT) in Grand Junction, Colorado to STP for 4.1 hours of flight time. Between June 27, 2021 and July 8, 2021 he flew multiple trips in a CL-605. On June 27, 2021 he flew two "wingtip test flights" as co-pilot from Provo Municipal Airport (PVU) in Provo, Utah for 1.5 hours. The following day he flew as PIC from PVU to Wichita Dwight D Eisenhower National Airport (ICT), Wichita, Kansas for 1.7 hours. On June 30, 2021 he flew as PIC on a 0.4-hour test flight around ICT, and then flew from ICT to Centennial Airport (APA) in Denver, Colorado for 1.2 hours. On July 5, 2021 he flew as SIC from APA to Napa County Airport (APC), Napa, California for 2.5 hours. On July 7, 2021 he flew as PIC from APC to APA for 1.9 hours, and on July 8, 2021 he flew as SIC from APA to John

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<sup>62</sup> Spokane, Washington is located about 20 miles from COE. Hotel records indicate that the co-pilot who accompanied the captain to COE checked out of his hotel room on July 22, 2021 about 1235.

<sup>63</sup> According to the director of security at the Davenport Hotel, when a guest opens their door from inside the room, it is recorded in their system as an "Inside open". The Davenport Hotel systems records inside opens along with guest card key access from the outside of their room. Source: Email to the NTSB dated January 28, 2022.

Glenn Columbus International Airport (CMH) in Columbus, Ohio, then PIC from CMH to William P Hobby Airport (HOU), Houston, Texas for a total of 5.0 hours.

On July 15, 2021 he flew a CL-605 for Bank of America as PIC from STP to Charlotte/Douglas International Airport (CLT) in Charlotte, North Carolina to Battle Creek Executive Airport at Kellogg Field (BTL) in Battle Creek, Michigan to CLT to STP for a total of 6.8 hours. On July 23, 2021 he repositioned from Minneapolis-St Paul International/Wold-Chamberlain Airport (MSP) in Minneapolis, Minnesota to Eagle County Regional Airport (EGE) in Eagle, Colorado. On July 24, 2021, he flew as PIC on a CL-604 for Jet Aviation from EGE to Francis S Gabreski Airport (FOK) in Westhampton Beach, New York, then from FOK to Laurence G Hanscom Field Airport (BED) in Bedford, Massachusetts.

On July 25, 2021 the co-pilot flew commercially on Delta Air Lines between General Edward Lawrence Logan International Airport (BOS) in Boston, Massachusetts to Seattle-Tacoma International Airport (SEA) in Seattle, Washington to Spokane International Airport (GEG) in Spokane, Washington to position himself for the Aeolus Air Charter, Inc. flight the next day.

On July 25, 2021 the co-pilot checked into the Davenport Tower Hotel and entered his hotel room about 1618. According to card swipe information, he left his room about 1625. He reentered his room about 2056, and there were no other entries/exits recorded for that day.

There was no card swipe information attributed to the co-pilot on July 26, 2021 other than when housekeeping entered the room about 0933. Hotel records indicate that the co-pilot was checked out by the hotel at 1259.

Hotel invoice records indicate that the co-pilot ate breakfast at the Safari Bar and Grill at the Davenport Tower Hotel about 0653.

### **3.0 Medical and Pathological**

#### **3.1 Captain**

According to the captain's First Class medical exam dated July 2, 2021, no concerns were reported by the captain and no significant issues were identified by the Aviation Medical Examiner (AME). The captain had 14 prior exams from a 1998 First Class exam through a January 19, 2021 First Class exam. No concerns were reported by the captain and no significant issues were identified by previous AMEs.<sup>64</sup>

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<sup>64</sup> Source: FAA.

On July 8, 2021 the captain took a pre-employment drug screening for Aeolus Air Charter, Inc. with negative results.<sup>65</sup>

### 3.2 Co-Pilot

According to the co-pilot's First Class medical exam dated January 27, 2021, no concerns were reported by the co-pilot and no significant issues were identified by the AME. The co-pilot had 48 prior exams from a 1988 Second Class exam through a 2020 First Class exam. The co-pilot reported a history of kidney stones (reported in 1995, 1997, and 1998), hay fever, right inguinal hernia repair in 1975, and a jaw fracture in a 1986 car accident.<sup>66</sup>

### 4.0 Airplane Information



**Photo 1: Photo of accident airplane N605TR.**<sup>67</sup>

The accident airplane was a Challenger 605, registration N605TR and serial number 5715. It was a sweptwing, twin-engine monoplane, certified as a CL-600, model 2B16 airplane in accordance with 14 *CFR* Part 25, 14 *CFR* Part 36 and their amendments. FAA records did not list a manufacture date or engine manufacturer.<sup>68</sup> The registered owner was Tarco Aircraft Funding LLC in Fort Lauderdale, Florida. The airplane was designed for two crew members, with accommodation for up to 19 passengers.

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<sup>65</sup> The test results (dated July 12, 2021) included screening for amphetamines, marijuana, opioids, cocaine and phencyclidine.

<sup>66</sup> Source: FAA.

<sup>67</sup> Source: <https://www.aircraft.com/aircraft/199392929/n605tr-2008-bombardier-challenger-605>.

<sup>68</sup> According to the NTSB Form 6120 completed by Aeolus Air Charter, Inc. the manufacture date for N605TR was March 28, 2007. The Form 6120 also indicated that the engines were both General Electric (GE) CF-34-38 (serial numbers 950573 and 950576).

The CL-605 was a variant of the CL-604. Major changes from the CL-604 to the CL-605 were the addition of a Rockwell Collins Proline 21 avionics suite, which consisted of four multi-function flat panel LCD units, reduced aircraft weight, larger cabin windows, autothrottle as standard equipment, and a new tail cone design.<sup>69</sup>

According to Bombardier records, the accident airplane was previously registered in Germany as registration D-AVPB in 2018 and was operated by MHS Aviation GmbH. In December 2018, the registration was changed to 9H-VPB and was operated by Blue Square Aviation Group Malta Ltd and listed for sale on August 13, 2019.

The airplane was sold to Tarco Aircraft Funding, LLC in Fort Lauderdale, Florida on February 27, 2020, and an application for change of the registration from Malta registration 9H-VPB to N605TR was filed with the FAA the same day. The airplane's registration was changed to N605TR on March 20, 2020.<sup>70</sup>

On May 1, 2021, N605TR was leased to Aeolus Air Charter, Inc.<sup>71</sup> On July 26, 2021 Aeolus Air Charter Inc. applied to the FAA Flight Standards District Office (FSDO) office in Fargo, North Dakota to amend the company's Operation Specification D085 and add Challenger 605 registration N605TR to the company's air carrier Part 135 operating certificate. At the time of the accident, Aeolus Air Charter, Inc. operated one airplane (N390SA, an RA-390-390 Beechcraft Premier) for Part 135 charter.

The NTSB requested a PTRS and SPAS data search of FAA records<sup>72</sup> for N605TR and Tarco Aircraft Funding LLC, and the FAA responded that it had no records for either.<sup>73</sup>

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<sup>69</sup> Source: FAA Flight Standardization Board Report (Revision 3) for the Bombardier CL-604/CL-605 (CL-600-2B16) dated May 25, 2012.

<sup>70</sup> See Attachment 8 - N605TR Registration History and Attachment 9 - Airworthiness History.

<sup>71</sup> See Attachment 7 - Tarco Lease.

<sup>72</sup> Source: NTSB request for information to the FAA #21-259.

<sup>73</sup> Source: FAA email to the NTSB, dated August 16, 2021. The FAA provided records to the NTSB related to the registration and airworthiness histories on N605TR, and a filed Statement of Citizenship for Tarco Aircraft Funding, LLC (related to aircraft registration N129AC).

## 4.1 Airplane Dimensions

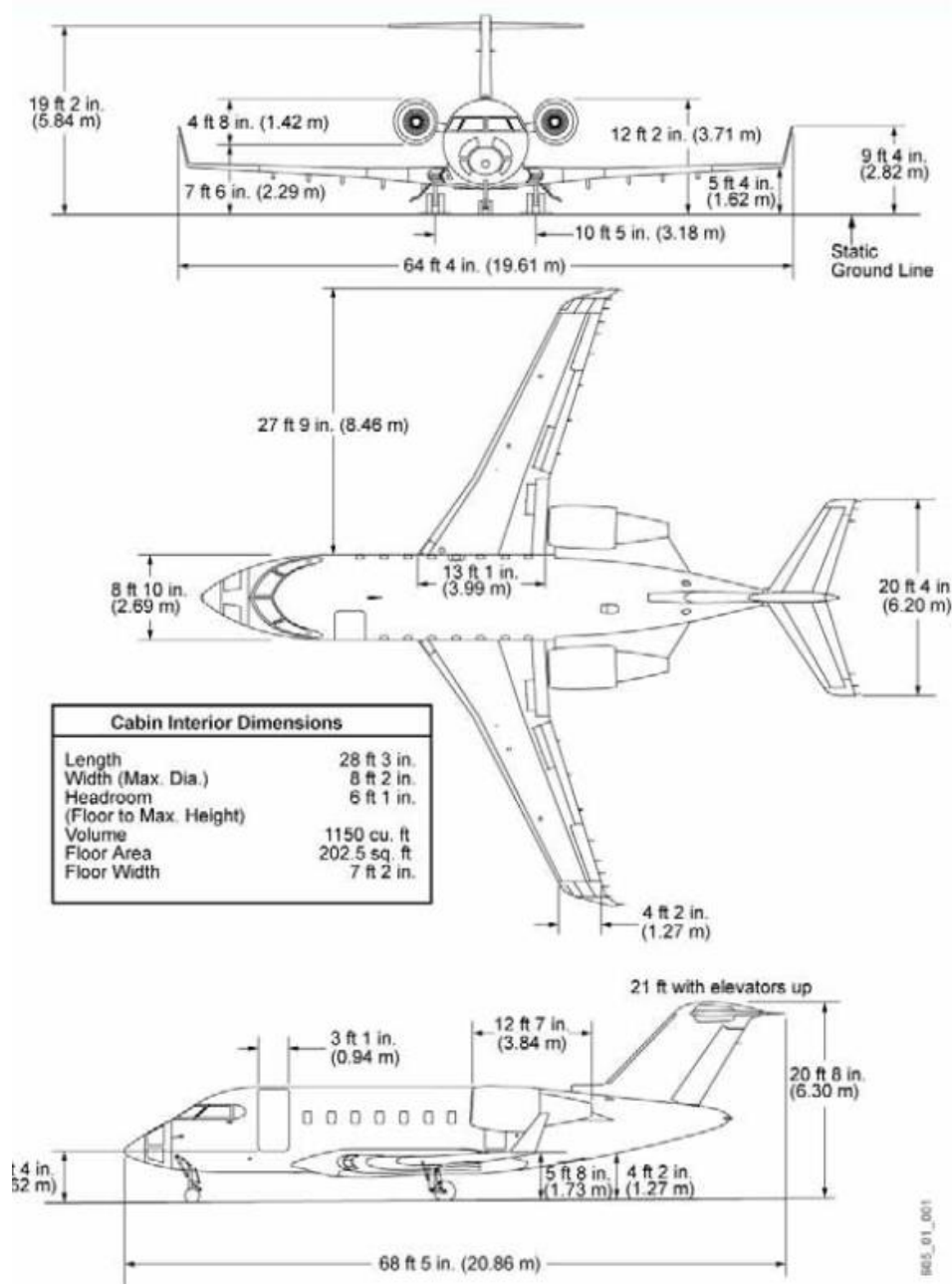


Figure 1: CL-605 Airplane Basic Dimensions.<sup>74</sup>

## 4.2 CL-605 Limitations

CL-605 systems limitations were in the Flight Crew Operating Manual (FCOM) Volume 2, Chapter 2. According to the FCOM, Chapter 2 contained the reproduction

<sup>74</sup> Source: CL-605 FCOM Volume 2.

of the limitations governing operation of the airplane, found within PSP 605-1, the FAA-approved Airplane Flight Manual (AFM).

#### 4.2.1 Operating Speeds

##### **RVSM MAXIMUM OPERATING SPEED**

The maximum cruise mach number during flight in RVSM airspace is 0.83.

##### **FLAPS EXTENDED SPEED**

The maximum speeds at which the flaps may be extended are:

- Flaps to 20 degrees: 231 KIAS
- Flaps to 30 degrees: 197 KIAS
- Flaps to 45 degrees: 189 KIAS

##### **MAXIMUM LANDING GEAR OPERATING SPEED**

The maximum airspeed at which it is safe to extend the landing gear is 197 KIAS / 0.6 MI.

The maximum airspeed at which it is safe to retract the landing gear is 197 KIAS / 0.6 MI.

##### **MAXIMUM LANDING GEAR EXTENDED SPEED**

The maximum airspeed at which the airplane may be flown with the landing gear extended and locked is 250 KIAS / 0.7 MI.

Flight at altitudes above 20,000 feet with the landing gear extended is prohibited.

**Figure 2: CL-605 Maximum Operating Speeds.<sup>75</sup>**

#### 4.2.2 Maneuvering Loads

##### **MANEUVERING LIMIT LOAD FACTORS**

These load factors limit the permissible angles of bank in turns and the severity of pull-up and push-over maneuvers:

- Flaps up: -1.0 G to 2.5 G.
- Flaps down: 0.0 G to 2.0 G.

##### **SIDE SLIP MANEUVERS**

Avoid unnecessary and large side-slip maneuvers during low speed high altitude cruise.

**Figure 3: CL-605 Maximum Load Factors.<sup>76</sup>**

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<sup>75</sup> Source: CL-605 FCOM Volume 1, page 02-06-1.

<sup>76</sup> Source: CL-605 FCOM Volume 1, page 02-07-1.

### 4.2.3 Flight Controls

#### Flaps

Enroute use of flaps is prohibited.

Flight with flaps extended at altitudes above 15,500 feet is prohibited.

#### Flight Spoilers

Flight below an altitude of 300 feet AGL with flight spoilers extended is prohibited.

To ensure adequate maneuver margins, flight spoilers must not be extended in flight at airspeeds below the recommended approach speed plus 10 KIAS (refer to Chapter 6; PERFORMANCE – LANDING PERFORMANCE).

**Figure 4: CL-605 Flight Control Limitations.**<sup>77</sup>

#### 4.2.3.1 Maximum Flap Speeds

| Maximum Flap Speeds |                  |
|---------------------|------------------|
| FLAP SETTING        | MAXIMUM AIRSPEED |
| 20 degrees          | 231 KIAS         |
| 30 degrees          | 197 KIAS         |
| 45 degrees          | 189 KIAS         |

#### NOTE

To prevent damage, maximum indicated airspeeds for each flap setting must not be exceeded. These are placarded on the instrument panel (See Airplane Flight Manual for current airspeeds).

**Figure 5: CL-605 Maximum Flap Speeds Chart.**<sup>78</sup>

### 4.2.4 Stall Speeds

Stall Speeds for the CL-605 were in the CL-605 FCOM Volume 1. See Attachment 19 – CL-605 Stall Speed Charts.

The FAA Airplane Flying Handbook (FAA-H-8083-3C) (2021), Chapter 5: Maintaining Aircraft Control: Upset Prevention and Recovery Training, stated the following in part:

*A skidding cross-control stall is most likely to occur in the traffic pattern during a poorly planned and executed base-to-final approach turn. There may be an unrecognized tailwind component and higher groundspeed on the base leg, which causes the pilot to turn late or with inadequate bank. The airplane overshoots the runway centerline, and the pilot attempts to correct by increasing the bank angle, increasing back elevator pressure, and applying excess rudder in the direction of the turn (i.e., inside or bottom rudder pressure) to bring the*

<sup>77</sup> Source: CL-605 FCOM Volume 1, page 02-08-2.

<sup>78</sup> Source: CL-605 FCOM Volume 2, page 10-10-15.

*nose around further to align it with the runway. The difference in lift between the inside and outside wing will increase, resulting in an unwanted increase in bank angle. At the same time, the nose of the airplane slices downward through the horizon. The natural reaction to this may be for the pilot to pull back on the elevator control, increasing the AOA toward critical. Should a stall be encountered with these inputs, the airplane may rapidly enter a spin. The safest action for an "overshoot" is to perform a go-around. At the relatively low altitude of a base-to-final approach turn, a pilot should be reluctant to use bank angles greater than 30 degrees and should not make a skidding turn if correcting for any overshoot.*

## **5.0 Weight and Balance**

Title 14 *CFR* 91.103 Preflight Action stated in part that each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight.

Title 14 *CFR* Part 91.9 covered general operating and flight rules for all aircraft, and stated the following in part:

*(b) Except as provided in paragraph (d) of this section, no person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane or Rotorcraft Flight Manual, markings, and placards, or as otherwise prescribed by the certificating authority of the country of registry.*

The Aeolus Air Charter, Inc. General Operations Manual (GOM ) (revision 0 dated June 28, 2021) stated the following, in part:

*All Aeolus Air Charter, Inc. aircraft are weighed every 36 months. Personnel operating Aeolus Air Charter, Inc. aircraft can verify that the subject aircraft has been weighed within the last 36 months by reviewing the aircraft maintenance report in the aircraft Hobbs Book, or the AFM.*

The NTSB made multiple attempts to obtain a 36-month certified weight of N605TR through the operator (Aeolus Air Charter, Inc.), the owner (Tarco Aircraft Funding, LLC), the previous maintenance facility (C&L Aviation Services) and the FAA. The NTSB was unable to obtain a current 36-month certified weight of N605TR.<sup>79</sup>

The Aeolus Air Charter, Inc. GOM stated the following, in part:

*The BOW or BEW will be determined by the Load Manifest form for the particular aircraft to be flown, and is available either on-line on the company*

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<sup>79</sup> Bombardier provided the NTSB with Bombardier Aircraft Weight and Balance S/N 5715 document, dated December 12, 2007, following manufacture of the accident airplane.

*website or in the office. The Chief Pilot is responsible to keep all available copies of the Load Manifest form for all aircraft updated as aircraft are altered or re-weighed. If any doubt exists, the pilot will consult the AFM directly.*

The Aeolus Air Charter, Inc. GOM stated the following, in part:

*A. The PIC is responsible for ensuring that he/she never exceeds the operational limitations of the aircraft (depending upon conditions, this limitation may be structural or related to performance). The PIC is responsible to ensure that a weight and balance calculation be performed for all commercial flight operations (Part 91 or Part 135), and that the aircraft is configured, loaded and operated in accordance with the calculation. The PIC may delegate the task of performing the calculation to a qualified crewmember, but retains responsibility for its accuracy.*

The Aeolus Air Charter, Inc. GOM stated the following, in part:

*B. Aeolus Air Charter, Inc. will utilize:*

- 1. A weight and balance plotter and graph manufactured for the specific aircraft, or*
- 2. Flight planning Weight & Balance iOS program, or*
- 3. The pilot may calculate the weight and balance mathematically, using the AFM and the specific weights, arms, and moments. The calculations will yield the total weight of the loaded aircraft, the maximum allowable takeoff weight for that flight, and the center of gravity limits.*

*C. Weight and balance calculations will be made prior to each flight.*

When the NTSB asked if he had received any copy of the weight and balance from the captain for the accident flight, the Aeolus Air Charter, Inc. DO said "no," and stated that he could only assume that the captain, as PIC, conducted a weight and balance as a "professional pilot." The Aeolus Air Charter, Inc. DO further stated it would not be his expectation to receive a copy of the weight and balance since the accident flight was a Part 91 operation and the captain "being the pilot-in-command had operational control. He would take care of the weight and balance on that."<sup>80</sup>

The NTSB obtained two separate copies of weight and balance and performance calculations for the accident flight made by the captain and co-pilot through their personal ForeFlight accounts. The captain's weight and balance calculations used N605TR with a basic empty weight (BEW) of 27,151 lbs. The captain's calculations further estimated that the landing weight in TRK would be 31,540 lbs. The co-pilot's weight and balance calculations used N605VV with a basic empty weight of

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<sup>80</sup> See Attachment 1 - Interview Transcripts.

27,151 lbs. The co-pilot's calculations further estimated that the landing weight in TRK would be 29,951 lbs.<sup>81</sup>

The following table provides an estimate of the actual weight and balance of the accident flight based on available evidence:<sup>82</sup>

| <b>WEIGHT &amp; BALANCE</b> (maximum certificated weights in <b>bold</b> ) <sup>83</sup> (weight in lbs.) |                                           |               |
|-----------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------|
|                                                                                                           | Basic Operating Weight <sup>84</sup>      | 27,034        |
|                                                                                                           | Passenger Weights (4) <sup>85</sup>       | 755           |
|                                                                                                           | Baggage Weight <sup>86</sup>              | 120           |
|                                                                                                           | Zero Fuel Weight                          | 27,909        |
|                                                                                                           | <b>Maximum Zero Fuel Weight</b>           | <b>32,000</b> |
|                                                                                                           | Fuel Weight <sup>87</sup>                 | 6,720         |
|                                                                                                           | Ramp Weight                               | 34,629        |
|                                                                                                           | <b>Maximum Taxi and Ramp Weight</b>       | <b>48,300</b> |
|                                                                                                           | Taxi Burn (estimated)                     | -300          |
|                                                                                                           | Takeoff Weight                            | 34,329        |
|                                                                                                           | <b>Maximum Takeoff Weight</b>             | <b>48,200</b> |
|                                                                                                           | Fuel burn to Accident Sight <sup>88</sup> | -3,392        |
|                                                                                                           | Estimated Landing Weight                  | 30,937        |
|                                                                                                           | <b>Maximum Landing Weight</b>             | <b>38,000</b> |

**Table 1: Accident Flight Estimated Weight and Balance.**<sup>89</sup>

<sup>81</sup> The captain and co-pilot's ForeFlight calculations were based on "4 soles onboard" (two pilots and two passengers). See Attachment 4 - ForeFlight Navlogs. Security camera footage in COE confirmed the accident flight departed COE with the two pilots, four passengers and two dogs onboard.

<sup>82</sup> Locations of where the passengers were seated in the airplane was unknown. There was insufficient evidence to calculate the center of gravity (CG) of the accident flight.

<sup>83</sup> Source: Challenger 605 FCOM Volume 1.

<sup>84</sup> Source: Bombardier Aircraft Weight and Balance S/N 5715 document, dated December 12, 2007. Weight includes the airplane basic empty weight, pilot (2) weights, crew baggage, manuals, galley/cabin supplies, life vests, and water servicing. According to FAA Advisory Circular 120-27F, Basic Operating Weight is defined as the empty weight of the aircraft plus the weight of the required crew, their baggage, and other standard items such as meals and potable water. See Attachment 6 - Weight and Balance Information.

<sup>85</sup> The four passenger's weights were derived from the Flight Manifest (See Attachment 5 - Flight Crew Itineraries) and state issued driver's license information obtained from the FBI via Accurint proprietary data-linking technology. The two dog weights were estimated at 60 lbs. total.

<sup>86</sup> Baggage weight was estimated at 30 lbs. per passenger. See FAA Advisory Circular 120-27F.

<sup>87</sup> According to FDR information, on taxi-out at COE, the left/right/auxiliary fuel tanks had 3,360, 3,200 and 160 lbs. of fuel in their respective fuel tanks. According to the CL-605 FCOM, Volume 1, page 02-05-6, the maximum usable fuel load for the CL-605 was 20,000 ..

<sup>88</sup> According to FDR information, prior to impact, the left/right/auxiliary fuel tanks had 1,696, 1,632 and 0 lbs. of fuel in their respective fuel tanks. According to the CL-605 FCOM, Volume 1, page 02-05-6, the maximum usable fuel load for the CL-605 was 20,000 lbs.

<sup>89</sup> See Attachment 6 - Weight and Balance Information.

## **6.0 Meteorological Information**

See Meteorology Group Chairman's Factual Report.

## **7.0 Aids to Navigation**

### **7.1 Electronic Flight Bags**

Aeolus Air Charter, Inc. was authorized by Operations Specifications A061 to conduct RA-390 Premier aircraft operations using an Electronic Flight Bag (EFB) for Part 135 flight. The Operations Specifications did not include the CL-605 since the airplane had not been added to the operating certificate.

When asked by the NTSB if the captain had an EFB in his possession, the DO said "I don't know if he did. I would assume that he did, but I don't know," and did not know if the captain or co-pilot used an iPad or EFB on the accident flight.

## **8.0 Airport Information**

Truckee-Tahoe Airport (TRK) was located about 2 miles east of Truckee, California at an elevation of 5,904 feet above msl. The airport had an operating ATC Control Tower (Class D airspace).<sup>90</sup>

The airport had two asphalt runway surfaces, designated runways 11/29 and 02/20. The accident flight was initially cleared for the TRK RNAV (GPS) Runway 20 approach to runway 20. Runway 20 was 4,654 feet long and 75 feet wide, had a 115-foot-long displaced threshold, and had a 2-box visual approach slope indicator (VASI)<sup>91</sup> on the left side of the runway with a 3.5° angle. The accident flight was subsequently cleared for a circle approach and landing on runway 11. Runway 11 was 7,000 feet long and 100 feet wide, had a grooved surface, and medium intensity runway lights (MIRL) and runway end identifier lights (REIL)<sup>92</sup> lighting systems. There was no VASI or precision approach path indicator (PAPI)<sup>93</sup> for runway 11.

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<sup>90</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), Class D airspace was 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 was individually tailored, and when instrument procedures were published, the airspace was normally designed to contain the procedures.

<sup>91</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), a VASI was visual aid of lights arranged to provide descent guidance information during the approach to the runway. A pilot on the correct glideslope will see red lights over white lights.

<sup>92</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), a REIL was a pair of synchronized flashing lights, located laterally on each side of the runway threshold, providing rapid and positive identification of the approach end of a runway.

<sup>93</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), a PAPI was a system of lights similar to the VASI but consisting of one row of lights in two- or four-light systems. A pilot on the correct glideslope will see two white lights and two red lights.

The FAA Airport/Facility Directory for TRK stated the following:

*Special Hazard: Mountainous terrain surrounds arpt and rwys, expect windshear (sic) and downdrafts.*

## 8.1 Sectional Chart

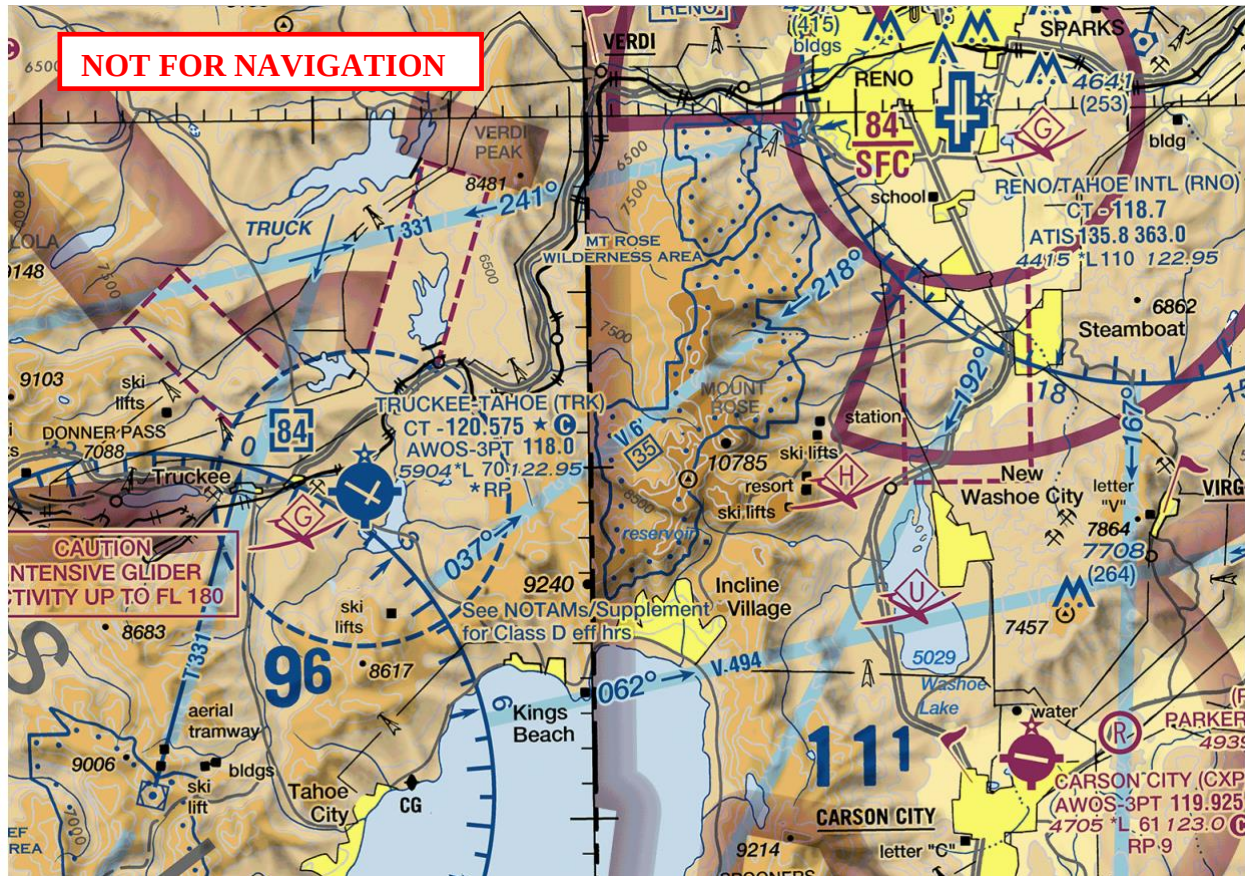


Figure 6: FAA Sectional Chart excerpt covering Truckee, California.

## 8.2 TRK Airport Chart

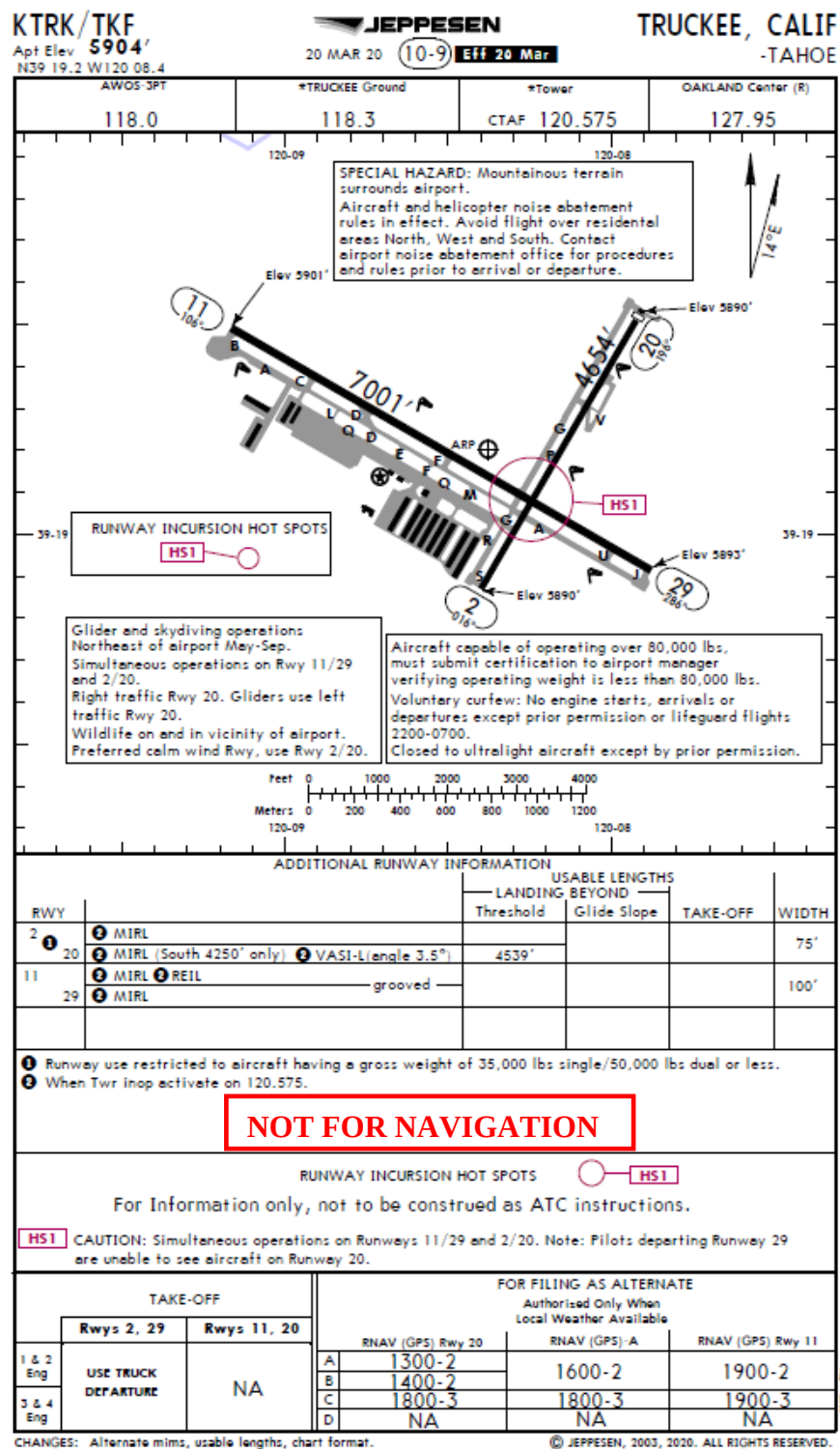


Figure 7: TRK Airport Chart.<sup>94</sup>

<sup>94</sup> Source: Jeppesen.

### 8.3 TRK RNAV (GPS) Runway 20 Approach Chart

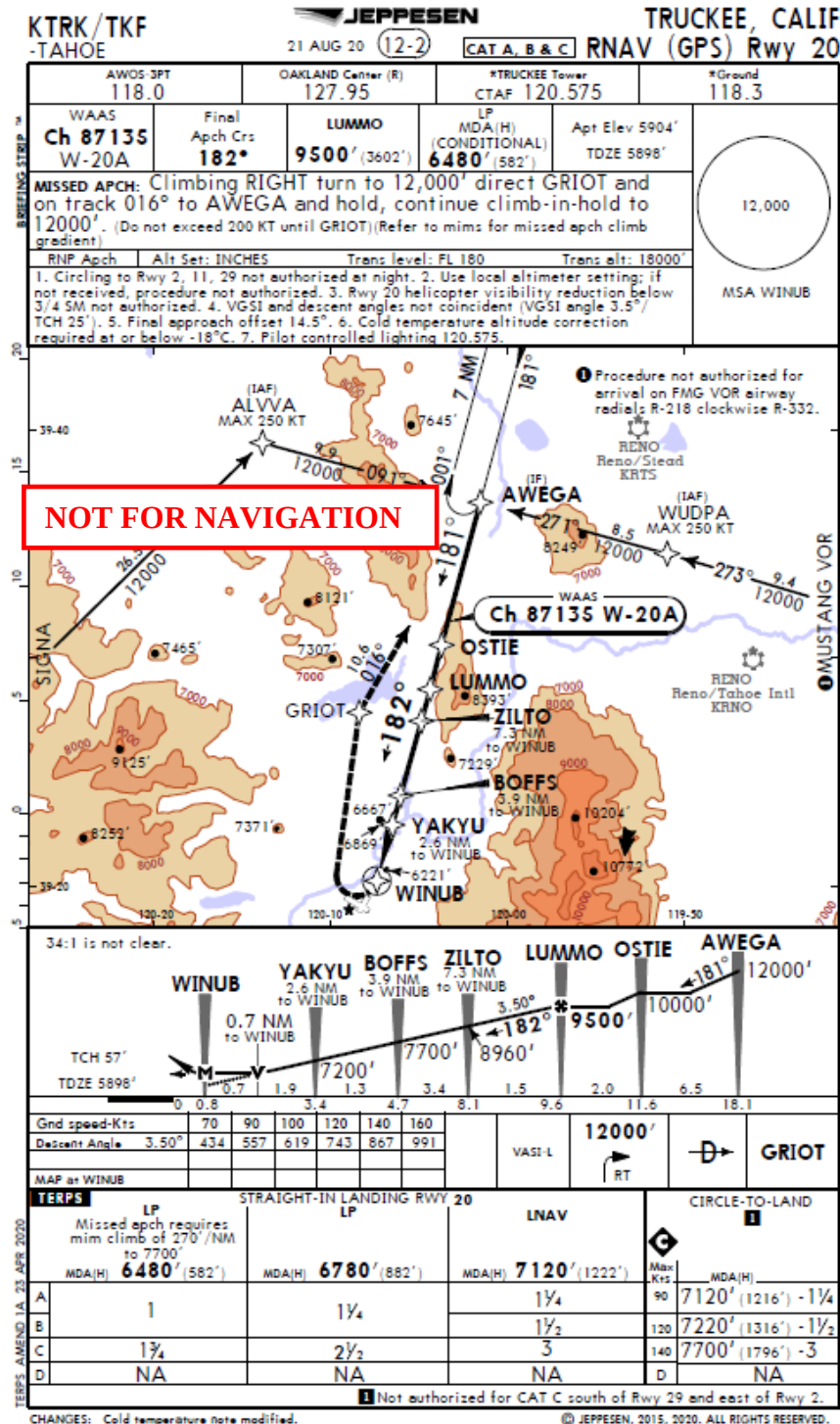


Figure 8: TRK RNAV (GPS) Runway 20 Approach Chart.<sup>95</sup>

<sup>95</sup> Source: Jeppesen.

## 8.4 TRK RNAV (GPS) Runway 11 Approach Chart

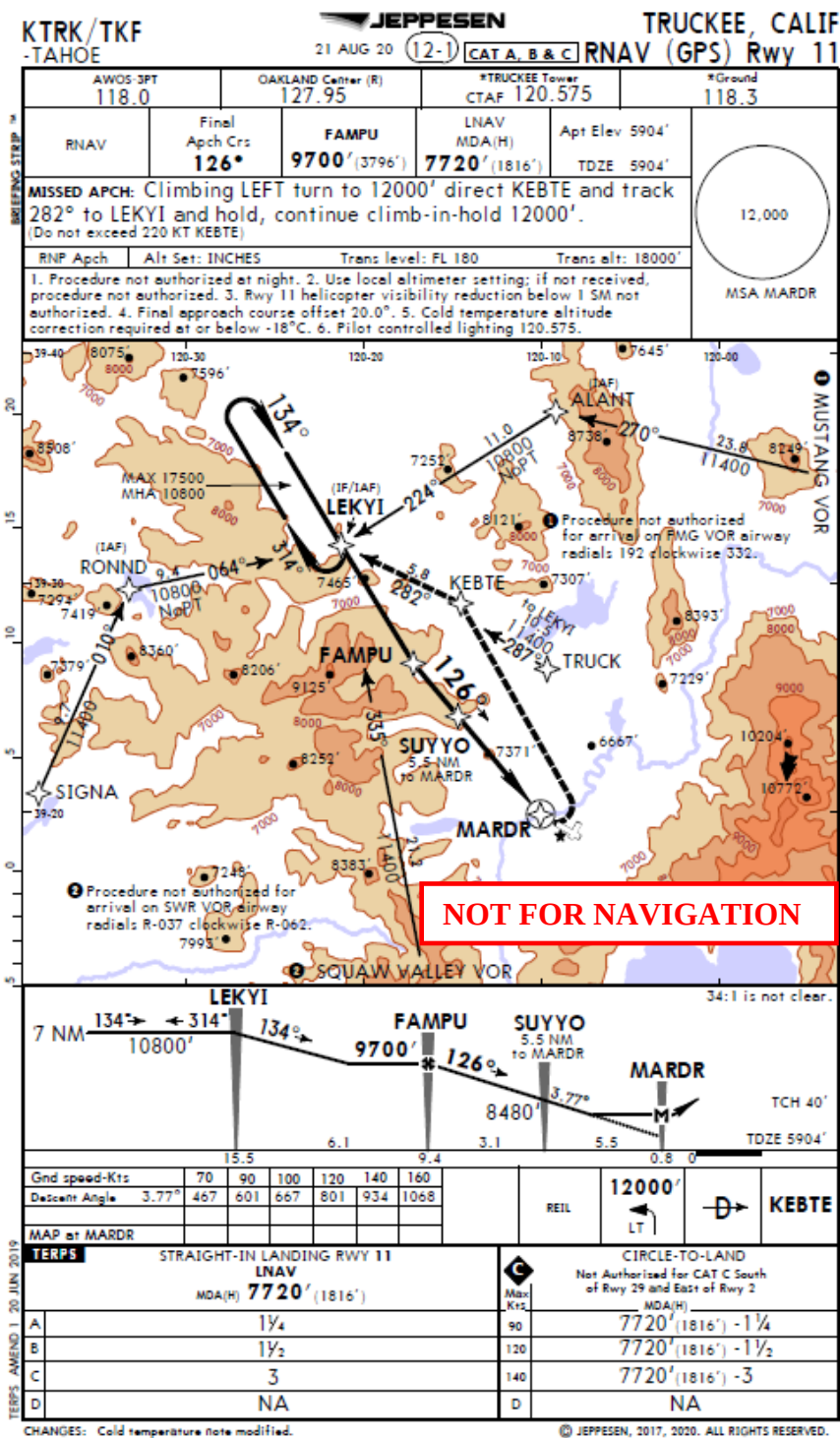


Figure 9: TRK RNAV (GPS) Runway 11 Approach Chart.<sup>96</sup>

<sup>96</sup> Source: Jeppesen.

## 9.0 Circling Approach

The accident occurred during a circle-to-land maneuver to runway 11 at TRK. According to the Pilot/Controller Glossary published in the Aeronautical Information Manual (AIM), a circle-to-land was a maneuver initiated by the pilot to align the aircraft with a runway when a straight-in landing from an instrument approach was not possible or was not desirable. At tower controlled airports, this maneuver was made only after ATC authorization had been obtained and the pilot had established required visual reference to the airport.

A "circle to runway" clearance was used by ATC to inform the pilot that he/she must circle-to-land because the runway in use was other than the runway aligned with the instrument approach procedure. The direction of the circling maneuver in relation to the airport/runway was required, the controller must state the direction (eight cardinal compass points) and specify a left or right downwind or base leg as appropriate. According to the AIM, standard left turns or specific instruction from the controller for maneuvering must be considered when circling to land.

### 9.1 Circling Approach Minimums

Circling minimums were published on approach charts as a statement of the minimum descent altitude (MDA)<sup>97</sup> required for the circling maneuver and the visibility requirements for the approach.<sup>98</sup> Published circling minimums provided obstacle clearance when pilots remained within the appropriate area of protection. Pilots would determine the category of the airplane for the approach based on the approach speed of the airplane, which in turn would determine the MDA and visibility requirements for the circle-to-land approach as depicted on the approach chart. According to 14 *CFR* 97.3, an aircraft approach category means a grouping of aircraft based on a speed of  $V_{REF}$ , if specified, or if  $V_{REF}$  is not specified,  $1.3 V_{SO}$  at the maximum certificated landing weight.<sup>99</sup>  $V_{REF}$ ,  $V_{SO}$ , and the maximum certificated landing weight were those values as established for the aircraft by the certification authority of the country of registry. The categories were as follows:

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<sup>97</sup> According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), the MDA is the lowest altitude (in feet msl) to which descent is authorized on final approach, or during circle-to-land maneuvering in execution of a nonprecision approach.

<sup>98</sup> According to the AIM, the circling MDA will provide 300 foot obstacle clearance within the area considered for obstacle clearance and may be lower than the LNAV/VNAV DA, but never lower than the straight in LNAV MDA. This may occur when different controlling obstacles are used or when other controlling factors force the LNAV MDA to be higher than 250 feet above the LNAV obstacle clearance surface (OCS).

<sup>99</sup>  $V_{REF}$  is defined as 1.3 times the stalling speed in the landing configuration ( $V_{SO}$ ). It is the required speed at the 50-foot height above the threshold end of the runway. Source: Pilot's Handbook of Aeronautical Knowledge, FAA-H-8083-25A, Chapter 10, page 10-32. According to Bombardier, the CL605  $V_{REF}$  is based on  $1.23 V_{SR}$  (where  $V_{SR} = 1.02 V_{SO}$ , therefore  $V_{REF} = 1.25 V_{SO}$ ). Source: FAA-approved AFM page 06-01-1.

- (1) Category A: Speed less than 91 knots.
- (2) Category B: Speed 91 knots or more but less than 121 knots.
- (3) Category C: Speed 121 knots or more but less than 141 knots.
- (4) Category D: Speed 141 knots or more but less than 166 knots.
- (5) Category E: Speed 166 knots or more.

According to the FAA Flight Standardization Board Report (Revision 3) for the Bombardier CL-604/CL-605 (CL-600-2B16) dated May 25, 2012, the Challenger CL-605 was certified for Category C straight-in approach minimums with landing flaps at 45°.

In 2020, the FAA published revisions to the AIM, including clarifications of "approach category" and its application in determining the appropriate straight-in or circling minima on an instrument approach.

Previous AIM language required pilots to use the next higher approach category if it was necessary to maneuver at a speed above the upper limits of the aircraft's defined approach category. Section 5-4-7 Instrument Approach Procedures, paragraph a. said in part:

*If it is necessary to operate at a speed in excess of the upper limit of the speed range for an aircraft's category, the minimums for the higher category must be used.*

The AIM was revised in 2020 with the following language in Section 5-4-7:

*"If it is necessary to operate at a speed in excess of the upper limit of the speed range for an aircraft's category, the minimums for the higher category should be used."*

Following an NTSB request for information to the FAA<sup>100</sup> as part of this accident investigation, the FAA provided the following response:

*The reason we changed from "Must" to "Should" is because "Must" is considered regulatory and regulatory requirements cannot be given through the AIM. We changed to "Should" at the request of legal as it relates more to the purpose of the AIM to provide pilots with information and not regulatory requirements which the AIM does not serve.*

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<sup>100</sup> NTSB request to the FAA #21-163.

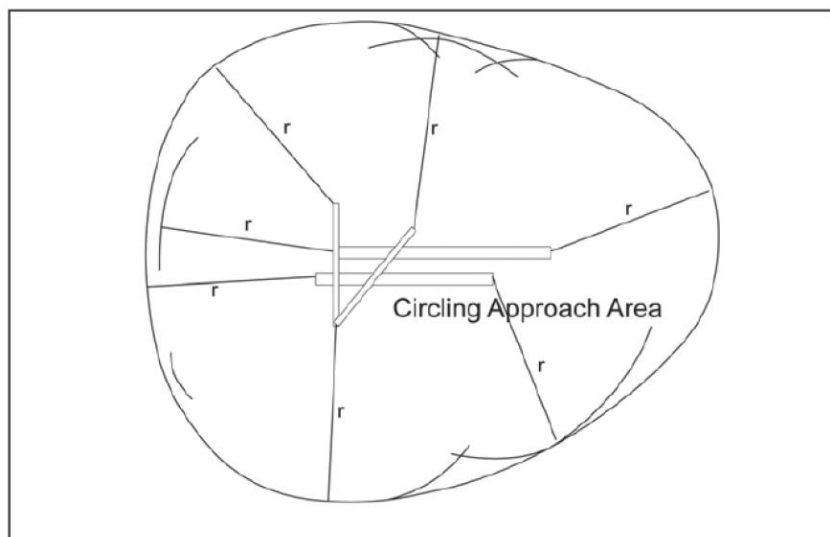
## 9.2 Protected Area

The FAA Instrument Procedures Handbook (FAA-H-8083-16A), page 4-8 and 4-9, stated that the circling approach area was the obstacle clearance area for airplanes maneuvering to land on a runway that does not meet the criteria for a straight-in approach. A minimum of 300 feet of obstacle clearance was provided in the circling segment, and pilots should remain at or above the circling altitude depicted on the approach chart until the airplane was continuously in a position from which a descent to a landing on the intended runway could be made at a normal rate of descent and using normal maneuvers.

The circling approach protected areas developed prior to 2012 used the radius distances shown in the following table, expressed in nautical miles, dependent on aircraft approach category:

| Circling MDA in feet MSL | Approach Category and Circling Radius (NM) |       |       |       |       |
|--------------------------|--------------------------------------------|-------|-------|-------|-------|
|                          | CAT A                                      | CAT B | CAT C | CAT D | CAT E |
| All Altitudes            | 1.3                                        | 1.5   | 1.7   | 2.3   | 4.5   |

**Figure 10: Pre-2012 Approach Category and Circling Radius chart.**<sup>101</sup>



**Figure 11: Chart depicting an example of pre-2012 circling approach protected areas.**<sup>102</sup>

According to the FAA, beginning with the November 15, 2012 chart publication date, the FAA began publishing new circling criteria (TERPS 8260.3B Change 21) that affected the circling approach area dimensions by expanding the areas to provide better obstacle protection. The new circling approach areas used an expanded radius

<sup>101</sup> Source: FAA Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS): TERPS/Landing Minima Data, Attachment 5.

<sup>102</sup> Source: FAA.

distance from the runway and included a circling altitude which accounted for the true airspeed increase with altitude, dependent on aircraft category.

| Circling MDA in feet MSL | Approach Category and Circling Radius (NM) |       |       |       |       |
|--------------------------|--------------------------------------------|-------|-------|-------|-------|
|                          | CAT A                                      | CAT B | CAT C | CAT D | CAT E |
| 1000 or less             | 1.3                                        | 1.7   | 2.7   | 3.6   | 4.5   |
| 1001 – 3000              | 1.3                                        | 1.8   | 2.8   | 3.7   | 4.6   |
| 3001 – 5000              | 1.3                                        | 1.8   | 2.9   | 3.8   | 4.8   |
| 5001 – 7000              | 1.3                                        | 1.9   | 3.0   | 4.0   | 5.0   |
| 7001 – 9000              | 1.4                                        | 2.0   | 3.2   | 4.2   | 5.3   |
| 9001 and above           | 1.4                                        | 2.1   | 3.3   | 4.4   | 5.5   |

**Figure 12: TERPS 8260.3B Change 21 modified circling approach areas.**<sup>103</sup>

The affected approach procedures would be denoted on the approach chart with a negative “C”  or on the circling line of the minima table to which the new criteria had been applied.

The TRK RNAV (GPS) Runway 20 approach chart depicted a negative “C” in the chart minimums and the expanded circling radius applied to the approach being flown on the accident flight.

| CIRCLE-TO-LAND                                                                      |                   |
|-------------------------------------------------------------------------------------|-------------------|
|  |                   |
| Max<br>Kts                                                                          | MDA(H)            |
| 90                                                                                  | 7120' (1216') -1¼ |
| 120                                                                                 | 7220' (1316') -1½ |
| 140                                                                                 | 7700' (1796') -3  |
| D                                                                                   | NA                |

**Figure 13: TRK RNAV 20 circle-to-land minimums with expanded circle-to-land minimums and a negative “C”.**

### 9.3 Company Information

Aeolus Air Charter, Inc. held a Part 135 Air Carrier Certificate (Number RHAA37P) for on-demand operations in common carriage pursuant to 14 *CFR* 119.21(a)(5). Their Part 135 operating certificate was dated July 13, 2021 (13 days prior to the accident at TRK). Their corporate offices and aircraft were based in Van Nuys,

<sup>103</sup> Source: FAA.

California.<sup>104</sup> The company had one airplane type (RA-390 Premier) on its Part 135 operating certificate (Operations Specifications D085).

According to payroll data, the company had eight total employees,<sup>105</sup> three of which were pilots. The company did not have a formal SMS. According to the CEO, Aeolus Air Charter, Inc. was a member of the NBAA and ACSF, but had not attended any safety meetings or conferences for each.

#### **9.4 Non-revenue Flights**

The Aeolus Air Charter, Inc. GOM stated the following, in part:

*Whether flights are released for revenue or non-revenue, the procedures for releasing the aircraft and terminating the flight will be same to the extent possible.*

The Aeolus Air Charter, Inc. GOM stated the following, in part:

- A. Non-revenue flights may occur under the categories listed in Paragraph 7.2 but will still be tracked by the Aeolus Air Charter, Inc. Ops Center. All aircraft will be released for flights under 14 CFR Part 91 and 14 CFR Part 135 with the same required flight forms.*
- B. This does include allowing the aircraft owner to operate their respective aircraft leased to Aeolus Air Charter, Inc. under 14 CFR Part 91. However the control and responsibility for the safe operation of the aircraft now resides with the aircraft owner.<sup>106</sup>*
- C. Prior to the return to revenue service the aircraft flight log's data will be entered into Aeolus Air Charter, Inc. electronic recordkeeping system and Maintenance computer systems.*

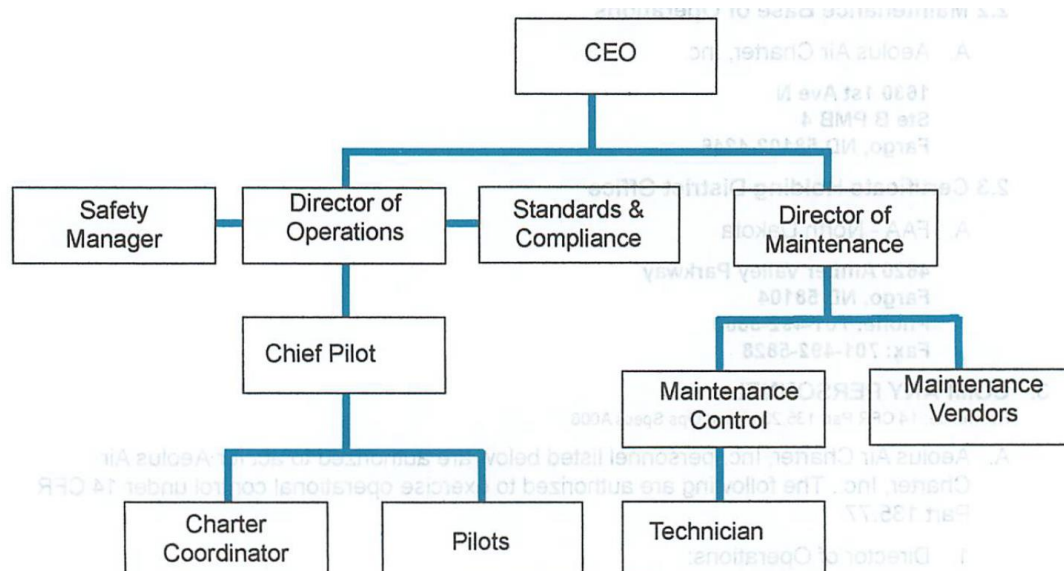
#### **9.5 Aeolus Air Charter, Inc. Organizational Chart**

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<sup>104</sup> Title 14 CFR 119.47(a) stated "Each certificate holder must maintain a principal base of operations. Each certificate holder may also establish a main operations base and a main maintenance base which may be located at either the same location as the principal base of operations or at separate locations." According to their Operations Specifications A001 for their Part 135 operating certificate, the Aeolus Air Charter, Inc. Primary Business Address with the FAA was in Fargo, North Dakota.

<sup>105</sup> According to his interview, the Aeolus Air Charter, Inc. director of maintenance, included in the total employees, was a contract employee for Aeolus Air Charter, Inc. that billed through his own company.

<sup>106</sup> The primary passenger onboard the accident flight was a business partner with the CEO of Aeolus Air Charter, Inc. and not the owner of the airplane (Tarco Aircraft Funding, LLC).



**Figure 14: Aeolus Air Charter, Inc. organizational chart.**<sup>107</sup>

## 9.6 Company Personnel Duties and Responsibilities

Aeolus Air Charter, Inc. personnel duties and responsibilities were defined in the GOM (revision 0, dated June 28, 2021).

### 9.6.1 Chief Executive Officer

The CEO was 28 years old and began Aeolus Air Charter, Inc. as a Part 135 charter operation with the intent of growing the company to a fleet of 10 airplanes.

The CEO was responsible for the Aeolus Air Charter, Inc. Flight Department. The director of operations and the director of maintenance reported directly to the CEO. According to the Aeolus Air Charter, Inc. GOM, along with the responsibility of the Flight Department, the CEO:

- Has the authority to resolve conflicts within the Flight Department.
- Hires and terminates employees.
- Sets the budget.

According to the Aeolus Air Charter, Inc. GOM, operational control remained the responsibility of the director of operations.<sup>108</sup>

<sup>107</sup> Source: Aeolus Air Charter, Inc. GOM page 2-2.

<sup>108</sup> According to 14 *CFR* Part 1, Operational Control, with respect to a flight, means the exercise of authority over initiating, conducting or terminating a flight.

### **9.6.2 Director of Operations**

The director of operations (DO) was 66 years old and a former airline pilot. He was a long-time family friend of the CEO when he was asked to assist in starting up Aeolus Air Charter, Inc.

According to the Aeolus Air Charter, Inc. GOM, the director of operations:

- Reports to the CEO.
- Is responsible for the operation of the flight organization to ensure a smoothly functioning operation.
- Meets the qualifications required by 14 *CFR* Part 119.71.
- Prepares and administers the flight operations budget.
- Is responsible for carrying out Aeolus Air Charter, Inc.'s policies and for compliance with all laws, rules, and regulations governing those flight and maintenance activities.
- Has final approval on the selection, training, and retention of all flight operations personnel.
- Is responsible for the safe operation of all aircraft owned, operated, or managed by Aeolus Air Charter, Inc.
- Is responsible for the proper operations and disposition of the flight department operating records.
- Is responsible for notifying the FAA and NTSB in case of an air carrier accident, and or incident.
- Monitors all flight and maintenance activity to help ensure that FAA compliance and safety are the priority. Is also responsible, with the director of maintenance, for the notification and dissemination of operational and safety information.
- Holds periodic safety meetings with department heads to air concerns and ensure that policies and procedures are followed.
- Shall ensure any persons involved with the sales or scheduling of revenue trips have sufficient training and knowledge to avoid accepting any trip which would violate the GOM or any applicable regulations.
- May initiate, terminate, and if properly trained as a crew member, operate flights under the air carrier certificate.
- Is responsible for the charter coordinator's duties and procedures
- Is the primary administrator of the electronic recordkeeping system.

### **9.6.3 Chief Pilot**

The chief pilot was 54 years old and was a former airline and corporate pilot. Aeolus Air Charter, Inc. was his first experience as a chief pilot.

According to the Aeolus Air Charter, Inc. GOM, the chief pilot:

- Reports to the director of operations.
- Meets the requirements of 14 *CFR* Parts 119.71(c), 135.95, 135.247, 135.293, 135.297, and 135.299.
- Maintains a current medical certificate as required by the Aeolus Air Charter, Inc.
- Reviews assignment of flight crewmembers.
- Performs duties as a flight crewmember when required.
- Maintains a liaison with the director of operations in all operations matters.
- Directs all training activities of flight crewmembers.
- Prepares and maintains proficiency records, flight schedules, reports, and correspondence pertaining to operations activities.
- Ensures that current copies of the Aeolus Air Charter, Inc. General Operations, Letter(s) of Authorization, RVSM, MEL/NEF manuals, as applicable, are carried on board each Aeolus Air Charter, Inc. aircraft.
- Designates check airmen and aircraft flight instructors.
- Disseminates information to all crewmembers as pertains to routes, airports, NOTAMS, NAVAIDS and Aeolus Air Charter, Inc. policies. Will maintain and make available to all employees a current copy of the Aeronautical Information Manual (AIM), International Flight Information Manual (IFIM) and supplement(s) as applicable, Aircraft Equipment Manual, Aircraft Flight Manual, 14 *CFR* Part 91, 14 *CFR* Part 119, 14 *CFR* Part 135 and Operations Specifications.
- Submits to FAA all reports required, pertaining to flight crews.
- Designates sufficient check pilots to ensure all flight crews conform to standard procedures as outlined in applicable FAA Regulations and Aeolus Air Charter, Inc. policies, and to ensure that all pilots maintain current route qualifications and receive proficiency checks as required by FAA and the Aeolus Air Charter, Inc.
- Maintains crewmember training records, currency compliance, and pilot qualifications for FAA quality control. Assists in Aeolus Air Charter, Inc. flight record discrepancies and the correction of.
- Coordinates with the director of maintenance for preparing and submitting the Mechanical Interruption Summary Report.
- Investigates and reports to the director of operations any aircraft accident, reportable incident, record discrepancy, or airman flight violation.
- Works closely with the director of maintenance to ensure that aircraft maintenance problems do not unnecessarily disrupt scheduled flight operations.
- Initiates the Aeolus Air Charter, Inc.'s Emergency Response Plan (ERP) as required.
- Maintains close liaison with local FAA on operational matters.

- Duties may be combined with that of the director of operations.

#### **9.6.4 Director of Maintenance**

The director of maintenance (DOM) was 40 years old, a United States Air Force veteran, and had previous experience as a director of maintenance prior to Aeolus Air Charter Inc. He was not a director of maintenance for any other certificated operator at the time of the accident.

According to the Aeolus Air Charter, Inc. GOM, the director of maintenance:

- Reports to the CEO.
- Provides the chief pilot with a list of currently available aircraft.
- Provides a schedule of planned maintenance periods for all aircraft.
- Oversees the Maintenance Control department.
- Coordinates with the chief pilot for changes in aircraft when a substitute aircraft must be used to meet a scheduled flight.
- Meets the requirements of 14 *CFR* Part 119.71.
- Ensures that maintenance manuals, technical data and standards are followed in inspecting and repairing all aircraft.
- Is responsible for directing, planning, and laying out details of inspection standards, methods, and procedures used by the repair facilities in complying with all applicable FAA regulations and manufacturer's recommendations.
- Is responsible for maintaining maintenance records to FAA standards on all aircraft managed, owned, operated, or serviced.
- Establishes procedures to ensure that the charter coordinators have a current availability status on all Aeolus Air Charter, Inc. and managed aircraft.
- Establishes and maintains a close working relationship with the FAA's principal maintenance inspector having certificate responsibility over Aeolus Air Charter, Inc.'s air carrier operations.
- Works with the facility manager to ensure that adequate maintenance and inspection facilities are available to meet requirements.
- Ensures that the reports required by 14 *CFR* Parts 135.415 and 135.417 are submitted utilizing Form 415 and the on-line FAA SDR Reporting System, or alternate means (example: e-mail) mutually agreeable to the Principal Maintenance Inspector and director of maintenance.
- Is responsible for ensuring that time limitations on MEL deferred items are tracked and that aircraft are not dispatched for trips when an MEL time limit (or other required maintenance or inspection requirement) may be exceeded.
- If necessary, is responsible for issuing a flight permit or special flight authorization.

- Annually, audits maintenance records for the occurrence of recurrent defects.
- May terminate flights under the air carrier certificate.
- Issues Airworthiness Release and coordinates with the director of operations with respect to operational control and releasing aircraft.
- Is responsible for recording and maintaining tool calibration form.
- Is responsible for ensuring weight and balance of Aeolus Air Charter, Inc. aircraft comply with 14 *CFR* Part 135.185.
- Is responsible for parts and life limited components used on Aeolus Air Charter, Inc. aircraft.
- Is responsible, with the director of operations, for the notification and dissemination of operational and safety information. Including Revisions and/or Updates to the AFMs.
- Will maintain a list of Aeolus Air Charter, Inc. qualified technicians and personnel authorized to perform an aircraft Airworthiness Release at the main maintenance base and at Aeolus Air Charter, Inc. approved certified repair stations.
- Is responsible for the MEL Management Program.

#### **9.6.5 Pilot-in-Command**

Title 14 *CFR* 91.3(a) stated the following:

*The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.*

According to the Aeolus Air Charter, Inc. GOM, the Pilot-in-Command:

- Reports to the chief pilot.
- Is responsible for canceling, delaying, rerouting, or diverting any flight upon determination that any unsafe conditions exist.
- Meets the requirements of 14 *CFR* Parts 135.95, 135.293, 135.297, and 135.299.
- Qualified to accept specific flight assignments, considering flight and rest requirements.
- Determines whether assigned flight can be initiated, conducted, or terminated safely and in accordance with Aeolus Air Charter, Inc.'s General Operations Manual, Training Manual, Operations Specifications, AFM, and other data as appropriate.
- Ensures all operations are conducted according to Aeolus Air Charter, Inc.'s General Operations, Training, Operations Specifications, AFM, and other data as appropriate.
- Is the final authority for the safe operation of the Aeolus Air Charter, Inc. aircraft.

- Directs the activities of the SIC, when one is assigned, ensuring they fully understand what duties are to be performed.
- Ensures that the assigned aircraft is airworthy and that all proper documents are on board the aircraft.
- Ensures that the proper quantity and grade of fuel is loaded on the aircraft.
- Ensures that a FAA flight plan is filed on each flight.
- Ensures that when a weight and balance calculation is required, that a load manifest is properly completed before takeoff.
- Promptly reports all known or suspected FAA violations or incidents to the chief pilot.
- Maintains a current medical certificate as required by the Aeolus Air Charter, Inc., and notifies the chief pilot if a medical (physical or mental) condition may impair their ability to perform the flight.
- Ensures the VOR and other aircraft equipment checks are properly performed.
- Maintains aircraft "stores" and appropriate catering for the flight.
- Ensures that passengers have been properly briefed and are informed the flight is being conducted by Aeolus Air Charter, Inc.
- Ensures that weather conditions and performance limitations are adequate for operations under the appropriate *CFRs*.
- Ensures that any maintenance write-ups are communicated to the director of maintenance and that the charter coordinator is alerted to the status of the aircraft.
- Determines applicability of the 14 *CFR* Part 135 regulations to each flight.
- Ensures that a copy of the General Operations Manual, Letters of Authorization and (when applicable) RVSM, AAIP and MEL Manuals, are onboard the aircraft.
- Maintains communications with the charter coordinator as to the status of the flight.

#### **9.6.6 Second-in-Command**

According to the Aeolus Air Charter, Inc. GOM, the Pilot-in-Command:

- Reports to the chief pilot.
- Is operationally responsible to the Pilot-in-Command on all flights.
- Assists the Pilot-In-Command with discharging safety responsibilities.
- Performs all flight duties and other duties as assigned by the Pilot-In-Command (including aircraft pre-flight, post-flight, passenger briefing, baggage, and cargo loading, etc.).
- Maintains a current medical certificate as required by the Aeolus Air Charter, Inc. and notifies the director of operations or chief pilot if a

medical (physical or mental) condition may impair their ability to perform the flight.

- Follows all *CFRs* and Aeolus Air Charter, Inc. policies pertinent to assigned duties.
- Assumes the duties of the Pilot-In-Command in the event the Pilot-In-Command is incapacitated.

## **10.0 Relevant Systems**

The CL-600 Model 2B16 (CL-605) Challenger airplane (Serial No. 5701 to 6049) FCOM was designed to provide the flight crew with readily accessible operational information. The purpose of the FCOM was:

- To provide information regarding operational procedures, performance and limitations
- To standardize terminology and behavioral patterns
- To provide rapid access to reference procedures
- To provide reference material for self-teaching
- To provide information on airplane systems and operations that are controlled and revised

The FCOM stated the following:

*Throughout this manual, the experience of the typical Challenger crew has been recognized, and for this reason, basic system principles have been omitted. For example, the text is not intended to teach the crew how to fly an airplane, but to enable an experienced crew to operate the airplane safely and proficiently.*

The FCOM was divided into two volumes:

Volume 1 - Procedures and Performance

Volume 2 - Systems Description

Challenger CL-605 systems descriptions were in the CL-600 Model 2B16 Challenger airplane (Serial No. 5701 to 6049) Flight Crew Operating Manual (FCOM), Volume 2 (revision 59 dated June 2, 2021).

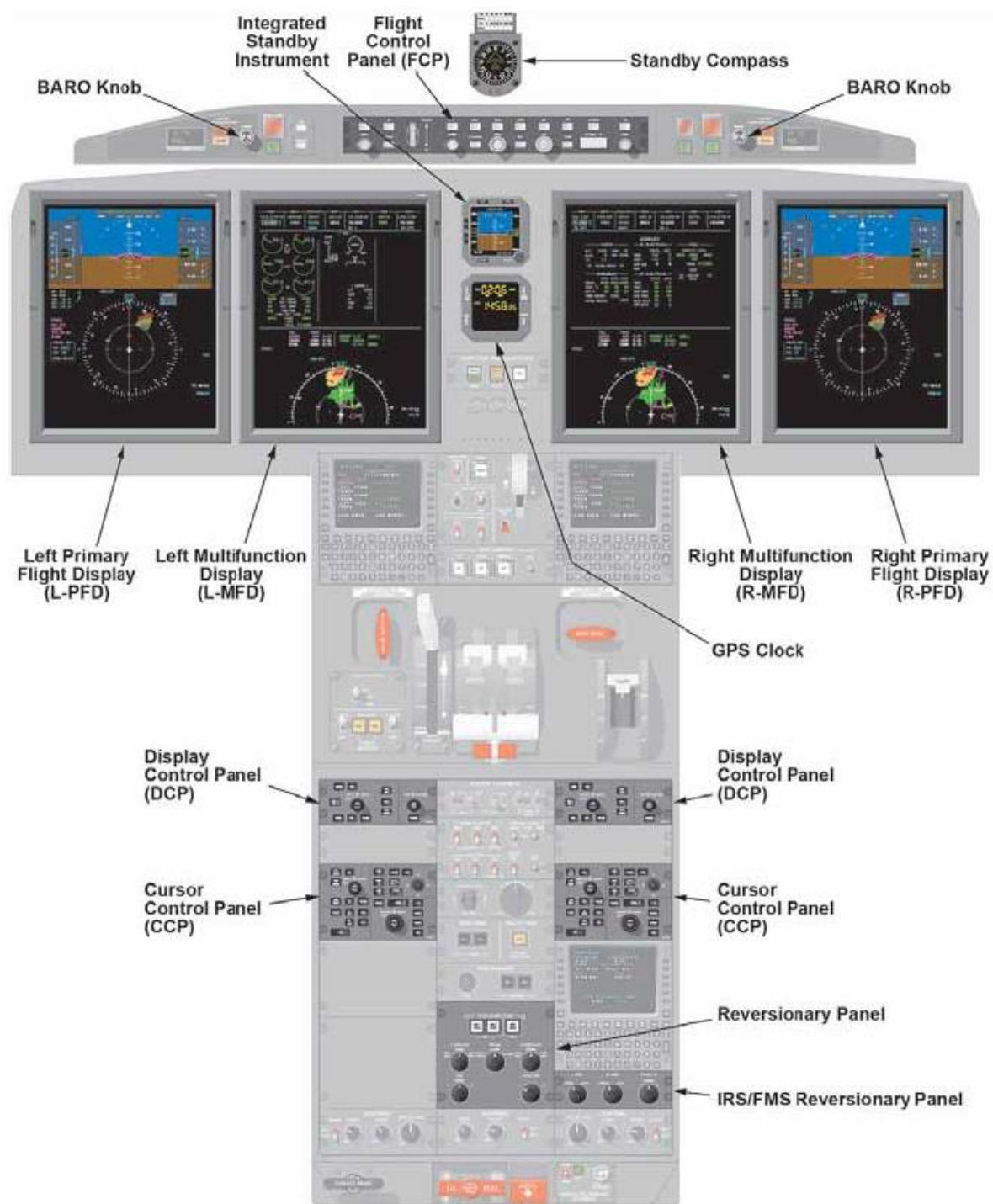
### **10.1 Electronic Flight Instruments System**

The CL-605 Electronic Flight Instruments System (EFIS) consisted of:

- Two adaptive flight displays to act as primary flight displays (PFDs)
- Two adaptive flight displays to act as multifunction displays (MFDs)

- Two display control panels (DCPs)
- Two cursor control panels (CCPs)
- One flight control panel (FCP)
- Two reversionary panels
- Two BARO knobs

The EFIS interfaced with the integrated avionics processing system (IAPS), which was the focal point of information flow for the entire airplane. The IAPS also contained the flight control computers (FCCs), flight management computers (FMCs), and maintenance diagnostic computer (MDC). The air data system and inertial reference system (IRS) provided information to the EFIS for display as conventional flight instruments.



**Figure 15: CL-605 Integrated Flight Instruments.**<sup>109</sup>

<sup>109</sup> Source: CL-605 FCOM Volume 2 page 11-10-2.



**Figure 16: CL-605 Primary Flight Display.<sup>110</sup>**

## 10.2 Flight Management Computer

A dual flight management system (FMS) on the CL-605 provided integrated cockpit and flight management functions. Each flight management system (FMS 1 and FMS 2) was composed of a control display unit (CDU) in the cockpit and a flight management computer (FMC) in the underfloor avionics equipment bay. A single data base unit (DBU) allowed data to be uploaded or downloaded to all the FMCs. A third flight management system (FMS 3) may be installed as a customer option.

<sup>110</sup> Source: CL-605 FCOM Volume 2 page 11-10-4.

According to a Maintenance Transaction Report from C&L Aviation Services, dated September 9, 2020, N605TR had three Collins FMC-6000 FMCs installed.<sup>111</sup>

The FMS cockpit management functions included:

- Navigation sensor control
- Radio tuning
- Multifunction display (MFD) control menus
- Navigation database management
- Control and management of the data loader
- Management of the data interface with external systems.

Flight management functions included:

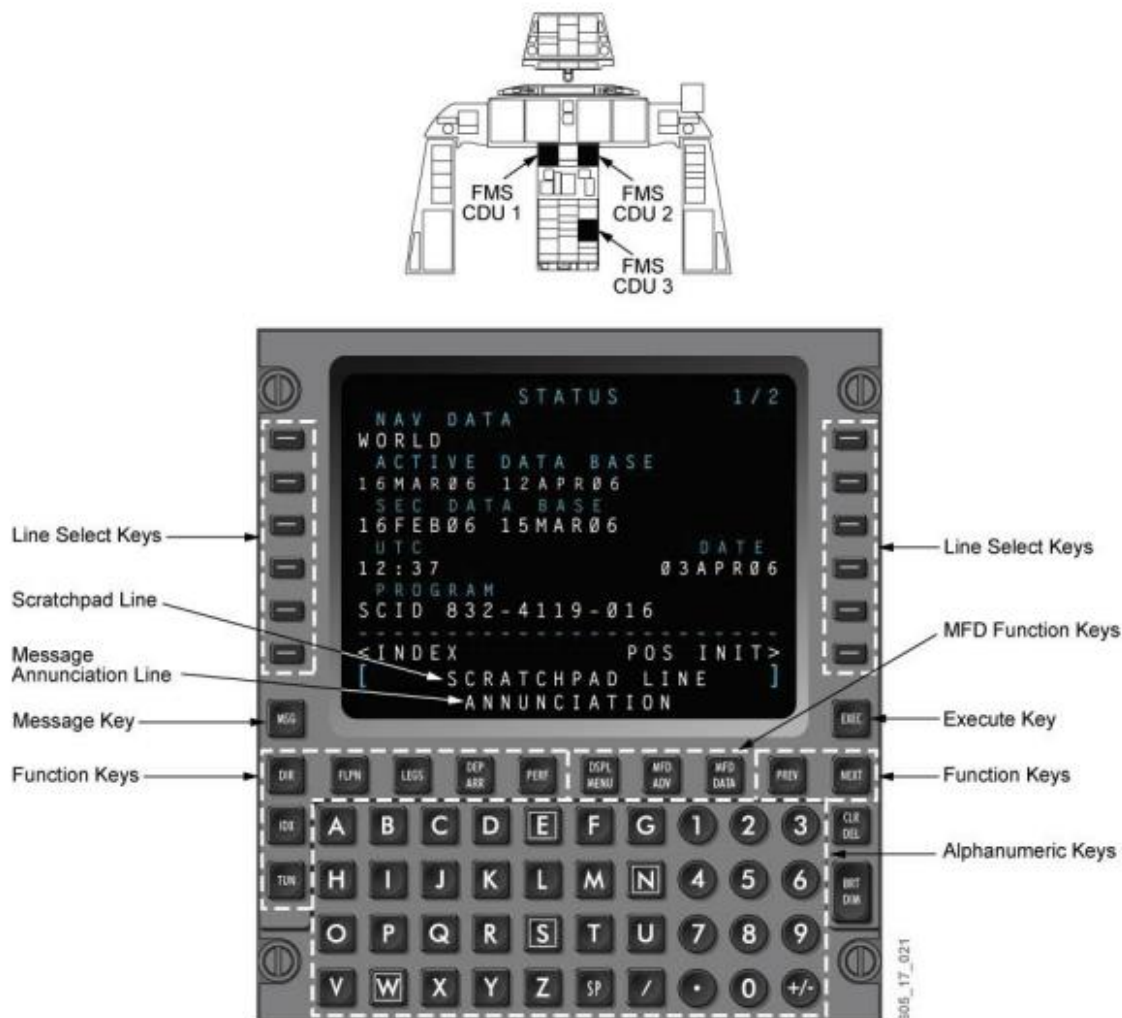
- Continuous calculation of the integrated navigation solution
- Flight plan inputs by the crew
- Lateral flight plan point-to-point navigation
- Vertical navigation
- Performance calculation
- Lateral/vertical steering commands to the flight control system.

### **10.3 Control Display Units (CDUs)**

The FMS CDU on the CL-605 was the cockpit interface of the flight management system. It allowed the flight crew to input, modify, and execute flight plans, as well as calculate aircraft performance. It also acted as a radio tuning interface through a dedicated TUNE page, and was the primary means of control for most navigation sensors. The CDU controlled certain information displays on the MFDs and advised the flight crew of FMS system status through a variety of message formats.

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<sup>111</sup> See Attachment 20 - FMC Maintenance Document.



**Figure 17: FMS Control Display Unit (CDU).**<sup>112</sup>

## 10.4 Automatic Flight Control System

According to the Challenger 605 FCOM, Volume 2, the Automatic Flight Control System (AFCS) on the CL-605 was a subsystem of the Collins Pro Line 21 Avionics System. It was a fully integrated flight control system that included a dual channel two-axis autopilot, each with integrated dual flight directors, dual yaw dampers, and automatic pitch trim control. The flight control system consisted primarily of the following equipment:

- Four flight control computers
- One flight control panel
- Aileron and elevator servos
- Two linear actuators for the rudder (yaw damping).

<sup>112</sup> Source: CL-605 FCOM Volume 2 page 17-10-148.

The Flight Control Computers (FCCs) received pilots' input from the selections made on the Flight Control Panel (FCP). Electronic signals from the FCCs sent guidance commands to the aileron and elevator servos, the yaw damper linear actuators, and the horizontal stabilizer trim control unit (HSTCU).

When the autopilot was engaged, the AFCS maneuvers the aircraft, while the pilot monitors the flight path by observing the flight guidance information presented on the EFIS primary flight display (PFD).

When the autopilot was disengaged, the pilot manually flew the aircraft in response to guidance provided by the flight director (FD) command bars on the PFD.

The Safe Flight enhanced autothrottle system (ATS) incorporated dual-servo control of the thrust levers to enable thrust and speed control for most phases of flight.

## **10.5 Air Data System Indications**

The PFD display on the CL-605 presented airspeed, altitude and vertical speed indications. Airspeed information was displayed on the left side of the PFD. Altitude and vertical speed information were displayed on the right side.

The pilot could choose either an IAS or Mach airspeed tape as the primary indication of speed. The airspeed display was a moving vertical tape, with the digital display of the current airspeed in the fixed window.

The indicated airspeed tape had an airspeed range from 40 to 400 knots. The tape had short tick marks every 5 knots, long tick marks every 10 knots and was numerically marked every 20 knots.

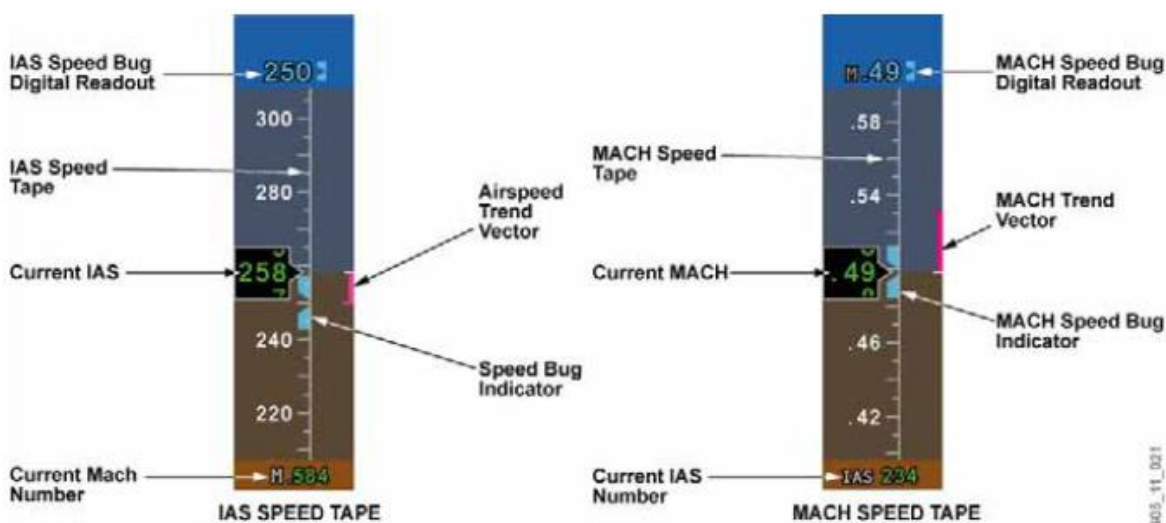
The airspeed trend vector originated from the tail of the indicated airspeed arrow. The magenta trend vector moved vertically in response to aircraft acceleration (extended up) or deceleration (extended down). If acceleration remained unchanged, the trend vector continuously predicted the aircraft's speed in 10 seconds.

The speed bug was sometimes referred to as the speed bucket because of its unique design. The bug was 10 knots wide. Measuring from the center, there was a  $\pm 5$  knot speed deviation to the outer edges of the indicator.

The SPEED knob on the Flight Control Panel (FCP) was used to set the airspeed reference bug to the desired speed on the airspeed tape. When the center of the SPEED knob was pressed, the speed reference toggled between Mach and IAS. When the FLC pushbutton on the FCP was pressed, the speed bug automatically aligned itself

with the aircraft's current airspeed. The speed bug could also be commanded by the FMS in VNAV (Vertical Navigation) sub modes.

The speed bug icon and digital readout were cyan when set with the SPEED knob on the FCP, and magenta when set by the FMS.



**Figure 18: CL-605 PFD Airspeed Information.**<sup>113</sup>

### 10.5.1 Reference Speeds

V-speed reference values  $V_1$ ,  $V_R$ ,  $V_2$ ,  $V_T$ ,  $V_{AC}$ , and  $V_{REF}$  on the CL-605 could be presented on the airspeed tape during takeoff and approach phases of flight. The speeds could be manually set and displayed (cyan characters) using the PFD REFS menu.<sup>114</sup> They could also be generated using the FMS performance pages and data. The Vs speeds would then be displayed in magenta on the airspeed tape.

Control of the V-speeds within the menu was achieved using the focus indicator and the standard menu controls on the DCP (MENU ADV/DATA knob and PUSH SELECT knob). Each of the reference speed values could be selected either on or off. When selected to ON, the associated reference value was displayed on the airspeed tape. Toggling the reference value between on and off was achieved by first highlighting the desired control using the focus indicator, and then pressing the PUSH SELECT knob. Each press of this button toggled the reference value back and forth between on and off. As V-speeds were toggled on, the focus indicator moved forward to the next selectable V-speed.

According to the CAE Simuflite Instructor who taught the accident co-pilot, when setting up the FMC for an approach, pilots were taught to use the performance

<sup>113</sup> Source: CL-605 FCOM Volume 2 page 11-10-22.

<sup>114</sup> See Attachment 17 - CL-605 Landing Speeds.

page in the FMC, verify the fuel weights, enter the winds and temperature at the destination, and then allow the FMC to automatically calculate the approach V-speeds and populate them on the PFD. The speeds provided were for VREF, VAC and VFTO.<sup>115</sup>

According to the Aeolus Air Charter, Inc. GOM (Standard Operating Procedures), approaches were required to be conducted at speeds prescribed by the AFM.

The CL-605 Quick Reference Handbook provided the following definitions of V-speeds:

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<sup>115</sup> In an email sent to the NTSB (dated June 8, 2022) Bombardier stated that *"the crew must ensure that not only OAT, but also Landing weight and QNH are accurate for the destination airport and entered manually, as system will default to current gross weight and coupled side QNH, (which at cruise or Top of Descent would still be 29.92/1013) and would not reflect the predicted landing weight and local QNH at destination airport, leading to inaccurate Vspeeds being displayed or Vspeeds suddenly being removed from the display (VSPEEDS DESELECTED FMS Message)."*

|                   |                                                                                                                                                                                                                                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAS               | Calibrated airspeed – Indicated airspeed corrected for static source position error.                                                                                                                                             |
| EAS               | Equivalent airspeed – Calibrated airspeed corrected for compressibility.                                                                                                                                                         |
| IAS               | Indicated airspeed – Airspeed indicator reading corrected for instrument error. Values in this manual assume zero instrument error.                                                                                              |
| M                 | Indicated Mach number – Machmeter reading corrected for instrument error.                                                                                                                                                        |
| M <sub>T</sub>    | True Mach number – Machmeter reading corrected for both instrument and static source position errors.                                                                                                                            |
| TAS               | True airspeed – Equivalent airspeed corrected for density.                                                                                                                                                                       |
| V <sub>1</sub>    | Takeoff decision speed (formerly designated as Critical engine failure recognition speed ) – The speed used as a reference at which, due to engine failure or other causes, the pilot may elect to stop or continue the takeoff. |
| V <sub>1MBE</sub> | Maximum V <sub>1</sub> for brake energy – The maximum speed on the ground from which a stop can be accomplished within the energy capabilities of the brakes.                                                                    |
| V <sub>1MCG</sub> | Minimum V <sub>1</sub> limited by control on the ground – The takeoff decision speed following an engine failure at V <sub>MCG</sub> . V <sub>1</sub> may not be less than V <sub>1MCG</sub> .                                   |
| V <sub>2</sub>    | Takeoff safety speed – Target climb speed to be attained at or before a height of 35 feet above the runway during a continued takeoff, following an engine failure.                                                              |
| V <sub>A</sub>    | Design maneuvering speed – The maximum speed at which application of full available aileron, rudder or elevator will not overstress the airplane.                                                                                |
| V <sub>AC</sub>   | Approach Climb Speed – The target climb speed to be attained after initiation of a Go-Around and selection of the approach climb configuration following an engine failure.                                                      |

**Figure 19: CL-605 V-Speed Definition Charts (1 of 3).**

|                 |                                                                                                                                                                                                                                                                                                    |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{ATE}$       | Autothrottle automatic engagement speed – The speed at which the Autothrottle will automatically engage. Corresponds nominally to $1.2 V_S$ and displayed on the Airspeed tape by an amber line located above the low speed cue indication.                                                        |
| $V_{EF}$        | Critical engine failure speed – The speed at which, if the critical engine fails, the engine failure is recognized at $V_1$ .                                                                                                                                                                      |
| $V_{FE}$        | Maximum flap extended speed – is the highest speed permissible with the wing flaps in a prescribed extended position.                                                                                                                                                                              |
| $V_{FTO}$       | Final takeoff climb speed – The speed attained at the end of the flight path acceleration segment during a continued takeoff following an engine failure, and is the climb speed scheduled for the final takeoff climb.                                                                            |
| $V_{LC}$        | Landing Climb Speed – The target climb speed to be attained after initiation of a Go-Around while in the landing configuration with all engines operating.                                                                                                                                         |
| $V_{LE}$        | Maximum landing gear extended speed – The maximum speed at which the airplane can be safely flown with the landing gear extended.                                                                                                                                                                  |
| $V_{LO}$        | Maximum landing gear operating speed – The maximum speed at which the landing gear can be safely extended or retracted.                                                                                                                                                                            |
| $V_{MO}/M_{MO}$ | Maximum Operating Limit Speed / Mach Number – The maximum operating limit speed (airspeed or Mach number) is the speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training operations. |
| $V_{MCA}$       | Minimum control speed, air – Minimum flight speed at which the airplane is controllable when the critical engine suddenly becomes inoperative, with the remaining engine at maximum takeoff thrust.                                                                                                |

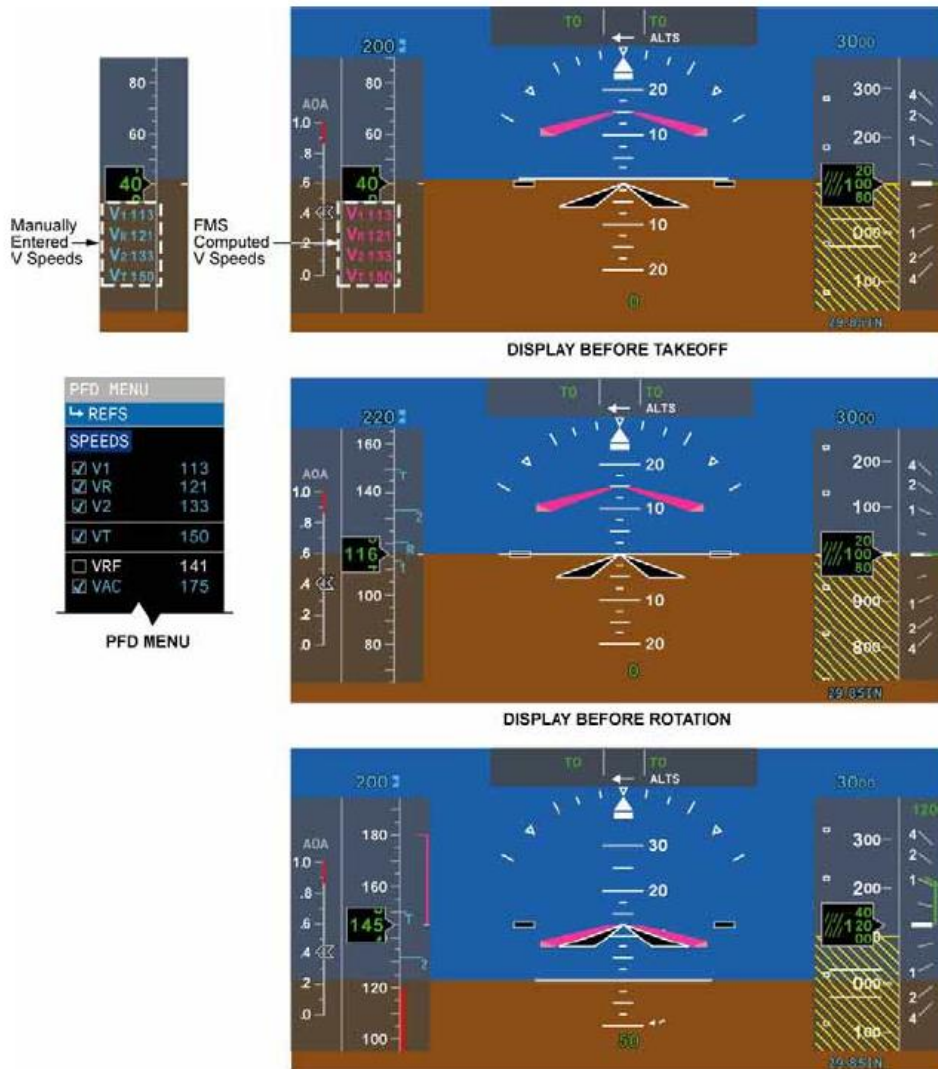
**Figure 20: CL-605 V-Speed Definition Charts (2 of 3).**

|           |                                                                                                                                                                                                                                                                        |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{MCG}$ | Minimum control speed, ground – Minimum speed on the ground at which control can be maintained and the takeoff continued using aerodynamic controls alone, when the critical engine suddenly becomes inoperative, with the remaining engine at maximum takeoff thrust. |
| $V_{MCL}$ | Minimum control speed during landing approach – Minimum flight speed at which the airplane is controllable when the critical engine suddenly becomes inoperative, with the remaining engine at maximum takeoff thrust.                                                 |
| $V_{MD}$  | Minimum Drag Speed – The speed that provides the maximum lift/drag ratio.                                                                                                                                                                                              |
| $V_R$     | Rotation speed – Speed at which rotation is initiated during takeoff.                                                                                                                                                                                                  |
| $V_{REF}$ | Approach speed – The landing reference speed at a height of 50 feet above the runway threshold in the normal landing configuration.                                                                                                                                    |
| $V_S$     | Stalling speed.                                                                                                                                                                                                                                                        |

**Figure 21: CL-605 V-Speed Definition Charts (3 of 3).<sup>116</sup>**

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<sup>116</sup> Source: CL605 Quick Reference Handbook (QRH) pages INTRO 17 through 19.



**Figure 22: Example PFD Reference Speed Indications.<sup>117</sup>**

According to the Rockwell Collins FMS v4.0 Flight Management System for the Challenger 605 Operator's Guide, four APPROACH REF pages showed approach runway information, meteorological conditions, and aircraft configurations used to determine approach V-speeds. This information was also used to determine Maximum Landing Weight (MLW), Landing Field Length (LFL), and Actual Landing Distance (ALD). Maximum weight limits were also computed. Access to the APPROACH REF pages was through the PERF MENU.

According to the FMS Operator's Guide, to set up the FMC for V-speed calculations, the pilot would access the APPROACH REF page 1, verify the destination airport and runway of intended landing, select a runway condition option (for example

<sup>117</sup> Source: CL-605 FCOM Volume 2 page 11-10-24.

dry), enter the wind data and Outside Air Temperature (OAT), and confirm the barometric setting.<sup>118</sup>

According to Rockwell Collins FMS v4.0 Flight Management System for the Challenger 605 Operator's Guide, the APPROACH REF page 1/4 showed the approach runway information and the ambient meteorological conditions used for determining approach V-speeds (VREF, VAC, VFTO). This information was also used to determine MLW and LFL. The information provided on the APPROACH REF pages was for the active flight plan only.



**Figure 23: FMS Control Display Unit (CDU) showing an example of APPROACH REF page 1/4.**<sup>119</sup>

The APPROACH REF page 2/4 showed data fields for approach V-speeds, landing weight data, and landing runway length data. It also allowed for selection of the computed approach V-speeds for display on the PFD airspeed scale.

The APPROACH REF 2/4 page showed the computed values for approach V-speeds: VREF (Reference Speed, flaps 45 degrees), VAC (Approach Climb Speed), and VFTO (Final Takeoff Speed, flaps zero). The FMS computed values for the APPROACH REF V-speeds showed in white on the CDU and MFD when the APPROACH REF V-speeds had not been selected for display on the PFD. The FMS computed values for APPROACH REF V-speeds showed in cyan on the CDU and MFD when they had been successfully selected for display on the PFD.

<sup>118</sup> In an email sent to the NTSB (dated June 8, 2022) Bombardier stated that "LW, QNH and OAT are required inputs to generate Vs speeds using the FMS. The OAT field is initially empty prompting a crew input. The QNH and LW fields are pre-filled using the aircraft current QNH and Gross Weight (GWT) data at the time the APPROACH PERF page is accessed. The crew must manually enter the predicted landing weight, local OAT and QNH to lock these values and generate accurate landing performance data."

<sup>119</sup> Source: Rockwell Collins FMS v4.0 Flight Management System for the Challenger 605 Operator's Guide.



**Figure 24: FMS Control Display Unit (CDU) showing an example of APPROACH REF page 2/4.**<sup>120</sup>

The SEND line select key (LSK) on the APPROACH REF 2/4 page was used to transmit the APPROACH REF V-speeds to the PFD for display. When the SEND command was initiated, the status message IN PROGRESS showed above the SEND LSK. If the V-speed values were correctly transferred to the PFD, COMPLETE replaced IN PROGRESS as the status message.

Landing Weight (LW) was a required input parameter for the computation of approach performance data. LW was pre-filled to the current aircraft Gross Weight (GWT) at the time the APPROACH REF pages were accessed (from a non-APPROACH REF page).

### 10.5.2 FMC Defaults

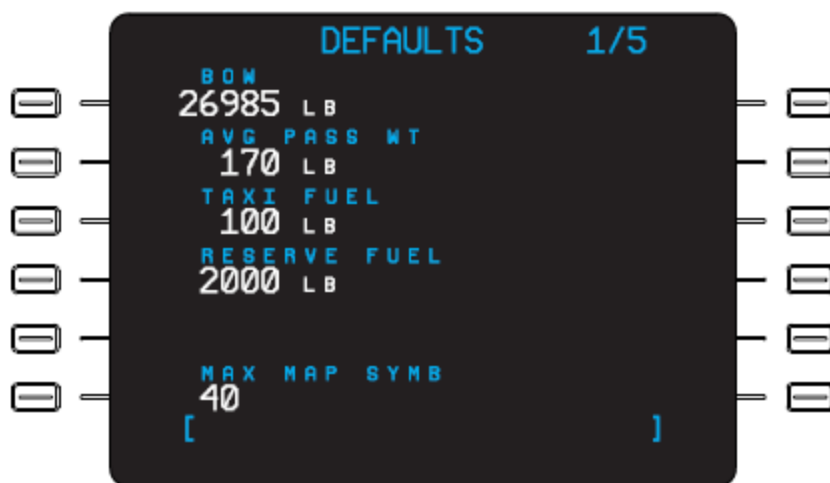
The DEFAULTS 1/5 page showed default values for the performance values that showed on the PERF INIT pages. The DEFAULTS 1/5 page was used to set or change the default values/settings for:

- Basic Operating Weight (BOW)
- Average Passenger Weight (AVG PASS WT)
- TAXI FUEL Weight
- RESERVE FUEL Weight
- MAX MAP SYMBOLS

The settings on the DEFAULTS pages remained in effect until they were changed. But, for any individual flight plan, any of the defaults on the appropriate

<sup>120</sup> Source: Rockwell Collins FMS v4.0 Flight Management System for the Challenger 605 Operator's Guide.

display page of a flight plan could be overridden. Overriding the default setting from within a flight plan did not change the settings on the DEFAULTS page.



**Figure 25: FMS Control Display Unit (CDU) showing an example of DEFAULTS page 1/5.<sup>121</sup>**

Pilot entry of cargo weight, number of passengers, and total fuel weight allowed the FMS to calculate Zero Fuel Weight (ZFW) and aircraft Gross Weight (GWT). If no manual entries for cargo and number of passengers were used (dashes show), the FMS program used the default BOW as the ZFW.

When entries for passenger weight and cargo weight were used, the FMS calculated ZFW.  $ZFW = \text{cargo weight} + \text{passenger weight} + \text{BOW}$ .

The ZFW was computed using basic operating weight, total passenger weight, and cargo weight. ZFW could also be entered manually. If ZFW was entered manually dashes would show for BOW, cargo, and passenger data fields. Manually entered data showed in larger font. ZFW was limited to the default maximum BOW in the database.

According to Bombardier, the FMS factory default Basic Operating Weight on the FMS-6000 was preset to 24,000 lbs.<sup>122</sup> This weight default was confirmed by Collins Aerospace and stated that the actual operating weight of the specific operator could differ, due to interior differences.<sup>123</sup> Operators would have to update the BOW in the FMC Defaults page with the actual BOW of the airplane for the FMC to accurately calculate performance values and speeds.<sup>124</sup>

<sup>121</sup> Source: Rockwell Collins FMS v4.0 Flight Management System for the Challenger 605 Operator's Guide.

<sup>122</sup> Source: Bombardier email to the NTSB dated September 23, 2021.

<sup>123</sup> Source: Collins Aerospace email to the NTSB dated November 30, 2021.

<sup>124</sup> Following the November 10, 2015, accident involving an Execuflight British Aerospace HS 125-700A (Hawker 700A), N237WR that departed controlled flight while on a nonprecision localizer approach to

The three FMCs on the accident airplane (N605TR) were removed and reinstalled on September 9, 2020 when maintenance was being performed on the airplane at C&L Aviation Services in Bangor, Maine.<sup>125</sup> According to interviews, Aeolus Air Charter, Inc. did not have an FMC software subscription with Collins Aerospace for updates of the FMCs installed on N605TR.<sup>126</sup>

For a detailed maintenance history on N605TR and the FMCs, see Systems Group Chairman's Factual Report in the docket for this investigation.

## **10.6 Low-speed Cue**

The low-speed cue on the CL-605 was generated by angle-of-attack information from the auxiliary angle-of-attack vane. It appeared three seconds after lift-off on the lower portion of the airspeed scale and was displayed as a solid red line.

A low-speed pre-alert occurred when the solid red line cue changed to an expanded alternating red and outlined checkerboard band and airspeed/Mach digital readout changed from green to yellow (the aircraft was within a few knots of activating the stick shaker). In the landing configuration (gear down, flaps 45), the top of the cue represented a calculated airspeed of 1.06 Vs, the speed at which the stick shaker would activate.

If current airspeed became less than the top of the low-speed cue, the airspeed/Mach digital readout changed color to red.

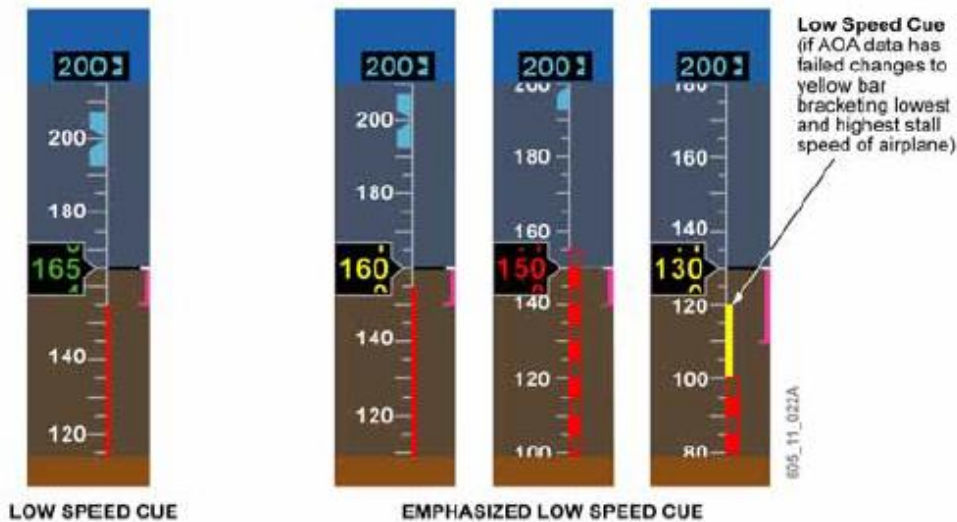
When angle-of-attack (AOA) data failed or was missing (which may or may not be due to a stall system failure), the low-speed cue changed to its default setting. The speed cue stopped at 100 knots and a yellow line extended upwards from the top of the checkerboard to 120 knots. The intent of this defaulted failure indication was to provide some remaining indication of low speed awareness, while indicating that the low-speed cue was in a degraded and defaulted mode.

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runway 25 at Akron Fulton International Airport (AKR) and impacted a four-unit apartment building in Akron, Ohio (Report #AAR-16-03) the NTSB issued Safety Recommendation A-16-040 to the FAA that stated "*Issue a safety alert for operators describing the circumstances of this accident and reminding operators to ensure that current and accurate information is entered into weight-and-balance software programs used in their operations.*" The recommendation was classified Closed - Acceptable Action on March 24, 2020.

<sup>125</sup> See Attachment 20 - FMC Maintenance Document.

<sup>126</sup> See Attachment 1 - Interview Transcripts.



**Figure 26: CL-605 Low-Speed Cues.**<sup>127</sup>

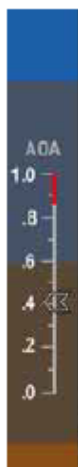
## 10.7 Angle-of-Attack

The AOA display on the CL-605 was a vertical tape located immediately to the left of the airspeed tape. Like the low-speed cue, this display was generated by angle-of-attack information from the auxiliary angle-of-attack vane. The AOA display function was advisory only and indicated airspeed must always be used as the primary reference.

A reading of 0.0 AOA corresponded to zero lift. The pusher activation was equal to a reading of 1.0 AOA.

The AOA scale was marked with a red band from 0.8734 to 1.0. Shaker activation was 1.07 Vs or 0.8734 AOA. 1.3 Vs corresponded to 0.5917 AOA. This was approximately equal to the AOA for V<sub>REF</sub> in non-accelerated flight.

<sup>127</sup> Source: CL-605 FCOM Volume 2 page 11-10-26.



**Figure 27: CL-605 Angle of Attach (AOA) Indicator.**<sup>128</sup>

## 10.8 Flaps

Two double-slotted flap panels (inboard and outboard) on the CL-605 were externally hinged on the trailing edge of each wing. A flap lever, located on the center pedestal, sent a signal to the flap control unit (FCU) to initiate flap movement.

The flaps may be set to one of four positions: 0, 20, 30, and 45 degrees. A flap gate was incorporated within the flap lever 20-degree detent. This minimized the possibility of accidental flap retraction to 0 degrees during a go-around procedure. Flap position was displayed on the EICAS page and the FLIGHT CONTROLS synoptic page, in both analog (colored bar) and digital formats. The indications on the EICAS page were in view only if the flaps were extended, or if the landing gear was not up and locked.

| Maximum Flap Speeds |                  |
|---------------------|------------------|
| FLAP SETTING        | MAXIMUM AIRSPEED |
| 20 degrees          | 231 KIAS         |
| 30 degrees          | 197 KIAS         |
| 45 degrees          | 189 KIAS         |

**Figure 28: CL-605 Maximum Flap Speeds (placarded in the airplane).**<sup>129</sup>

## 10.9 Flight Spoilers

Flight spoilers on the CL-605 provided lift dumping and speed control when airborne, and reduced ground roll during landing and rejected takeoffs.

<sup>128</sup> Source: CL-605 FCOM Volume 2 page 11-10-27.

<sup>129</sup> Source: CL-605 FCOM Volume 2 page 10-10-15.

Each flight spoiler panel was hydraulically operated by two identical PCUs, powered by hydraulic systems 1 and 2. The flight spoilers were mechanically controlled by the flight spoiler control lever on the center pedestal and could be deployed up to a maximum of 40° in flight or on the ground.

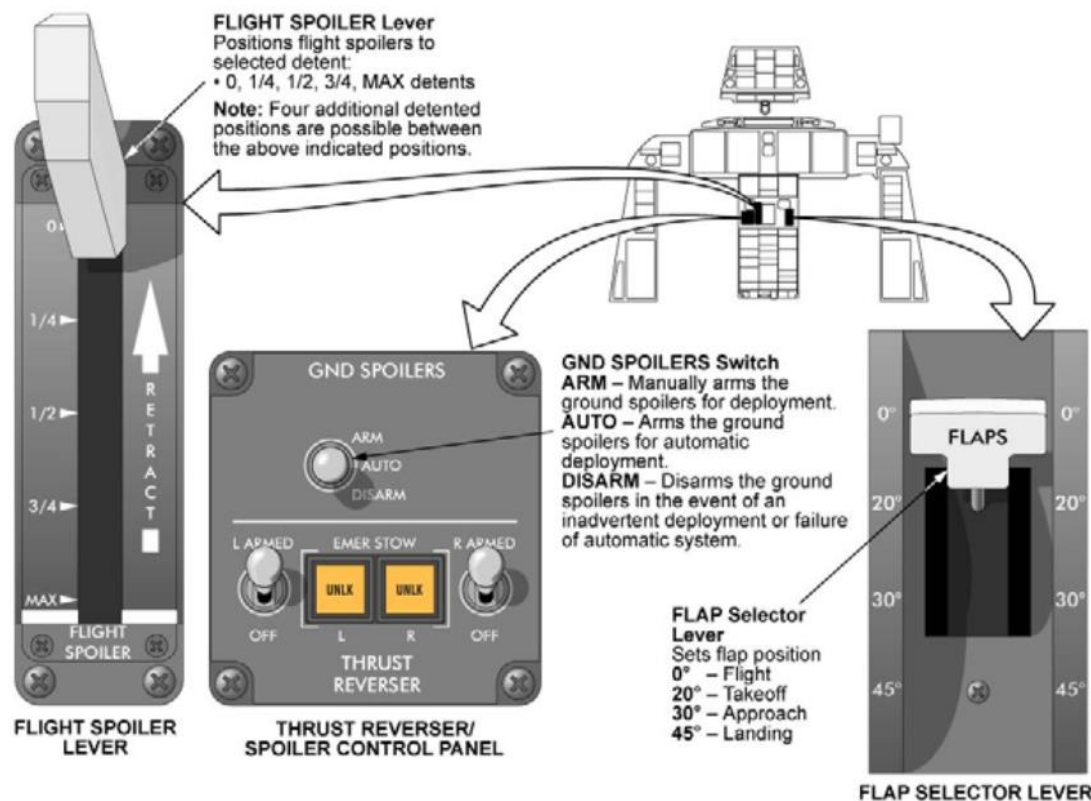
The flight spoiler control lever traveled through nine detents, allowing the pilot to select variable amounts of flight spoiler deployment.

Spoiler position was indicated on both the EICAS page and FLIGHT CONTROLS synoptic page, using white arrows which moved upward towards lines indicating relative extension (for flight spoilers only), and full extension (for both flight and ground spoilers). When the flight and ground spoilers were fully retracted, all EICAS spoiler icons and position arrows disappeared.

An amber FLT SPLRS DEPLOY caution EICAS message appeared if the flight spoilers were deployed in flight, and:

- The aircraft radio altitude was between 10 and 300 feet AGL
- The left or right engine N1 was greater than 79%
- If radio altitude was not available, at any time the landing gear was extended.

If the flight spoilers were not stowed with the aircraft in takeoff mode, a CONFIG SPOILERS warning EICAS message and aural warning would be displayed/sounded.



**Figure 29: CL-605 Flap and Spoiler Controls.**

## 10.10 Stall Protection System

According to the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B), a stall was a rapid decrease in lift caused by the separation of airflow from the wing's surface, brought on by exceeding the critical angle of attack (AOA). AOA is defined as the acute angle between the chord line of the airfoil and the direction of the relative wind. An aerodynamic stall can occur when the airplane flies too slowly, or when higher wing loads are imposed due to maneuvers such as pull-ups or banked flight. A stall could occur at any pitch attitude or airspeed.

The stall protection system (SPS) on the CL-605 provided the flight crew with aural, visual and tactile (stick shaker) indications of an impending stall and, if no corrective action was taken, would activate a stick pusher to prevent the aircraft from entering a full stall.

Stall Protection System Computer (SPS) was a dual-channel computer that monitored the following inputs:

- Angle of attack - LH, RH angle-of-attack vanes
- Lateral acceleration - Inertial reference system (IRS)
- Flap position

- Pressure altitude – Air data computers (ADCs)

The SPS used these inputs to continuously calculate AOA trip points while in flight. The AOA trip points were biased with the lateral accelerometers (sideslip and skid), flap position and pressure altitude.

As the trip point was approached, continuous ignition was activated. If the AOA continued to increase, the stick shaker activated and the autopilot disengaged. If the AOA continued to increase, the stick pusher activated and a red STALL annunciation was displayed left of the ADI and master warning lights on the glareshield and a warbler aural warning activated. The stick pusher only activated when the signals from both channels of the SPS computer were in agreement.

The FCOM included the following NOTE:

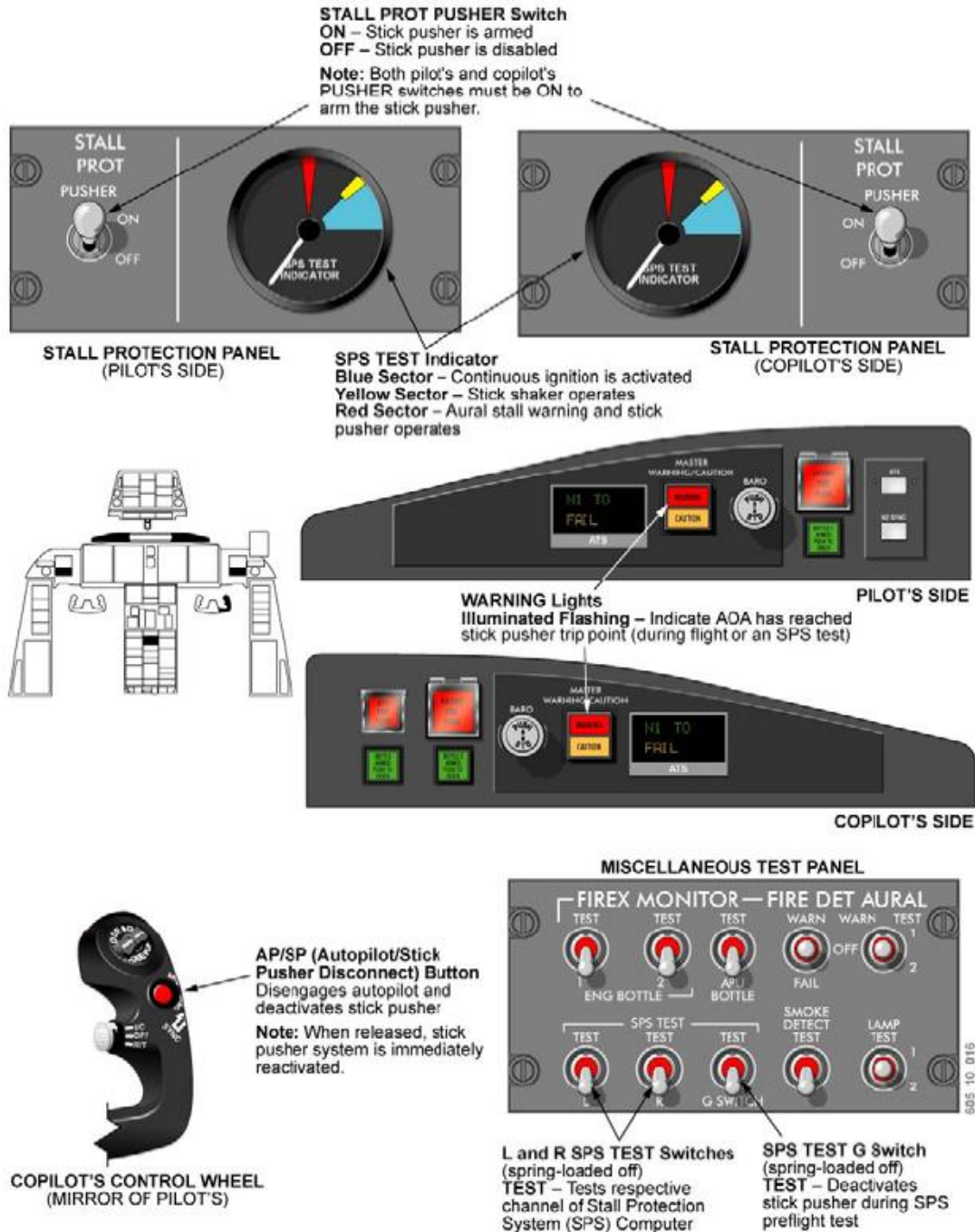
*The crew should initiate approved recovery techniques at the first indication of an impending stall (i.e., recognition of proximity of low-speed cue at airframe buffet, at autoignition, or any time the stick shaker or pusher activates).*

In the event of an AOA increase rate greater than one degree per second, the SPS computer lowered the AOA trip points to activate the aural, visual and tactile indications at a lower AOA. This prevented the aircraft's pitching momentum from carrying it through the stall warning/stick pusher sequence into the stall.

The stick pusher disconnect subsystem was armed when both STALL PROT PUSHER switches, located on the pilot and co-pilot side panels, were ON. An acceleration switch would disconnect the stick pusher to prevent an unusual attitude, if less than +0.5 'G' was reached during pusher operation. The pusher could also be disabled momentarily by pushing the AP/SP DISC button on the pilot's or co-pilot's control wheels, which would disconnect the pusher only as long as either button was held in. In the event of a malfunction, the stick pusher could be deactivated by switching either STALL PROT PUSHER switch to OFF (located on the side panels). To enable pusher operation, both switches had to be returned to the ON position.

The FCOM provided the following NOTE:

*The stick shaker is always armed. The STALL PROT PUSHER switches affect only the stick pusher function.*



**Figure 30: CL-605 Stall Protection System.**<sup>130</sup>

<sup>130</sup> Source: CL-605 FCOM Volume 2 page 10-10-27.

## 11.0 Relevant Procedures

### 11.1 Aeolus Air Charter, Inc Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) for Aeolus Air Charter, Inc. pilots were in the Aeolus Air Charter, Inc. GOM. According to the Aeolus Air Charter, Inc. DO, it was his expectation that pilots would comply with the SOPs regardless of whether the flight was flown under Part 135 or Part 91.

According to the SOPs, the Normal Procedures Checklist was used to ensure that all important items had been accomplished, and the checklist for each phase of flight was required to be accomplished as specified in the approved checklist.

Normally, crew duties were divided between the PIC and SIC on the ground, and in the air between the PF and the PM. Although crew duties were divided, each pilot was supposed to always maintain an awareness of the other pilot's activities.

Company SOPs were not intended to take precedent over *CFRs*, the FAA-approved AFM, or the pilot's good judgment. In an abnormal or emergency situation, the PIC retained the authority to deviate from company SOPs as necessary to ensure safety of flight.

Crews were required to follow company procedures to their best judgement.

|     |                        |                                                                                                                                                                                                                                                                                                                          |
|-----|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PF  | Pilot Flying           |                                                                                                                                                                                                                                                                                                                          |
| PM  | Pilot Monitoring       |                                                                                                                                                                                                                                                                                                                          |
| PIC | Pilot-in-Command       | This is the Captain assigned to the flight. This person is ultimately responsible for the safe operation of the flight. The PIC may be seated in either the left or right seat if he or she has received training and been evaluated in that seat position as long as the other pilot is qualified for either seat also. |
| SIC | Second-in-Command      |                                                                                                                                                                                                                                                                                                                          |
| ACM | Additional Crew Member | On certain flights a third crewmember may be assigned for flight and duty rest considerations.                                                                                                                                                                                                                           |

**Figure 31: Aeolus Air Charter, Inc. pilot responsibilities.**<sup>131</sup>

#### 11.1.1 Checklist Procedures

According to the Aeolus Air Charter, Inc. GOM, checklists would be completed by the SIC when the aircraft was on the ground and by the PM when the aircraft was in flight, or as required by the manufacturer's SOPs. Checklist items would be read aloud, and the correct response would be read by either pilot completing the checklist or by the other pilot, as appropriate. The After Takeoff, After Landing and Shutdown checklists could be completed silently. When all checklist items had been completed,

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<sup>131</sup> Source: Aeolus Air Charter, Inc. GOM page 3-1.

the pilot reading/performing the checklist would announce "\_\_\_\_ Checklist is complete."

When the SIC could not verify an item, that item would require a challenge and response. When all items were completed the SIC would advise "\_\_\_\_checklist complete."

The aircraft flight manual outlined checklist procedures and contained the appropriate checklists for various normal and non-normal conditions.

The GOM included the following Note:

*Use of these checklists or company approved checklists is mandatory.*

#### **11.1.2 Standard Callouts (Aeolus Air Charter, Inc.)**

The Aeolus Air Charter, Inc. GOM (Standard Operating Procedures) stated the following, in part:

*The following are recommendations and standardized procedures for operating Aeolus Air Charter, Inc. aircraft. If the information conflicts with the FAA approved flight aircraft flight manual [sic], the AFM will take precedence.*

| Phase of Flight                                       | Crew Member | Callouts                                                                                          |
|-------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------|
| Descent                                               |             |                                                                                                   |
| 1,000 feet above each assigned altitude               | PM          | "_____ descending _____."                                                                         |
| Approaching transition level                          | PM          | "Altimeters set to _____."                                                                        |
| All Approaches and Landings                           |             |                                                                                                   |
| At approximately 1,000 feet AFE                       | PM          | "1,000"                                                                                           |
| At 500 feet AFE                                       | PM          | "500."                                                                                            |
| All Instrument Approaches                             |             |                                                                                                   |
| Annunciated FD/AP modes                               | PM          | "NAV armed, APPROACH armed, etc." as appropriate.                                                 |
| Non-Precision Approaches                              |             |                                                                                                   |
| Approaching DA/MDA/DDA (approximately 100 feet above) | PM          | "Approaching Minimums."                                                                           |
| At minimums                                           | PM          | "Minimums"                                                                                        |
| When runway is in sight.                              | PF          | "Runway in sight, continue."                                                                      |
| At missed approach point                              | PM          | "Missed approach point."<br>"Go around." "Go around Flaps"                                        |
| If runway not in sight                                | PF<br>PM    | "Go around Flaps" With positive rate announce "Positive Rate" and continue                        |
| Prior to leaving MDA                                  | PF          | "Approach lights in sight," or "Runway in sight," or "Going visual and Leaving MDA." <sup>1</sup> |
| All Precision Approaches                              |             |                                                                                                   |
| First movement of localizer                           | PM          | "Localizer alive."                                                                                |
| First positive movement of glide slope indicator      | PM<br>PM    | "Glideslope alive."<br>"Approaching minimums."                                                    |
| Approaching DA (approximately 100 feet above)         | PF          | "Runway in sight," or "Approach lights in sight." <sup>1</sup>                                    |
| At or before DA                                       | PMPF and    | "Minimums." <sup>2</sup>                                                                          |
| At minimums                                           | PM          | "Missed Approach," or "Go around and going missed"                                                |
| If runway not in sight at minimums                    |             |                                                                                                   |

**Figure 32: Aeolus Air Charter, Inc. Standard Callouts.**<sup>132</sup>

### 11.1.3 Positive Transfer of Controls

According to the Aeolus Air Inc. GOM, for a Positive Transfer of Control with the autopilot not engaged, pilots were required to perform the following:

1. PF will state "You have the controls."
2. The new PF will place his hands on the yoke and state, "I have the controls."

<sup>132</sup> Source: Table 3-3 from the Aeolus Air Charter, Inc. GOM (Standard Operating Procedures), page 3-17.

3. The new PM will release the controls.

#### **11.1.4 Approach Briefing**

According to the Aeolus Air Charter, Inc. GOM, the PF will conduct an approach briefing for the planned approach. The approach briefing was ideally conducted prior to the Top of Descent. When a visual approach was anticipated and an approach procedure served the landing runway (preferably an ILS) the approach would be tuned and used as a backup for the visual approach.

The PF normally transferred aircraft control to the PM during the approach briefing. In addition, the following should also be addressed in the approach briefing:

- Approach to be flown and backup approach, if available
- Special procedures during the approach, such as circling approach, interception of a radial from an arc, VDP (Visual Descent Point), etc.
- Altitudes of IAF, FAF, step-downs, sector altitudes, and obstacles
- Minimums (Decision Height, MDA), Height Above Touchdown, Height above Touchdown, and radio altimeter setting

#### **11.2 Bombardier CL-605 Normal Procedures**

Bombardier's CL-605 procedures and performance information were in the CL-600 Model 2B16 Challenger airplane (Serial No. 5701 to 6049) FCOM, Volume 1 (Procedures and Performance), revision 59 dated June 2, 2021.

According to Bombardier, the FCOM Volume 1 was the complete operating procedures document for the CL-605. It was the responsibility of pilots who were qualified to operate the airplane to be entirely familiar with the information contained in the publication to ensure that the airplane was always operated within the approved flight envelope.

For clarity and simplicity, the manual was written in the imperative in order that the information and operating instructions may be presented in a positive sense and require no interpretation by the user.

In some procedures, the designations "PF" and "PNF" were used. "PF" meant that the associated action was always performed by the pilot presently flying the airplane, whether it was the pilot or the co-pilot. "PNF" meant the pilot not flying the airplane.

Chapter 4 of the FCOM Volume 1 contained detailed procedures for conducting a normal flight with all airplane systems operational. Procedures were listed

sequentially by phase of flight, starting with the exterior safety inspection and extending through post-flight duties at the destination. Line items defined the steps to be accomplished during each phase of flight and were expanded to define the action required to perform the steps.<sup>133</sup>

## 11.2.1 Circle Approach

The CL-605 circle approach procedures and profile were contained in the CL-605 FCOM Volume 1, and are depicted in the following tables:

### Circling Approach

When performing a circling approach, maintain the airplane configuration from the final approach fix (FAF) onwards (flaps 30° and landing gear down). At the circling MDA with the field in sight, maneuver to establish a downwind leg parallel to the runway at a distance of approximately 1 1/2 miles.

#### At the established downwind:

- (1) Circling MDA ..... Maintain
- (2) Flaps ..... 30 degrees
- (3) Airspeed ..... Flaps 30° speed  
+ 10 KIAS

#### When abeam the runway threshold:

- (4) Chronometer ..... Start      Time for 15 to 30 seconds,  
plus or minus wind correction.

#### After the desired timing has elapsed, start the turn towards the base leg:

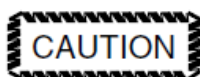
- (5) Descent ..... Initiate

#### Approaching 400 feet, start turn towards final, and when landing is assured:

- (6) Flaps ..... 45 degrees
- (7) Airspeed .....  $V_{REF} + WIND$       Wind correction is half steady  
state crosswind plus all gust  
(regardless of direction).  
Maximum correction is  
+ 20 KIAS.

### NOTE

The autopilot, if used, should be disconnected no later than 320 feet AGL.

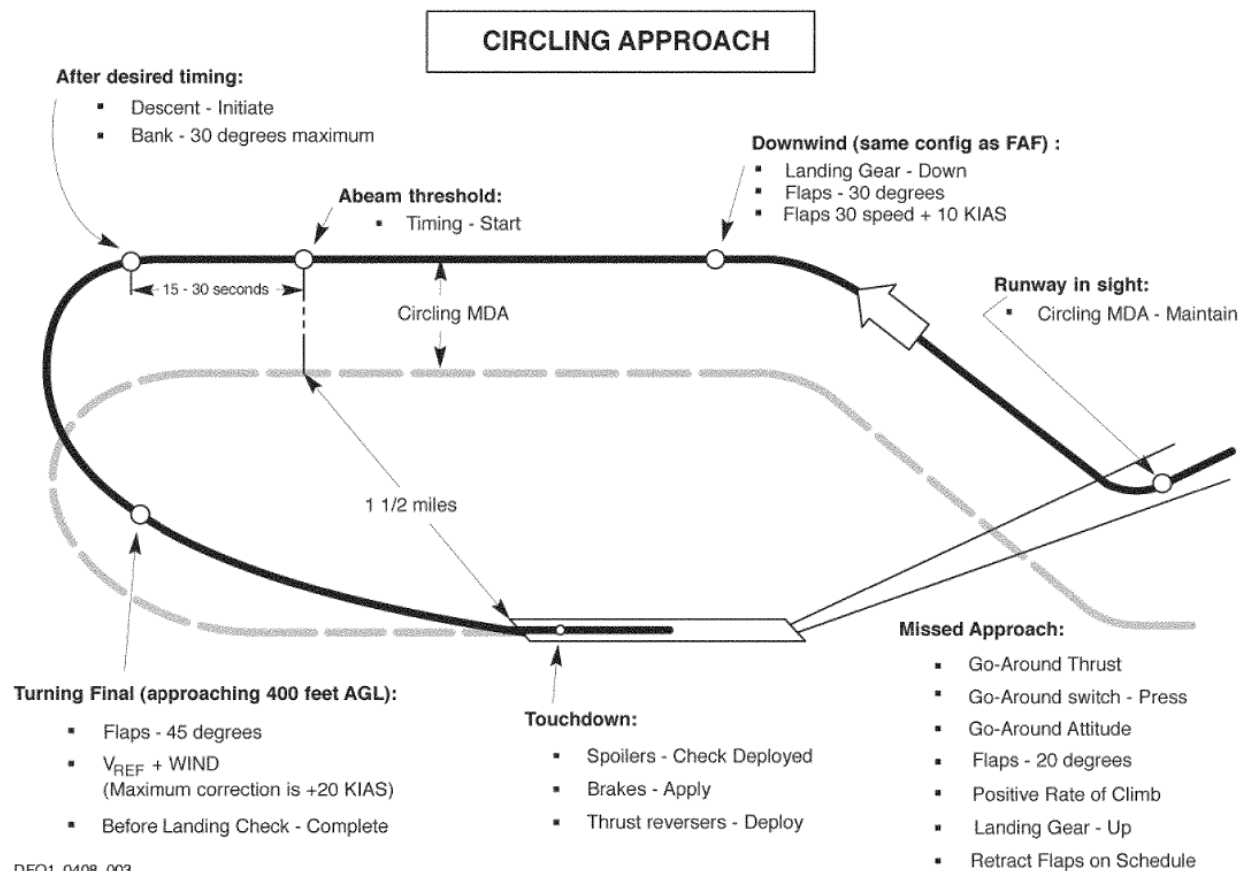


PFD negative barometric altitude is indicated by a yellow NEG flag within the barometric altitude window.

**Figure 33: CL-605 Circle Approach Procedures.**<sup>134</sup>

<sup>133</sup> For additional information, See Attachment 18 - CL605 Normal Procedures.

<sup>134</sup> Source: CL-605 FCOM Volume 1 page 04-08-9.



**Figure 34: CL-605 Circle Approach Profile.**<sup>135</sup>

### 11.2.2 Maneuvering and Approach Speeds

According to the CL-605 FCOM Volume 1, the minimum maneuvering speed was obtained by adding 10 knots to the approach speed as defined in the Airplane Flight Manual. The 10-knot additive provided adequate margin to stick shaker actuation for an inadvertent 15° overshoot beyond the normal 30° bank, when recommended procedures were followed.<sup>136</sup>

### 11.2.3 Standard CL-605 Callouts (Bombardier)

Standard pilot callouts for the CL-605 were defined in the CL-605 FCOM Volume 1, and depicted in the following figures:

<sup>135</sup> Source: CL-605 FCOM Volume 1 page 04-08-10.

<sup>136</sup> Source: CL-605 FCOM Volume 1 page 04-08-1. The NTSB reviewed the CL-605 FCOM and QRH, and the "Flaps 30" speed as referenced in the circle approach procedure and profile is not defined. For the "Flaps Fail" checklist in the CL-605 QRH, there was a reference for flying an approach if the flaps failed at 30°, which requires the pilot to add 7 knots to the  $V_{REF}$  speed (flaps 45°).

**CALLOUTS DURING CLIMB**

| CONDITION                                                     | CALL                | CREW MEMBER |
|---------------------------------------------------------------|---------------------|-------------|
| Passing transition altitude                                   | Transition altitude | PNF         |
| 1,000 feet before reaching clearance altitude or flight level | 1,000 feet to go    | PNF         |

**CALLOUTS DURING DESCENT**

| CONDITION                                              | CALL             | CREW MEMBER |
|--------------------------------------------------------|------------------|-------------|
| 1,000 feet before reaching clearance level or altitude | 1,000 feet to go | PNF         |
| Passing transition level                               | Transition level | PNF         |

**CALLOUTS DURING APPROACH**

| CONDITION                                                           | CALL                 | CREW MEMBER |
|---------------------------------------------------------------------|----------------------|-------------|
| Conditions for initial flaps extension are fulfilled                | Flaps 20             | PF          |
| When EICAS indicates flaps at 20 degrees                            | Flaps 20 – Indicated | PNF         |
| When localizer course bar starts to move from full scale deflection | Localizer alive      | PNF         |
| When glideslope pointer starts to move downward                     | Glideslope alive     | PNF         |

**Figure 35: CL-605 Standard Callouts (1 of 3).<sup>137</sup>**

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<sup>137</sup> Source: CL-605 FCOM Volume 1 page 04-03-2.

**CALLOUTS DURING APPROACH AND LANDING**

| CONDITION                                                             | CALL                               | CREW MEMBER |
|-----------------------------------------------------------------------|------------------------------------|-------------|
| When at the appropriate segment of the approach                       | Gear down,<br>Before Landing Check | PF          |
| When landing gear is down and EICAS indicates 3 green DN lights on    | Gear down – 3 greens               | PNF         |
| When BEFORE LANDING CHECK is completed                                | Before Landing Check – Complete    | PNF         |
| Conditions for flaps extension to 30 degrees/45 degrees are fulfilled | Flaps 30/45                        | PF          |
| When EICAS indicates flaps at 30 or 45                                | Flaps 30/45 – Indicated            | PNF         |
| At final approach fix (FAF)                                           | Final approach fix (by name)       | Both        |
| If maximum localizer deviation is exceeded                            | Localizer                          | PNF         |
| If maximum glideslope deviation is exceeded                           | Glide path                         | PNF         |
| If maximum speed deviation is exceeded                                | Speed                              | PNF         |
| If maximum descent rate is exceeded                                   | Sink rate                          | PNF         |
| If maximum altitude deviation is exceeded                             | Altitude                           | PNF         |
| At 500 AGL (Precision approaches)                                     | 500 feet AGL                       | PNF         |
| At 100 feet above decision height (DH) or decision altitude (DA)      | 100 above Decision                 | PNF         |
| At decision height (DH) or decision altitude (DA)                     | Decision                           | PNF         |
| At 100 feet above Minimum Descent Altitude (MDA)                      | 100 above MDA                      | PNF         |
| At Minimum Descent Altitude (MDA)                                     | Minimums                           | PNF         |
| At Missed Approach Point (MAP)                                        | Missed approach point              | PNF         |
| At the MAP or DH/DA, when visual reference is established             | Landing                            | PF          |
| At pilot's decision to become PF                                      | I have control                     | Pilot       |
| At minimum height for autopilot use, if still engaged                 | Autopilot – disengage              | PNF         |

**Figure 36: CL-605 Standard Callouts (2 of 3).<sup>138</sup>**

<sup>138</sup> Source: CL-605 FCOM Volume 1 page 04-03-3.

#### CALLOUTS DURING GO-AROUND

| CONDITION                                                                                            | CALL                     | CREW MEMBER |
|------------------------------------------------------------------------------------------------------|--------------------------|-------------|
| At the MAP or DH/DA and the runway is not in sight or at any instance when a go-around is called for | Go-Around                | PF          |
| While advancing the thrust levers to the vertical position                                           | Go-Around thrust         | PF          |
| When Go-Around thrust is set                                                                         | Go-Around thrust – set   | PNF         |
| While achieving G/A attitude and thrust                                                              | Flaps 20                 | PF          |
| When EICAS indicates flaps at 20 degrees                                                             | Flaps 20 – Indicated     | PNF         |
| When positive rate of climb is attained                                                              | Positive rate<br>Gear up | PNF<br>PF   |
| EICAS indicates 3 white UP lights on                                                                 | Gear up – Indicated      | PNF         |

#### CALLOUTS DURING LANDING ROLL

| CONDITION                                                       | CALL           | CREW MEMBER |
|-----------------------------------------------------------------|----------------|-------------|
| EICAS page L and R REV ARMED advisory message is on at 70 knots | Two greens     | PNF         |
| When Pilot wants to take control                                | I have control | Pilot       |

**Figure 37: CL-605 Standard Callouts (3 of 3).**<sup>139</sup>

### 11.3 Stable Approach Criteria

According to FAA AC 120-71A (dated February 27, 2003), Appendix 2 Stabilized Approach: Concept and Terms, a stabilized approach is characterized by a constant-angle, constant-rate of descent approach profile ending near the touchdown point, where the landing maneuver begins. A stabilized approach is the safest profile in all but special cases, in which another profile may be required by unusual conditions.

Flights should be stabilized by 1,000 feet height above touchdown (HAT) in instrument meteorological conditions (IMC), and by 500 feet HAT in visual meteorological conditions (VMC). Stabilized approach criteria include the following:

- The airplane is on the correct track.
- The airplane is in the proper landing configuration.
- After glide path intercept the pilot requires no more than normal bracketing corrections to maintain the correct track and desired profile (3° descent angle, nominal) to landing within the touchdown zone.
- The airplane is within the acceptable range specified in the approved operating manual used by the pilot
- The rate of descent is no greater than 1,000 feet per minute (FPM).
- Power setting is appropriate for the landing configuration selected.

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<sup>139</sup> Source: CL-605 FCOM Volume 1 page 04-03-3.

### **11.3.1 Aeolus Air Charter Stabilized Approach Criteria**

According to the Aeolus Air Charter, Inc. GOM, the PM shall monitor all approaches and at a minimum verbalize the following deviations:

1. One dot localizer or glide slope deviation
2. ½ dot VOR course deviation
3. Descent rates in excess of 1,000 feet per minute
4. Deviation from bug speeds of +10 or -5 knots
5. Any descent below minimums without the appropriate runway visual cues.

Approaches in VMC must be stabilized by no later than 500 feet AFE (above field elevation) and 1,000 feet AFE in Instrument Meteorological Conditions (IMC). A stabilized approach was defined as:

1. Aircraft in landing configuration
2. Aircraft in a position for a normal descent to the runway
3. Airspeed on target (IMC) or approaching target (VMC)
4. Airspeed on target (VMC) by 500 feet AFE

According to the Aeolus Air Charter, Inc. GOM, a go-around initiation could be made by either the PF or the PM. Approaches were required to be conducted at speeds prescribed by the AFM.

### **11.4 Go-Around**

According to the CL-605 FCOM Volume 1, a go-around was recommended in the event of a missed approach or any other situation which would necessitate making a go-around maneuver with the airplane in the landing configuration.

When fully configured (landing gear down and flaps full) and arriving at the missed approach point (MAP), Decision Height (DH), Decision Altitude (DA) or anytime during a circle-to-land approach and the flight crew decided to execute a go-around, the procedure to follow was:

1. Thrust Lever advance to the pre-determined go-around N1 setting, while simultaneously pressing the Take-off/Go-around (TOGA) switch and ATS DISC switch
2. FLIGHT SPOILER lever (if extended) select to retract
3. Airplane rotate at a speed not less than VREF
4. Pitch attitude adjust to achieve a speed of not less than V2 + 10 knots as the flaps are retracted to 20°

5. Flaps select to 20°

## **12.0 Controlled Flight into Terrain**

The FAA defines a Controlled Flight into Terrain (CFIT) accident as one that “occurs when an airworthy aircraft is flown, under the control of a qualified pilot, into terrain . . . with inadequate awareness on the part of the pilot of the impending collision.” In April 2003, the FAA published AC 61-134, entitled “General Aviation Controlled Flight Into Terrain Awareness.” The AC highlighted the inherent risk that CFIT posed for general aviation (GA) pilots.

The AC defined “situational awareness” as the pilot’s knowledge “of what is happening around the aircraft at all times in both the vertical and horizontal planes. This includes the ability to project the near-term status and position of the aircraft in relation to other aircraft, terrain, and other potential hazards.”

The AC stated that “in visual meteorological conditions, the pilot in command (PIC) is responsible for terrain and obstacle clearance (See and Avoid) . . .” and identified several CFIT risks, including:

- Loss of situational awareness
- Breakdown in good aeronautical decision making
- Failure to comply with appropriate regulations
- Failure to comply with minimum safe altitudes.

## **F. LIST OF ATTACHMENTS**

Attachment 1 - Interview Transcripts  
Attachment 2 - Records of Conversation  
Attachment 3 - Flight Release Information  
Attachment 4 - ForeFlight Navlogs  
Attachment 5 - Flight Crew Itineraries  
Attachment 6 - Weight and Balance Information  
Attachment 7 - Tarco Lease  
Attachment 8 - N605TR Registration History  
Attachment 9 - N605TR Airworthiness Records  
Attachment 10 - Captain Information  
Attachment 11 - Captain's Logbook (Excerpts)  
Attachment 12 - Captain Training Records  
Attachment 13 - Co-Pilot Information  
Attachment 14 - Co-Pilot Training Records  
Attachment 15 - Co-Pilot's Logbook (Excerpts)

Attachment 16 - CL-605 Callouts  
Attachment 17 - CL-605 Landing Speeds  
Attachment 18 - CL-605 Normal Procedures  
Attachment 19 - CL-605 Stall Speed Charts  
Attachment 20 - FMC Maintenance Document

Submitted by:

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