NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, DC 20594

July 6, 2001

Group Chairman's Factual Report of Investigation

AIR TRAFFIC GROUP

A. ACCIDENT

Aircraft:	N303GA, Gulfstream Aerospace G III
Location:	Aspen, Colorado
Date:	March 29, 2001
Time:	1902 Mountain Standard Time (MST)
	0202, March 30, 2001, Coordinated Universal Time (UTC)[1]
NTSB No.:	DCA01MA034

B. AIR TRAFFIC GROUP

Chairman:	William English, National Transportation Safety Board
Member:	Dan Diggins, FAA, Office of Accident Investigation (Acting)
Member:	Darren Gaines, National Air Traffic Controller's Association
Member:	Brad Rush, FAA, Office of System Standards, AVN-160

C. SUMMARY

On March 29, 2001, at 19:02 Mountain Standard Time (MST) time, a Gulfstream III, registration number N303GA, operated by AVJET Corp., collided with terrain about 0.4 miles northwest of the Aspen-Pitkin County Airport, Aspen, Colorado. The airplane was destroyed and the flight crew of 2, one flight attendant, and all 15 passengers were fatally injured during impact with sloping terrain. The accident site was about 100 feet above the airport elevation of 7815 feet. The flight had arrived under Instrument Flight Rules and had reported the airport in sight. The flight was operating as an IFR flight under FAR Part 135 operations. The weather at 18:53 was wind 250 degrees at 3 knots, visibility 10 miles, light snow, few clouds at 1,500 feet, ceiling 2,500 feet broken, 5,000 feet broken. Approximately 10 minutes after the accident the visibility decreased to 1¾ miles in light snow.

[1] All times are Coordinated Universal Time unless otherwise noted

D. DETAILS OF THE INVESTIGATION

1.0 GROUP ACTIVITIES

The group was formed on March 30, 2001, at the Aspen-Pitkin County Airport/Sardy Field (ASE). Assisting the group at the ASE Air Traffic Control Tower (ATCT) were Ms. Barbara De Brul, ASE ATCT Air Traffic Manager, and Mr. Tom Davidson, FAA Northwest Mountain Region, System Effectiveness Office (ANM-505).

Initial group activities included a general familiarization of the Air Traffic Control (ATC) facility and surrounding airspace. Radar data[2] was provided by the FAA, and copied to Performance Group Chairman for vehicle performance study. The group photographed views from the tower and the layout of the tower cab. The group reviewed the ATC radar data, voice tapes and a draft transcript. Registration numbers of other airplanes operating in the area near the time of the accident were forwarded to the Operations Group.

On scene investigation continued with a review of FAA Notices to Airmen[3] (NOTAMs) regarding the ASE VOR[4]/DME[5] or GPS[6]-C instrument approach procedure (see section 4c). Controller interviews were conducted on March 31, 2001. The Aspen stage of the on scene investigation concluded on April 2, 2001. The group reconvened at the FAA Office of System Standards (AVN-100), Oklahoma City, Oklahoma, on April 2. Follow up interviews were conducted by the group at the FAA Northwest Mountain Regional Office (ANM), Seattle, Washington, on April 30, 2001. Additional follow up interviews were conducted in Oklahoma City on May 1, 2001. (see section 5)

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[2] Any radar derived information in this report is intended to illustrate the information available to ATC personnel for use as the basis of control instructions or advisories and is not intended to indicate actual vehicle performance. Descriptions of position, time and altitude used in this report were derived from the Aspen ARTS 2E Continuous Data Recording (CDR) Editor Track data (filters TA and TU). Distance measurements are based on symbols appearing on the D-BRITE video map. Use of this data provides the processed information most closely resembling the Air Traffic Control D-BRITE display for use in evaluating the Air Traffic System aspects of the accident. The ARTS 2E CDR Editor Target data extraction (filter TG) is unprocessed for ATC purposes and more closely resembles the actual airplane position in relation to navigation aids and geography. That extraction is used as the basis for the Airplane Performance Group report.

[3] **AIM (excerpt) 5-1-3. NOTICE TO AIRMEN (NOTAM) SYSTEM**
a. Time-critical aeronautical information which is of either a temporary nature or not sufficiently known in advance to permit publication on aeronautical charts or in other operational publications receives immediate dissemination via the National NOTAM System… 3. FDC NOTAM's (a) On those occasions when it becomes necessary to disseminate information which is regulatory in nature, the National Flight Data Center (NFDC), in Washington, DC, will issue an FDC NOTAM. FDC NOTAM's contain such things as amendments to published IAP's and other current aeronautical charts.

[4] VHF Omni Range radio navigational aid which provides pilots azimuth information from the station.

[5] Distance Measuring Equipment, a radio navigational aid which provides pilots with distance information from the station.

[6] Global Positioning System, a satellite based navigational system which provides pilots with three dimensional position information without reliance on ground based radio navigational aids.

2.0 HISTORY OF FLIGHT

On March 29, at approximately 2000, the pilot of N303GA contacted the Hawthorne, California, Automated Flight Service Station (HHR AFSS). The pilot asked for a weather briefing for a trip "from burbank to aspen departing at fourteen hundred zulu.[7]" The HHR AFSS Specialist provided a weather briefing to the pilot (for details on the weather information, see Meteorology Group Factual), and included NOTAM information. The Specialist stated "the tower there at aspen closes at 0600 zulu [UTC] this weekend, and they have an update for the v o r d m e or g p s charlie amendment four bravo, circling minimums are not authorized at night is what it says here." The Specialist also checked for NOTAMs for the enroute segment of flight, and advised the pilot that parachute jumping was in effect near the Red Table VOR. The pilot said "let me file a flight plan then, it will be i f r , november three zero three golf alpha, a gulfstream three slant… umm, it's f m s so it's slant india, true airspeed four sixty." The Specialist then prompted the pilot for the departure time of 2200 UTC, "two o'clock then?" and asked for the pilot's requested altitude. The pilot said "four ten to aspen one hour plus forty five, no remarks, fuel um four…five hours, let's make rifle [airport] as our alternate and pilot's name…" The pilot and Specialist discussed the spelling of the name and then continued "…based at burbank." The Specialist asked for the phone number and the pilot responded "I don't have the number, its avjet company." The pilot then said seventeen[8] people on board, its [the airplane] uh, light gray and brown." The Specialist then asked "any particular route you want?" The pilot responded "oh yeah, sure, um, palmdale boulder grand junction red table." The Specialist confirmed the fixes and the pilot said he wanted to file a return flight plan. The pilot read "at zero zero zero…zero zulu going from aspen at three nine zero, grand junction boulder palmdale, uh four hours fuel on board." The Specialist asked "so, an hour forty five back then, too?" The pilot replied in the affirmative and added "three people on board." The specialist completed the flight plan and advised the pilot that pilot weather reports would be appreciated.

According to FAA records, N303GA departed Burbank, California Airport at 2238, and arrived at Los Angeles, International Airport (LAX), California at 2249. At about 2301, the pilot of N303GA contacted LAX ATCT, Clearance Delivery position, and requested an instrument flight rules (IFR) clearance to ASE. The controller responded that N303GA was "cleared to aspen via loop two departure, daggett, as filed…". The pilot acknowledged. At about 0010, the pilot of N303GA contacted LAX ATCT, Ground Control and said "at garrett aviation request taxi [clearance]." The controller instructed N303GA to taxi to runway 25 left, via taxiway F. At 0012, the ground controller instructed N303GA to monitor the LAX ATCT Local Control (LAX LC) frequency. At 0014, the pilot of N303GA said to LAX LC "we have a curfew at aspen." LAX LC advised him that he would be "number two or three" and that there should be minimal delay. At about 0016, LAX LC instructed N303GA to position and hold on runway 25 left, then shortly afterward, cleared the airplane for takeoff.

N303GA contacted Southern California Terminal Radar Approach Control (SCT) and was cleared to climb to Flight Level[9] (FL) 230 via the LOOP2 departure. At 0024:03, the SCT

[7] This word is not clear on the rerecording, but is a best estimation. The airplane departed Burbank at 1438 Pacific Standard Time.
[8] This word is not entirely legible, and is a best estimate of the pilot's speech.
[9] Altitude measured reference the standard pressure datum of 29.92 inches of mercury.

controller instructed the pilot of N303GA to contact Los Angeles Air Route Traffic Control Center (ZLA). The pilot did so. At 0024:41, the ZLA controller instructed N303GA to "climb and maintain flight level three seven zero." The pilot acknowledged. At 0025:46, the ZLA controller instructed N303GA to proceed "direct las vegas nevada, direct aspen." The pilot acknowledged.

At 0030:10, the pilot of N303GA asked the ZLA controller if he had any ride reports, and said "we're getting some light chop[10]." N303GA's Mode C[11] altitude indicated FL330. The ZLA controller replied that "three three zero and three seven zero are continuous light chop until at least the las vegas area." The pilot acknowledged. At 0031:10, the pilot of N303GA asked "do you have any smooth altitudes?" The airplane was at FL338. The ZLA controller asked another airplane on frequency at FL330 if the ride was smooth, and that pilot replied affirmative. At 0032:10, the pilot of N303GA requested clearance to FL330, the ZLA controller complied. N303GA was at FL355, then mode C began indicating lower altitudes. N303GA reached FL330 at 0034:45, approximately 23 miles[12] west of Daggett, California, VOR (DAG).

At 0044:32, N303GA was 45 miles southwest of Las Vegas at FL330. The ZLA controller cleared the airplane direct to PITMN intersection, a fix about 22 miles west of ASE. At 0111, ZLA transferred control of N303GA to Denver Air Route Traffic Control Center (ZDV).

At 0128 Aspen observed official sunset.

At 0136:15, the ZDV sector 24 controller cleared N303GA for descent to FL210. The airplane was approximately 82 miles west of ASE. At 0143:25, N303GA leveled at FL210, 30 miles west of ASE.

At 0144:32, the pilot of N303GA contacted Aspen ATCT approach control (TC) and reported "level two one zero with hotel[13]." TC responded and instructed the pilot to "reduce speed to two one zero [knots][14] or slower." The pilot acknowledged. N303GA crossed the PITMN intersection at 0144:42 at FL210.

At 0144:59, the pilot of N527JA reported to TC that he was executing a missed approach. The pilot of N303GA asked TC "is he practicing [approaches to Aspen]?" TC replied "he

[10] Turbulence that causes slight, rapid and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude.

[11] A feature of the aircraft transponder which transmits pressure altitude reference the standard datum of 29.92 inches of mercury to radar beacon sites. ATC computers convert the transmitted altitude using local barometric pressure when the aircraft is operating below 18,000 feet mean sea level. Altitudes in this report are based on mode C information.

[12] "Miles" refers to nautical miles, equivalent to 6076.12 feet, unless otherwise noted.

[13] ATIS (Automatic Terminal Information Service) broadcast coded "H", or Hotel. "aspen airport information hotel zero zero five three zulu observation, wind zero three zero at four, visibility one zero, sky condition two thousand scattered, ceiling five thousand five hundred broken, nine thousand broken. temperature two, dew point minus three, altimeter two niner eight six. expect a v o r d m e charlie approach landing runway one five, departing runway three three. follow noise abatement procedures. em-saw not available due to mountainous terrain. aspen primary radar not available. radar traffic advisories and service available for transponder equipped aircraft only. advise on initial contact you have information hotel."

[14] All speeds are in knots, equivalent to one nautical mile per hour.

missed…we saw him at ten thousand four hundred [feet][15]" At 0145:40, TC instructed the pilot of N303GA to "fly heading three six zero [degrees][16] for sequencing." The pilot acknowledged.

At 0147:40, TC made a blanket broadcast saying, "attention all aircraft the last arrival aircraft [N900MF] got the airport in sight at ten thousand four hundred making a straight in approach." At 0147:49, the pilot of N303GA said "where three golf alpha is I can almost see up the canyon from here, I don't know the terrain well enough or I would take the visual." Radar indicated the airplane was at FL190 located 15 miles west of ASE, 5 miles south of the ASE video map symbology representing the Roaring Fork River. N303GA was flying a course of approximately 360 degrees. (see attachment 3) At 0148:24, N900MF landed on runway 15 after completing a VOR/DME or GPS-C approach.

TC continued to provide altitude and heading instructions to N303GA to position the airplane for vectors for a straight-in[17] VOR/DME or GPS-C approach procedure. At 0153:14, TC said "gulfstream three golf alpha turn right heading one four zero intercept the final approach course maintain one six thousand." The pilot acknowledged.

At 0153:38, TC made a blanket announcement "attention all aircraft, last aircraft [N898R] went miss." At 0155:08, the pilot of N898R transmitted "eight nine eight romeo on the miss."

Civil twilight ended at 0155 (see Meteorology Group Factual report, "Astronomical Data" section).

At 0156:08, TC said "gulfstream three golf alpha is five miles from red table cross red table at or above one four thousand cleared for v o r d m e approach." The pilot acknowledged. At 0156:44, TC made a blanket broadcast "attention all aircraft information india[18] is current, remarks visibility north[19], two [miles]." At the same time, the Local Controller (LC) made the same announcement on the local control frequency.

At 0157:20, TC instructed the pilot of N303GA to "contact tower one one eight point eight five." The pilot acknowledged.

At 0157:30, the pilot of N303GA reported to LC "gulfstream three golf alpha v o r approach."

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

[16] All headings and courses are in reference to magnetic north, unless otherwise noted.

[17] In this context only, the phrase "straight-in" indicates that the airplane is not expected to perform a procedure turn, or holding pattern in lieu of procedure turn. See AIM paragraph 5-4-8

[18] "aspen airport information india zero one five three zulu. wind two five zero at three, visibility one zero, light snow. few clouds one thousand five hundred, ceiling two thousand five hundred broken, five thousand five hundred broken. temperature one, dew point minus three, altimeter two niner eight niner. expect v o r d m e charlie approach landing runway one five departing runway three three. follow noise abatement procedures. notice to airmen em-saw not available due to mountainous terrain. aspen primary radar not available. radar traffic advisories and service available for transponder equipped aircraft only. advise on initial contact you have information india."

[19] **AIM 7-1-16b.** Prevailing visibility is the greatest visibility equaled or exceeded throughout at least one half of the horizon circle, not necessarily contiguous. Segments of the horizon circle which may have a significantly different visibility may be reported in the remarks section of the weather report; i.e., the southeastern quadrant of the horizon circle may be determined to be 2 miles in mist while the remaining quadrants are determined to be 3 miles in mist.

At 0157:35, LC said "challenger seven juliet alpha do you have the airport in sight?" The pilot of N303GA said "uh negative, I am v o r approach." LC repeated "challenger seven juliet alpha do you have the airport in sight?" At this time radar indicated N527JA was passing the 9.5 DME step-down fix at an indicated altitude of 10,100 feet.

At 0157:49, LC said "gulfstream three zero three golf alpha number two following a challenger two mile final wind two four zero at five, runway one five cleared to land." The pilot of N303GA acknowledged.

At 0158:08, LC repeated "challenger seven juliet alpha do you have the airport in sight?" The pilot of N527JA replied "negative, going around." At this time N527JA was passing 11.2 DME south of Red Table VOR (DBL) at an indicated altitude of 9,800. At 0158:13, N527JA's mode C began increasing.

At 0200:28, the pilot of N303GA asked "are the lights all the way up?" LC replied "affirmative they are on high." At this time, N303GA was passing 7.2 DME south of DBL, at an indicated altitude of 11,000. At 0200:48, the airplane was passing 9 DME south of DBL at an indicated altitude of 9,900. (see attachment 3) LC said "gulfstream three golf alpha do you have the runway in sight?" The pilot replied "runway in sight three golf alpha." LC responded "gulfstream three golf alpha cleared vis… uh roger." At 0201:02, N303GA was passing 9.5 DME south of DBL, at an indicated altitude of 9,400.

According to controller interviews, at about 0201:45, the airplane became visible through snow showers to the north of the field, in the vicinity of the Shale Bluffs. The airplane was passing 11.4 DME south of DBL at an altitude of 8,100. The airplane was in a steep left bank, with landing light visible shining directly at the tower. LC noted the airplane's position and attitude, made a comment of concern, and picked up the crash phone. At 0201:53, an unintelligible transmission presumed to be from N303GA was heard on the local control frequency. The transmission ended at 0201:57. At about 0202, LC activated the crash phone and all controllers in the cab observed a large explosion. The Ground Controller (GC) took the crash phone from LC and began passing information to county and airport emergency crews.

3.0 ENVIRONMENT

a. Geography and Airport

Aspen-Pitkin County/Sardy Field is located about 2 miles north of the city of Aspen, Colorado. The airport has one runway, 15/33, with a total length of 7006 feet[20]. Threshold elevation measured at the approach end of runway 33 is 7,815 feet[21]. The runway slopes downward to the northwest, the touchdown zone elevation of runway 15 is measured at 7,731 feet, and the threshold elevation of runway 15 at 7,674 feet.

[20] Although some FAA publications indicate 7,004 feet, the Airports Group utilized the county airport information of 7,006 feet as the most accurate measurement.
[21] This value was changed to 7,820 feet in June, 2001.

The runway is equipped with Medium Intensity Runway Lights (MIRL) along the perimeter of the landing surface, and Runway End Identifier Lights (REIL) at each end of the runway. A Precision Approach Path Indicator (PAPI) light system is installed on the left side of runway 15. For further details on airport facilities, see the Airports Group Factual Report.

The airport is surrounded by high precipitous terrain on all sides. Minimum IFR altitudes for use in air traffic control exceed 10,000 feet (see attachment 4 for ASE Minimum Vectoring Altitude chart). The principal route for operations in and out of the area is via a valley formed by the Roaring Fork River and Highway 82 to the northwest. There are areas of precipitous terrain up to 6300 feet above the airport within 10 miles. (See attachment 5)

There is one public use Standard Instrument Approach Procedure (SIAP) serving ASE, the VOR/DME or GPS-C[22] (attachment 6). The procedure is based on DBL, with a final approach course defined by the DBL 164 degree radial. Minimum Descent Altitude (MDA) is 10,200 feet, which equates to 2,385 feet above airport (HAA). Straight-in minima are not provided. For further details on the history and construction of the procedure see section 4.

b. ATC Facilities and Equipment

Aspen ATCT is a combined tower and terminal radar approach control with radar service provided from a position physically located in the tower cab. This type of facility is termed a TRACAB by the FAA. The tower is located on the east side of the airport, approximately 2500 feet southeast of the approach end of runway 15. Controls for airport lighting are located in the cab, three intensity settings for the MIRLs and REILs are available. The facility standard operating procedure manual, ASE ATCT Order 7110.2G, notes that lights should be operated in accordance with FAA Order 7110.65 except that step 3 (highest intensity) of the REIL "***shall*** only be used when requested by the pilot." An on/off switch is the only control available to the controllers for the PAPI light system.

Discrete radio communications frequencies are available at the tower for ATIS (120.4 mHz[23]), Ground Control (121.9), Local/Tower Control (118.85), Approach Control (123.8) and emergency frequency (121.5). Additionally, a remote communications air/ground (RCAG) outlet is available to ZDV (134.5). Landline communications are provided between the tower and ZDV and Denver Automated Flight Service Station.

ASE TRACAB is equipped with a beacon[24]-only radar system, no primary radar coverage is available. An FAA standard BI-5 beacon interrogator is located atop Cozy Point, approximately 2000 feet west of the approach end of runway 15. Coverage exists to near the surface of the airport, and out to approximately 50 miles. Low altitude coverage is masked in many areas due

[22] There is a public use charted visual approach procedure, the Roaring Fork Visual. Additionally there are Special Instrument Procedures developed for use by specific operators. Approval to fly the Special Procedures requires specific pilot training and proficiency, and aircraft performance, and is provided oversight by the FAA Northwest Mountain Region.

[23] Megahertz, defined as one million cycles per second. All radio frequencies in this report are in mHz.

[24] Also known as secondary radar, in which transponder equipment on board the aircraft actively replies to signals from the ground station with a discrete code.

to high terrain. The BI-5 is processed at ASE by an ARTS[25] 2e system, and displayed on two D-BRITE[26] units in the tower. A D-BRITE for the approach control position is installed in the tower console at the east-southeastern side of the cab. The second D-BRITE is used by the local controller, and is mounted on overhead tracks (see attachment 7). Minimum Safe Altitude Warning (MSAW) services by the TRACAB are not available due to the complexity of the surrounding terrain. According to the FAA, MSAW programming could not function without an unacceptably high rate of false alarms. A warning to pilots about the lack of MSAW and primary radar surveillance is published in the FAA Airports/Facility Directory (AFD). A waiver is in effect allowing ASE ATCT to operate without MSAW or primary surveillance as specified in FAA Order 7210.3, paragraph 11-2-7b (see attachment 4). According to Mr. Gaines and Mr. Diggins, the FAA is in the process of attempting the development of a new version of MSAW which will operate favorably in areas with precipitous terrain such as ASE.

Weather information is provided by an Automatic Surface Observation System (ASOS) at ASE. The Operator Interface Device (OID) is located in the tower cab. All ASE controllers are certified Limited Aviation Weather Reporting Service (LAWRS) observers and are able to make edits and amendments to the ASOS observations. For more detailed information on weather equipment at ASE, see Meteorology Group Chairman's Factual Report.

c. Standard Operating Procedures

ASE ATCT operates between 0700 and 2300 local time, seven days per week. FAA publications list the operating hours as 0700 to 2200 local time, with Denver ARTCC assuming responsibility for ATC between 2200 and 2300, however, as of January 1, 2001, ASE ATCT amended operating hours to remain open until 2300. A Notice to Airmen was issued explaining the change. The tower's operating hours now correspond to the operating hours of the airport itself. Denver ARTCC assumes responsibility for the airspace surrounding ASE between 2300 and 0700 local, however the airport itself is closed. Denver ARTCC airspace delegated to ASE is described in the ZDV/ASE Letter of Agreement (see attachment 4) and includes the airspace below FL210 over and south of the airport, and below FL190 to the north. Minimum IFR altitudes range from 16,500 feet in the southern area to 12,000 feet in an area over the Roaring Fork River, between LINDZ intersection and ASE airport.

ASE ATCT traffic count in 1999 totaled 46,282 operations. The airport reports an average of 144 operations per day. Airport acceptance rate is variable due to weather and limitations imposed by the precipitous terrain. According to ASE personnel, lack of airport ramp space and local noise abatement restrictions also detract from capacity.

While controllers are able to provide radar vector service to establish airplanes on the VOR/DME or GPS-C final approach course, they must apply additional longitudinal separation beyond that specified in FAA Order 7110.65[27]. Because of the orientation of the approach course, runway, missed approach, and departure procedures, traffic generally conflicts in opposite direction flows. The VOR/DME or GPS-C final approach course, Special GPS 15, and

[25] Automatic Radar Tracking System.
[26] Digital Bright Radar Indicator Tower Equipment.
[27] Nominally three to five nautical miles.

the IPKN LDA[28] back course used for missed approach and departure are all contained within a 44 degree wide section northwest of the airport. Controllers must ensure that airplanes on the various procedures have sufficient course divergence before discontinuing other forms of separation. The high terrain limits the flexibility of controllers to provide traffic separation vectors. Under good weather conditions controllers normally space arriving aircraft by about 8 to 10 miles. When arrival aircraft require circling maneuvers for landing, spacing increases to about 13 miles. During periods of high departure demand, or when weather conditions are such that missed approaches become likely, final approach spacing may increase to 20 miles. Weather minima for either VFR or IFR operations are effectively much higher than the norm[29]. The Charted Visual approach procedure is not available when conditions are lower than 6,000 foot ceiling and 10 statute miles[30] visibility, or at night. Standard practice at ASE ATCT is to consider the airport IFR when such conditions exist.

Controllers at ASE ATCT closely monitor the progress of airplanes executing the VOR/DME or GPS-C approach. A normal part of controller training concentrates on paying close attention to an aircraft's proximity to the required minimum step-down altitudes published on the approach procedures. Controllers are trained to advise pilots immediately whenever they observe an aircraft pass below a required step-down fix minimum altitude. Most controllers reported they will ask the pilot if the runway is in sight when they observe the altitude about 200 feet lower than published. They said that gives the pilot some leeway for altimeter or transponder error, and it closely correlates with how MSAW functionality would provide warnings also. If the pilot does not report that the runway is in sight, the controllers explained that they would then issue a low altitude alert and perhaps missed approach instructions.

Traffic pattern operation at ASE is constrained by terrain and noise abatement procedures. Landings on runway 33 require specific written permission by the airport authority. Assessments of traffic pattern operation by FAA Flight Inspection pilots indicate that flying a normal pattern as described in the Aeronautical Information Manual (AIM) could place an aircraft below the level of terrain between the aircraft and the runway (see attachment 8). Controllers report that it is extremely rare for a pilot to enter a traffic pattern or circle to the west of the runway[31]. A commonly performed maneuver to land on runway 15 after flying the VOR/DME or GPS-C approach is to pass over the approach end of the runway, as far as midfield, then enter a descending left turn or pattern describing 360 degrees, and land on runway 15. Controllers reported that they will usually not initiate such a maneuver, but routinely authorize it for arriving pilots. They consider such a maneuver to be "circling" and not an "overhead approach.[32]"

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[28] Localizer type directional aid.

[29] Standard VFR weather minima at a towered airport is 1000 foot ceiling, 3 miles visibility.

[30] Visibility is normally measured in statute miles, equivalent to 5,280 feet.

[31] A Learjet accident at Aspen in 1991 involved a maneuver to the west of the runway.

[32] **AIM 5-4-24. OVERHEAD APPROACH MANEUVER**

a. Pilots operating in accordance with an IFR flight plan in visual meteorological conditions (VMC) may request ATC authorization for an overhead maneuver. An overhead maneuver is not an instrument approach procedure. Overhead maneuver patterns are developed at airports where aircraft have an operational need to conduct the maneuver. An aircraft conducting an overhead maneuver is considered to be VFR and the IFR flight plan is cancelled when the aircraft crosses the landing threshold on the initial approach portion of the maneuver. (See FIG 5-4-22.) The existence of a standard overhead maneuver pattern does not eliminate the possible requirement for an aircraft to conform to conventional rectangular patterns if an overhead maneuver cannot be approved. Aircraft operating to an airport without a functioning control tower must initiate cancellation of an IFR flight plan prior to

4.0 INSTRUMENT APPROACH PROCEDURE

a. History

The Aspen VOR/DME-C, amendment 3, was first established on December 15, 1988 with the installation of the IPKN Localizer Type Directional Aid (LDA) Back Course (BC) missed approach facility[33]. The original procedure, established on March 13, 1986, included a missed approach course which turned back to the north to the Carbondale NDB (now defunct). The final course guidance was defined by the DBL 163 radial, with a final approach fix established at 6 DME south of DBL. Minimum descent altitude was 10,840 feet. The procedure was not authorized at night.

On October 12, 1989 the Northwest Mountain Regional Flight Procedures Office (ANM-220) issued a memo directing the Sacramento, California Flight Inspection Field Office[34] to "remove the note restricting night operations from the Aspen Colorado VOR/DME-C public procedure." The Field Office sent a series of memos in response, explaining the criteria used to deny night minima and refusing to comply with the request. An approach chart effective March 2, 1990 includes the note "Procedure NA at Night." (see attachment 8)

According to FAA records, user groups strongly desired lower landing minima on the VOR/DME-C, and the FAA initiated various efforts to attempt to construct a procedure with a lower minimum descent altitude (MDA). Missed approach climb requirements and obstacles in the final approach segment were limiting factors in the minima for the VOR/DME-C, amendment 3. Amendment 4 of the procedure involved the realignment of the final approach course to the DBL 164 radial.

Amendment 4 also included the addition of two step down fixes, with appropriate minimum altitudes reduced through application of FAA Order 8260.3B paragraph 289[35]. With these changes, the MDA was lowered from 10,840 to 10,200 feet msl. This approach was completed in May of 1991, and included a notation reading "Procedure NA at Night."

On September 2, 1993, the FAA issued amendment 4A to the procedure, due to the expansion of a NoPT (No Procedure Turn) arrival area between airway radials from the DBL 297 clockwise to

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executing the overhead maneuver. Cancellation of the IFR flight plan must be accomplished after crossing the landing threshold on the initial portion of the maneuver or after landing. Controllers may authorize an overhead maneuver…

[33] A "back course" facility generates indications on cockpit navigation equipment opposite to normal indications when flying a localizer inbound. For purposes of establishing the missed approach, and supporting departure procedures, at ASE, pilots fly the course away from the station, thereby receiving normal navigation indications.

[34] Now transferred to the Oklahoma City office.

[35] **289. OBSTACLES CLOSE TO A FINAL APPROACH OR STEPDOWN FIX.** Existing obstacles close to the FAF/stepdown fix may be eliminated from consideration if the following conditions are met:
a. The obstacle is in the final approach trapezoid within 1 NM past the point the FAF/stepdown fix can first be received, and
b. The obstacle does not penetrate a 7:1 obstacle identification surface (OIS). The surface begins at the earliest point the fix can be received and extends toward the MAP 1 NM...
c. Obstacles eliminated from consideration by application of this paragraph shall be noted on the procedure.

the DBL 046. No changes to minima or other guidance beyond the initial approach fix occurred.

During the early 1990's, various user groups complained that the Pitkin County airport authority was unfairly discriminating by enforcing the night curfew for operations at the airport by general aviation aircraft. The FAA supported the complainants and informed the County that federal airport funding would be lost if they discriminated against a user group in this fashion. The FAA and Pitkin County commissioned studies on VFR flight in the Aspen area during this time period. (see attachment 9) In 1994, legislation was passed by Congress, HR 2739, Section 517 (see attachment 10), requiring stricter pilot currency and certification standards to operate under night VFR into Aspen, and the curfew on general aviation aircraft landing at ASE was lifted. Additionally, requirements for IFR operations at night were also specified, including a statement that pilots must operate on "an instrument approach or departure procedure approved by the Federal Aviation Administration." At the time of the legislation's passage, the only public use SIAP, the VOR/DME-C[36], was noted "NA at night."

On October 11, 1994, a memorandum from the FAA Manager of the Flight Standards Technical Programs Division (AFS-400) was sent to the Northwest Mountain regional office, ANM-200 instructing "Per request of AVR-2, …delete the night restriction on the…VOR/DME-C…and take whatever action is necessary to permanently remove the note…" (See attachment 5) On the same day, a NOTAM was released, creating amendment 4B to the VOR/DME-C approach. The only change was the removal of the night restriction.

Further information on the events described above will be included in Factual Report Addenda 1.

In February of 1998, the FAA issued Change 17 to Order 8260.3B (Terminal Procedures, or "TERPS"). Paragraph 251b of this order deals with situations in which obstructions interfere with the area off the arrival end of a runway in which pilots transition from instrument procedures to a visual landing ("visual area"). In cases where obstacles penetrate an imaginary 20:1 slope emanating from the runway threshold, certain actions must be taken. Visibility minima may be increased, lighting or removing of obstructions may be necessary, or in some cases, night minima may be denied. According to Mr. Rush, unlighted obstacles penetrate the imaginary surface in the visual area for runway 15 at Aspen. However, paragraph 251b of TERPS was never implemented. In October of 1998, a series of memos were issued from the FAA Office of Flight Standards (AFS-420) instructing procedures specialists to not apply paragraph 251b, but instead "AFS would develop a time-phase-in implementation plan for handling such penetrations." (see attachment 16).

The VOR/DME or GPS-C, amendment 4B, was in effect until March 27, 2001.

[36] The addition of "or GPS" to the name of the approach was part of the FAA's GPS Overlay program which commenced in 1995 and affected the majority of non-precision instrument approaches. No operational changes were made to the procedures so renamed, the name change simply notified GPS-equipped users that the procedure had been added to approved GPS databases. The renaming of GPS Overlay Procedures did not generate an amendment to the SIAP.

b. Present Description

The present procedure is based on conventional VOR navigation for the Initial, Intermediate, and Final approach segments. Red Table VOR (DBL) serves as the Initial Approach Fix (IAF), aircraft inbound to DBL from the north via airways V108, V361/421, and V356, are not required to perform a procedure turn type maneuver, and may turn inbound to the DBL 164 radial[37]. Initial approach altitude is 14,000 feet. Additionally, ASE Approach Controllers may provide radar vector service to intercept the DBL 164/344 radial allowing the pilot to bypass the procedure turn. For aircraft arriving on other than the above mentioned airways, and not under radar vector service[38], a holding pattern in lieu of a procedure turn is provided. The holding pattern is standard one minute legs, right turns, north of the VOR on the 344 radial.

An intermediate approach segment is provided between DBL and the DBL 164 radial, 6 DME fix, named ALLIX. A step down fix is incorporated in this segment at 3 DME south of DBL. Minimum altitude between DBL and the 3 DME fix is 12,700, resulting in a 433.33 feet per mile descent gradient. Minimum altitude from 3 DME to ALLIX is 12,200, a 166.67 feet per mile gradient. Descent gradient for the segment from DBL to ALLIX is 300 feet per mile.

ALLIX is the final approach fix for the procedure, the beginning of the final approach segment. A step-down fix is provided in the final segment at 9.5 DME south of DBL. Minimum altitude between ALLIX and the step down fix is 10,400, resulting in a 514.3 feet per mile descent gradient. The final approach segment ends at the missed approach point (MAP) 11 DME south of DBL at the MDA of 10,200, resulting in a gradient of 133.33 feet per mile. The gradient between ALLIX and the MAP is 400 feet per mile. Gradient between ALLIX and the threshold crossing altitude at the end of runway 15 of 7729,[39] is 700 feet per mile. Gradient from the 9.5 DME step down fix is 921 feet per mile. Gradient from the MAP is 1,765 feet per mile.

According to the procedure data record, the final approach course intersects the extended centerline of runway 15 2,912 feet from the threshold[40].

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[37] Maneuvering in this fashion is sometimes termed a "straight in approach." In this context, the terminology does not correspond to the minima or landing maneuver, only to the execution of a procedure turn.

[38] Radar vector service in accordance with FAA Order 7110.65, paragraph 5-9-1 allows a pilot to bypass a published procedure turn.

[39] Threshold elevation of 7674 plus maximum TCH of 55 feet.

[40] **FAA Order 8260.3B 513. FINAL APPROACH SEGMENT**. The final approach may be made either "FROM" or "TOWARD" the facility. The final approach segment begins at the final approach fix and ends at the runway or missed approach point, whichever is encountered last.
a. Alignment. The alignment of the final approach course with the runway centerline determines whether a straight-in or circling only approach may be established. The alignment criteria differs depending on whether the facility is OFF or ON the airport…
(1) Off-Airport Facility.
(a) Straight-In. The angle of convergence of the final approach course and the extended runway centerline shall not exceed 30 degrees. The final approach course should be aligned to intersect the runway centerline at the runway threshold. However, when an operational advantage can be achieved, the point of intersection may be established as much as 3000 feet outward from the runway threshold.
(b) Circling Approach. When the final approach course alignment does not meet the criteria for a straight-in landing, only a circling approach shall be authorized, and the course alignment should be made to the center of the landing area. When an operational advantage can be achieved, the final approach course may be aligned to any portion of the usable landing surface.

Minimum visibility is 2 statute miles for Category[41] A and B aircraft, 3 statute miles for Category C. The distance between the MAP and the airport, and the Height Above Airport (HAA) at MDA are determining factors for the visibility minima (TERPS paragraphs 330 and 331). Category D aircraft are not authorized to fly the procedure.

Nonprecision[42] approach procedures may specify straight-in minima, circling minima, or both. According to TERPS, "straight-in" is defined as "a descent in an approved procedure in which the final approach course (FAC) alignment and descent gradient permits authorization of straight-in landing minimums." "Circling" is defined as "a descent to circling minimums from which a circle to land maneuver is performed, or an approach procedure which does not meet criteria for authorizing straight-in landing minimums."

The main criteria specified in TERPS which must be met in order to establish straight-in minima are final approach course alignment with the runway, and maximum descent gradient. In order to establish straight-in minima, the final approach course must be aligned within 30 degrees[43] of the runway extended centerline[44], and intercept the centerline no more than 3,000 feet from the threshold.

Additionally, TERPS paragraph 252 specifies that the maximum gradient between the Final Approach Fix (FAF) minimum altitude, and the runway threshold crossing height must be no more than 400 feet per nautical mile. If this value is exceeded, only circling minima may be established regardless of the course alignment. According to FAA files, the Aspen VOR/DME-C does not have straight in minima provided "due to excessive desent graidents. (sic)"

The Aeronautical Information Manual, paragraph 5-4-18d states:

> *The fact that a straight-in minimum is not published does not preclude pilots from landing straight-in if they have the active runway in sight and have sufficient time to make a normal approach for landing. Under such conditions and when ATC has cleared them for landing on that runway, pilots are not expected to circle even though only circling minimums are published. If they desire to circle, they should advise ATC.*

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[41] **FAA Order 8260.3B APPROACH CATEGORIES (CAT)**. Aircraft performance differences have an effect on the airspace and visibility needed to perform certain maneuvers. Because of these differences, aircraft manufacturer/operational directives assign an alphabetical category to each aircraft so that the appropriate obstacle clearance areas and landing and departure minimums can be established in accordance with the criteria in this manual. The categories used and referenced throughout this manual are: CAT A, B, C, D, and/or E. "Aircraft approach category" means a grouping of aircraft based on a speed of 1.3 VS0 (at maximum certificated landing weight). VS0 and the maximum certificated landing weight are those values as established for the aircraft by the certificating authority of the country of registry. The categories are as follows:
(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.

[42] An approach procedure which does not provide external electronic vertical guidance to the aircraft.

[43] 15 degrees for RNAV approaches.

[44] ASE runway 15 is aligned to 148 degrees magnetic.

When an approach procedure does not meet criteria for straight-in landing minimums authorization, it is identified by the type of navigational aid which provides final approach guidance, and a single letter alphabetical suffix, e.g. VOR/DME or GPS – C.

c. Notice to Airmen (NOTAM)

On March 21, 2001, a commissioning flight check was performed at the Aspen airport in support of a proposed GPS Standard Instrument Approach Procedure to runway 15. Mr. Michael Ahern was pilot in command of the flight inspection airplane (see interview section, and attachment 11). Mr. Ahern completed the inspection and noted on a Procedural Control form "cannot make straight in to 15 from MAP. Need VDP[45] 3 nm prior (approx) to MAP for descent to landing on rwy 15," "circling areas not sufficient for descent to landing rwy 33" and "should be no circling allowed at night." The proposed approach had both straight in and circling minima established.

Upon returning to Oklahoma City, Mr. Ahern delivered his concerns to the procedures specialist and team lead. While discussing the GPS procedure, it was noticed by the AVN-120 staff that the VOR/DME or GPS-C approach did not have a restriction on night operations. AVN-120, and AVN-160 staff agreed that a note should be added to the VOR/DME or GPS-C procedure. A NOTAM was developed for the procedure which stated "circling NA[46] at night". Initially the NOTAM was coded as a "T", or temporary, NOTAM, but was immediately amended to a "P", or permanent NOTAM. The NOTAM was sent from the NFPO to the US NOTAM Office (USNOF), National Flight Data Center (NFDC), and Seattle Flight Procedures Office at about 1848 on March 27, 2001.

The P NOTAM, 1/3034, was received at the Denver ARTCC Flight Data Communications (FDC) position at 1849. The FDC specialists are responsible for distributing NOTAMs internally to affected ARTCC sectors, and externally to associated towers and other facilities. Under normal circumstances, Denver ARTCC FDC sends NOTAMs via fax machine to Aspen ATCT. Aspen does not have a stand alone fax machine, but uses a computer with fax software to receive the notices. The Denver ARTCC FDC Specialist did not fax NOTAM 1/3034 to Aspen ATCT. (see attachment 15) The NOTAM was distributed internally to the sector which assumes the Aspen airspace when the tower is closed, however, the airport is also closed for the same period. The NOTAM was received at the Hawthorne, California, Automated Flight Service Station, and was included in the preflight briefing issued to the pilot of N303GA.

After the accident, FAA staff at the Northwest Mountain Region became concerned over the potential for pilot confusion about the wording of the NOTAM. On the evening of March 30, NOTAM 1/3142 for the VOR/DME or GPS-C was issued, stating "procedure NA at night." According to the FAA, their procedures staff believed the wording of the first NOTAM would lead pilots to infer that straight in[47] landings to runway 15 were authorized at night. FAA

[45] Visual Descent Point: A defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the approach threshold of that runway, or approach lights, or other markings identifiable with the approach end of that runway are clearly visible to the pilot.

[46] 14 CFR Part 97, Section 1, *Definitions*, states that "'NA' means 'Not Authorized'".

[47] In this context "straight-in" means the pilot makes no turns greater than a cumulative 30 degrees to align the

procedures staff indicated that a strict read of the first NOTAM[48] should signify that the landing minimums are not authorized at night, therefore the approach was not usable.

5.0 INTERVIEWS AND BRIEFINGS

FAA Air Traffic Controllers at Aspen ATCT were interviewed on March 31, 2001, with the assistance of Mr. Tom Davidson, ANM-500, and Ms. Barbara De Brul, ASE Air Traffic Manager. Additional written statements by the controllers were requested by the Systems Group on April 1, 2001, to attempt to gather more details about the airplane's landing gear position. Those statements are attached to the Systems Group Report.

Eric Castelli Toll **Radar Approach Controller (RA)**

Mr. Toll was interviewed on March 31, 2001. In response to questions he provided the following information.

Mr. Toll has been a controller for about five years. He attended Beaver College, in Pennsylvania, and matriculated in the Air Traffic Control program. Beaver College operates a control tower and provides graduates with a Control Tower Operator certificate. He participated in an internship at Pittsburgh, Pennsylvania, ATCT while attending college. He worked for a non-federal contract tower operator at Eagle/Rifle, Colorado. Mr. Toll entered on duty with the FAA at Aspen on May 9, 1999, his operating initials are EC. Mr. Toll holds a private pilot certificate with about 150 hours total time. He has also worked as an aircraft fueler at Pittsburgh. He does not have any FAA staff or supervisory ATC experience. Mr. Toll is a NATCA member; and has collateral duties maintaining updates of charts and orders at the facility.

Mr. Toll said he took "a while" to certify on local control at ASE due to the complexities of the opposite direction traffic flow. He is currently fully certified at all positions at ASE. He said he has handled "a couple" of emergencies at ASE and a near- midair collision at Eagle.

On March 29, Mr. Toll was assigned to work the 1400 to 2200 (MST) shift, and it was the first day of his workweek. He described traffic and complexity as moderate because of snow showers moving in and out along the final approach course.

Mr. Toll was working the radar approach position, and could not recall if it was dark outside when he first talked to N303GA. He said that just before the accident traffic was moderately busy because aircraft were beginning to conduct missed approaches, and he needed to accommodate those aircraft as well as the inbound traffic. He said handling of N303GA was normal, except he did note that the pilot said he was not familiar with the local terrain.

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airplane for landing.

[48] In actuality, four NOTAMs were issued. The NOTAM reading "circling NA at night" was initially issued as NOTAM 1/3032, but accidentally coded as a "T" or temporary NOTAM. NOTAM 1/3033 was immediately issued to cancel 1/3032, then NOTAM 1/3034 was issued with the same wording, but coded as a "P" or permanent NOTAM. This sequence of NOTAMs 1/3032, 1/3033, and 1/3034 is referred to in this report as the "first NOTAM". On the evening on March 30, FDC (T)NOTAM 1/3142 was issued reading "Procedure NA at Night." 1/3142 is referred to in this report as the "second NOTAM."

Mr. Toll said the normal spacing of aircraft on final is about 13 miles when aircraft are circling for landing, up to 20 miles when there is substantial departure demand. He explained that the maneuvering, and required protection for missed approach procedure forces the extra separation on the approach course. Normally, the local controller and/or the Controller–in-Charge will advise the radar controller when aircraft are circling. He added that, due to local noise restrictions, ATC cannot initiate an instruction for a pilot to land on runway 33, the pilot has to make the request.

Upon further questioning by the group, Mr. Toll explained that, at Aspen, a typical maneuver for aircraft to "circle" to runway 15 is to overfly the field to enter a left traffic pattern. Normally pilots will advise they are circling, but not always. He said he has never seen anyone circle to runway 33 at night. In his experience he noted that business jet class aircraft normally need to perform the circling maneuver when weather conditions drop below about a 3,500 foot ceiling and 5 miles visibility. He said under better conditions pilots can usually see the runway early and descend below MDA. He added that he has also seen many aircraft perform missed approaches even after they break out.

He said he never will instruct a pilot to make right traffic, if a pilot were to ask to circle, he would either say "maneuver as necessary", or "make left traffic". He said his technique is to ask pilots to report the airport in sight as soon as possible when he is working the Local Control position. Normally when aircraft are below 10,000 feet MSL, controllers ask pilots if they have airport in sight. He did not hear the conversation between N303GA and the local controller regarding the runway light setting. He added that there is no MSAW processing at Aspen.

Mr. Toll said the fact that aircraft were performing missed approaches on the evening of March 29 was not unusual given the weather conditions present. He said most of the missed approach airplanes "miss" from the minimum descent altitude of 10,200 feet. Controllers can augment the ASOS observation with prevailing visibility, remarks, sky conditions, and any restrictions to visibility.

He explained that normal procedure and training for the radar controller after issuing a communication change to tower, is to continue monitoring the aircraft's altitude reference step-down fixes. He thought N303GA's initial descent on approach looked normal.

Mr. Toll first became aware of a problem with N303GA when he overheard the local controller say "What's this Gulfstream doing?" He turned around and saw the aircraft on short final in a steep left bank. He said he saw bright lights and the outline of the airframe. Mr. Toll added that N303GA's location and altitude did not look too unusual, but he added that was in the context of Aspen; he emphasized that airplanes do "weird" things here. He added that there are no lights or prominent visible objects on Shale Bluffs, he has to judge altitude by visual reference to the runway in that location. It was his impression that "pilots are scared" coming into Aspen.

He said he looked back at the radar display and saw a mode C altitude of 8,000 feet on N303GA, then heard someone announce "ALERT 3" on the crash phone. He looked back and saw a large fire. Mr. Toll thought whichever controller picked up the crash phone did so before the explosion. He said initially he thought the local controller was overreacting, but he could not be

completely sure of the sequence of events.

Mr. Toll did not know of any night restriction for instrument approaches at Aspen, but he added that there are routine "night pushes" because pilots want to get in or out before nightfall. He did say that the Aspen 2 Departure Procedure is not authorized at night, and said that in his experience, most air taxi operators won't come into the airport at night or with weather conditions lower than about a 5,000 foot ceiling and five miles visibility. Standard procedure at ASE is to take an instrument traffic count when conditions drop below a 6000 foot ceiling and five miles visibility. Flight strips are marked with a red line to indicate the aircraft arrived under these conditions. He said ATC does not police the airport noise curfew at all.

Gentri Lee Engelke **Ground Controller (GC)**

Ms. Engelke was interviewed on March 31, 2001. In response to questions she provided the following information:

Ms. Engelke has been a controller since March 15, 1998, she has been assigned to Aspen ATCT the entire time. Her operating initials are LG. She achieved full certification in October of 1999. She completed an air traffic control undergraduate degree program at the University of North Dakota, in Grand Forks. She explained that many graduates of college ATC programs are initially placed at ASE. She has no other air traffic experience, but holds an FAA private pilot certificate and has about 200 hours total time. She is a NATCA member and performs a collateral duty of maintaining the traffic count statistics for the facility. Ms. Engelke said that ASE is an ATC Level 5 facility based on traffic count and complexity.

Ms. Engelke has handled other accidents as a controller, almost all were small aircraft without fatalities. Once she handled a fatal light aircraft accident involving controlled flight into terrain.

On the evening of March 29, Ms. Engelke was assigned a 1200 to 2000 (MST) shift. She arrived early on compensatory time to perform traffic count duties. March 29 was the third day of her workweek, she normally is off-duty on Sunday and Monday. She characterized the conditions that afternoon as "in and out" changeable weather conditions. She said that it is typical to observe rapidly varying snow showery conditions at Aspen. She termed the weather "not bad-wintry, but snow showers." The Flight Data position is responsible for augmenting the ASOS observations.

She had been working the GC position since 0118, and could not remember the traffic load. GC was combined with flight data (FD) and clearance delivery (CD). She explained that FD and CD are commonly combined with GC except during periods of high departure demand. Ms. Engelke stated that typically traffic levels "die off quite a bit at night". She said the tower was staffed normally, or "maybe a little more than usual". Often GC will be combined with Local Control as the traffic volume drops. She said traffic is normally very slow after dark, with usually only locally based operators and scheduled carriers flying.

The first time Ms. Engelke became aware of N303GA was when she overheard the local controller (LC) ask if "airport in sight". She then heard LC say "what's this gulfstream doing". Ms. Engelke stood up and looked toward the final approach area as she heard LC say "Oh my

God he's going to crash". At about the same time, she saw an explosion that "lit up the sky."

Ms. Engelke heard the CIC shout "Alert three", meaning to initiate emergency response. She grabbed the crash phone and began following items on the emergency checklist. She said that she thought LC may have actually been holding the crash phone, but Ms. Engleke took it away, as it is GC responsibility to initiate emergency response. She said she specified the location of the crash to the airport fire crew using a grid map in the tower.

Ms. Engelke said she could see lights on the wing of airplane, but couldn't recall the airplane's attitude. She said it "happened too fast." She did recall that the weather in the immediate area was "snowing pretty good." After she got off the phone, she remembered the airport fire truck (ARFF699) call on the ground control frequency for more information. She answered the fire crew, and said she observed the truck out on the highway within seconds.

Ms. Engleke was asked to describe some common practices she has observed at Aspen airport. She said that "circling" maneuvers from the VOR/DME-C commonly consist of an airplane flying overhead, or close to overhead, the approach end of runway 15, then entering a left crosswind traffic pattern to land on runway 15. She said she has rarely, if ever, seen an airplane circle to runway 33 at night. She said most pilots would advise if they plan to perform the circling maneuver she described.

Ms. Engelke stated that controllers at Aspen are taught to monitor aircraft altitudes as they cross step-down fixes on the VOR/DME-C approach. Normally, if a controller observes an airplane pass below a prescribed step-down altitude, he will ask the pilot if the airport is in sight. If a negative reply is received, a low altitude alert and/or go-around instructions are issued.

Ms. Engelke had no knowledge of any night restrictions on instrument approaches to ASE. She said corporate jets normally only land straight-in when they are on visual approaches. When asked to explain, she said she believes that aircraft need to be cleared for visual approaches when they report the runway in-sight while on the VOR/DME-C approach, in order to continue descent below minimum descent altitude. She said she would normally not coordinate with approach control when clearing an inbound aircraft for a visual approach under these circumstances. She added that it would not be unusual to observe aircraft performing missed approaches in weather conditions similar to that of March 29. She has often observed pilots descend well below MDA then decide to execute a missed approach.

Ms. Engelke recalled that the runway lights were set on the "high" position at the time of the accident. There are 3 steps available to control the light intensity. She said the PAPIs (Precision Approach Path Indicator) only have an on/off switch.

Clarissa Hope Hendricks **Controller in Charge (CIC)**

Ms. Hendricks was interviewed on March 31, 2001. In response to questions she provided the following information:

Ms. Hendricks has been a controller since March 15, 1998, Aspen has been her only duty station. Her operating initials are CH. She achieved full certification on November 28, 1999. She is a

graduate of the University of Alaska, Anchorage, aviation program. She is a student pilot, but has not flown in some time. She is certified as an On-The-Job Training Instructor, but has not served in any staff positions or details. Ms. Hendricks has been certified as a Controller in Charge for about one year. She said that almost everybody in the facility is CIC certified. She has experience handling other accidents, involving small aircraft, at Aspen.

On March 29, Ms. Hendricks was working a 1500 to 2300 (MST) "closing" shift, it was the first day of her workweek. She characterized the traffic as light to moderate, with overcast conditions. She said there was, light snow "off and on", with visibility lower to the north near the time of the accident. She emphasized that in the minutes leading up to the accident it was "very dark."

Ms. Hendricks said that she had just come up to the tower cab when she saw the first missed approach by one of the inbound airplanes. She told the radar controller that the pilot was executing a missed approach. Shortly after that she heard the local controller say "What's that gulfstream doing?" She looked out and saw the airplane turning and stated "it looked like it was lining up to the runway." She said at first it appeared somewhat normal, but then "widened out." She said she could tell the airplane was low, but it "didn't appear dramatically so."

She heard the local controller say "Oh my God he's going to crash." Ms. Hendricks yelled "call alert 3". She said she saw the airplane in a steep left bank with the landing lights shining right at the tower, which she said is not normal. Ms. Hendricks said she thinks she called for the crash phone just before the explosion occurred. She told the radar controller to shut off traffic, and performed the items on the emergency notification checklist.

She said the left bank was "extreme," about 45 degrees. She was looking through snow at the airplane. She said she never saw the Challenger which performed a missed approach prior to N303GA.

Ms. Hendricks said airplanes typically circle to the left from overhead the field. She said it was very rare to see anyone circle to runway 33 at night, "only locals [pilots] will do it." She said most controllers at Aspen will issue a visual approach clearance to pilots who break out early on the VOR/DME-C approach. She said that is not necessary but many do it as a technique to allow the pilots to maneuver more. She said that sometimes pilots will advise her that they are going to circle, but not always.

Ms. Hendricks said she was not aware of any night restrictions on approach procedures to Aspen, although she said pilots definitely avoid operating there at night. She said many pilots can't see the airport from MDA at the MAP due to the steep angle, and they will perform a miss at that time. She said she has often seen airplanes perform a missed approach after descending below MDA, whether issued a visual approach or the VOR/DME-C approach.

Tammy Jean Ford **Local Control (LC)**

Ms. Ford was interviewed on March 31, 2001. In response to questions she provided the following information.

Ms. Ford is a developmental controller at Aspen and her operating initials are TY. She is certified at all positions except radar approach control, and is in training status at that position. Ms. Ford began her ATC career at Elmendorf Air Force Base, Anchorage, Alaska, in 1981. On March 17, 1986 she entered on duty with the FAA as an Air Traffic Assistant at Anchorage Tower. In 1990, Ms. Ford transferred to the Cold Bay, Alaska, Flight Service Station (FSS). She was assigned to various FSS's in Alaska[49] until October 12, 1997 when she transferred to Denver, Colorado FSS. She started as a terminal controller at Aspen August 1, 1999. Ms. Ford was a temporary supervisor and training specialist while assigned to Flight Service. She is not a pilot.

March 29 was the third day of Ms. Ford's workweek, she was assigned a 1200 to 2000 (MST) shift. Ms. Ford characterized the traffic load as "slow to steady", becoming "steady" about 30 minutes prior to the accident. She said the visibility at the time of the accident was clear in all quadrants except to the north of the field, where the visibility was 2 miles in snow. Ms. Ford recalled that 2 airplanes executed missed approaches prior to N303GA, and she said there was one departure at roughly the same time. She said she could see the first airplane that missed, but never sighted the second one. She said it is not uncommon for pilots to miss the approach in similar weather conditions, and that these type of conditions are also very common. She added that locally based pilots complete instrument approaches more regularly than itinerant pilots.

Ms. Ford said that typical practice at Aspen is for controllers to radar monitor the airplane's progress via the step-down fixes to see if they descend below minimum altitudes. If so, the controller will query the pilots if they have the runway in sight. If the pilot does not report the runway in sight, controllers will issue a low altitude alert and/or go-around instructions. She added that as a general technique she will often issue a visual approach clearance to a pilot who has reported the airport in sight. She said she won't normally use that technique unless she is sure the pilot won't lose sight of the runway.

Ms. Ford said that if a pilot tells her that he wishes to circle, she will typically ask which runway they prefer. Normally runway 15 arrivals will fly overhead the field and descend in left turns. She said pilots will usually accept up to a 10 knot tailwind before circling to runway 33 during daylight hours. Aircraft landing runway 33 at night are rare. Ms. Ford said she was not aware of any restrictions at night on the VOR/DME-C approach. She added "I am now." She did add that the Roaring Fork Charted Visual procedure is not authorized at night.

Ms. Ford first became aware of N303GA when the pilot reported on frequency approximately over Red Table VOR. At the time she was closely monitoring one of the preceding airplanes, N427JA, and she saw that airplane descend below a step down fix. She asked N427JA if the airport was in sight, and the pilot of N303GA replied "on VOR approach." Ms. Ford then observed N427JA pass the step down fix and enter an area with a lower MDA, so was not as

[49] Cold Bay, Fairbanks, North Bay, Barrow, and Dead Horse

concerned about that airplane. She then responded to N303GA, issued the airport and weather information and cleared the pilot to land on runway 15.

She next observed N427JA "go low again" and when she queried the pilot, he responded that he was "going around." She instructed the pilot of N427JA to contact the approach controller, and noted she had to repeat the instruction. Ms. Ford then began monitoring N303GA's progress along the VOR/DME-C approach. She said she saw the airplane descend below one of the step-downs, she thought it was the 10,400 foot MDA, but was not sure. She then asked the pilot if the runway was in sight. When the pilot replied that it was in sight, she began to issue a visual approach clearance but cut herself off. She said she realized the visual approach clearance was not appropriate because of the snow showers in the vicinity.

Ms. Ford did not see the airplane during the exchange, but shortly afterward saw N303GA "come out of the snow, pointed at Shale [Bluffs]." When she saw the airplane, which appeared low and to the right of the runway centerline, she said out loud to no one in particular "What's this Gulfstream doing?" She said it then appeared that the pilot "got the runway and turned toward it." She said it looked like it was accelerating and the lights were pointed directly at the tower. She noted the airplane was rolling rapidly to the left and said "Oh my God, he's going to crash" and immediately reached for the crash phone. She hit the emergency siren switch to notify ARFF right as she saw an explosion "light up the sky." She then told the approach controller to break the next airplane off the approach and hold traffic.

FAA National Flight Procedures Office, First Session

On April 2, 2001 the group reconvened at the FAA's National Flight Procedures Office (NFPO) in Oklahoma City, Oklahoma, to examine the circumstances surrounding the issuance of the March 27 NOTAM affecting the VOR/DME or GPS-C approach. A group interview/briefing was conducted at the NFPO. In attendance were:

Russ Jones, FAA Office of System Standards, AVN-100
Brad Rush, FAA Office of System Standards, AVN-160 (After the briefing, Mr. Rush was added to the group.)
Mike Ahern, Flight Inspection Pilot, Oklahoma City Flight Inspection Field Office
Tom Casserly, Flight Inspection Pilot, Oklahoma City Flight Inspection Field Office
Don Pate, FAA Flight Standards, AFS-420

The meeting commenced with a PowerPoint presentation by Mr. Jones explaining the mission and operations of the NFPO (see attachment 12). Mr. Jones explained that the mission of the NFPO is twofold, first is the development of instrument flight procedures, and second, the maintenance of existing procedures. He elaborated that maintenance does not mean physical repair of navigational aids, but rather, periodic review of flight procedures for safety and quality. According to FAA Order 8260.19, published instrument flight procedures must be reviewed by a specialist every two calendar years, and a flight check to assure navigation performance and obstacle identification must be performed every 540 days. (see attachment 17 for records of Aspen VOR/DME or GPS-C reviews) Additionally, the presentation included an explanation of the NOTAM distribution process. Mr. Rush explained the steps taken between the initiation and

publication of a NOTAM, and that the NFPO was currently in the process of streamlining the procedures. He explained the ultimate goal is to transition to a web-based system.

As background to the issuance of the NOTAMs on the VOR/DME-C procedure, Mr. Jones explained an FAA program called CAST, Commercial Aviation Safety Team. Part of the project is a CFIT (Controlled Flight Into Terrain) sub-group. The CFIT group has prioritized airports based on an NTSB risk model, and is performing projects on high risk Part 139 airports first. Aspen is considered a high risk airport due to the severe mountainous terrain. The CFIT sub-group identified non-precision approaches as a priority project, noting that CFIT accidents were five times more likely on a non-precision approach than a procedure with vertical guidance. (see attachment 20)

Part of the CAST CFIT initiatives related to Aspen, is an attempt to develop an LNAV/VNAV[50] approach to Aspen. Procedures specialists at the NFPO design the procedures using the parameters described in FAA Order 8260.3B (TERPS) and other criteria. Flight Inspection pilots assess the flyability and human factors aspects of the procedure. In support of this effort, a commissioning flight check was performed on March 21, 2001. Guidance on such an assessment is contained in the FAA Flight Inspection Manual, 8200.1, section 214 (see attachment 19). Mr. Rush explained that FAA Flight Inspection Pilots and Procedures Specialists have a certain amount of discretion and judgment when designing and/or approving an approach procedure. He provided the group with some excerpts from appropriate documents explaining the procedures and coordination process.

Mr. Ahern said he was acting as pilot in command of the Flight Check airplane on March 21, 2001, and was assigned to perform a commissioning check on the proposed public-use LNAV/VNAV runway 15 procedure to Aspen. Mr. Ahern has been a flight inspection pilot for 14 years, he was the procedure specialist who initially designed the Aspen VOR/DME-C amendment 4, in 1989[51]. The new procedure was intended to be a public use approach, available to GPS equipped users and would have both straight in and circling minima. Mr. Ahern explained that a commissioning flight check is a much more thorough operation than a periodic evaluation flight check. During the course of the check, he became concerned about the effects of the terrain on the flyability and human factors aspects of performing circling maneuvers at night. He decided to report this concern, along with his desire that the approach have a prescribed visual descent point on his report.

While he was in the process of writing up his report on the flight check, either he or Mr. Casserly, he was not sure, noted that the VOR/DME or GPS-C had circling minima approved for night. Mr. Ahern said the same reasoning and concern applied to that approach as well, and reported such to his superiors. Mr. Ahern emphasized that he has had much experience as a procedures design specialist as well as serving as a flight check pilot.

[50] "Lateral Navigation/ Vertical Navigation, a non-precision GPS based procedure that provides a glideslope-like guidance to the pilot based on barometric altitude and GPS position information. See attachment 18.

[51] Mr. Ahern and Mr. Rush explained that during the late 80's time frame, flight check pilots and procedures specialists were part of one job description.. Those functions have been largely separated into different job descriptions since the mid-90's.

After reporting his opinion that circling should not be allowed at night on the VOR/DME or GPS-C approach, nor from the proposed LNAV/VNAV approach, he planned on writing a report on his findings. In the meantime, the first NOTAM was issued reading "circling NA at night." When asked directly, Mr. Ahern stated that the wording of the first NOTAM did mean that the entire approach was not usable at night. Additionally, he said that was exactly what he intended. He explained that since the VOR/DME or GPS-C only has circling minima, removing the circling minima via the NOTAM causes the entire procedure to be unauthorized. Mr. Casserly and Mr. Rush completely agreed with that opinion.

Mr. Ahern says he never saw the NOTAM, and completed his report on the night of, and approximately an hour prior to, the accident. Mr. Ahern said the first NOTAM and the second NOTAM are operationally identical. Mr. Casserly said he did not know of any commonly available reference material pilots would use to make the interpretation. Mr. Rush added that the Notice to Airman Publication would be the reference material. All the interviewees agreed that NOTAM wording "should be understandable" to the average pilot, and that enough information should be included to communicate the meaning.

Mr. Ahern was not sure if a visual descent point could be created for the VOR/DME or GPS-C that would meet TERPS criteria. He added that establishing a VDP would not change the capability for the procedure to provide straight-in minima, it would only serve as an advisory to pilots when they intersect a normal glidepath to the runway threshold.

Mr. Ahern speculated that possible items that might help with night flyability in the future include establishing a VDP, adding color chart contours, an RNAV approach to a point-in-space with a fly-visual segment, approach and/or lead-in lights. Mr. Rush added that publishing color chart contours is an FAA program which is in its early stages. (See attachment 6 for a Jeppeson Co. publication of the VOR/DME or GPS-C with color contours.)

The approach was originally charted with a note on it saying "proc NA at night" (see attachment 8). According to the ASE package at the NFPO, the notation was removed in 1994 based on direction from the FAA Headquarters flight standards division. Mr. Rush and Mr. Pate did not know the justification behind the direction, but they were tasked with finding all possible information. They opined that political pressure over general aviation access to the airport was behind it.

Mr. Ahern said that the proposed LNAV/VNAV approach would allow IFR access at night to Aspen. Although circling maneuvers would still be prohibited, straight in minima would be published. Mr. Ahern said that while he would like to see a VDP established for that procedure, it is not a "show stopper" and thought he could approve the procedure without it. Waivers may be required to establish the VDP. Lights may aid as a mitigating safety factor with the waivers. When asked about the status of the PAPI lights at ASE, none of the interviewees had any knowledge of a baffling[52] restriction. Mr. Rush added that the PAPI installation at ASE has no bearing on the instrument approach, he said that while designers attempt to fit IFR descent gradients with existing visual slopes, that is not at all possible at ASE. AVN-120 considers the

[52] Baffles are sections of aluminum placed along side the lights to prevent glare from shining into passing motorists on the highway. See the Airports Group report for details on light baffles.

ASE PAPIs to be a VFR tool only.

Mr. Rush said that the LNAV/VNAV approach was due to be flight checked the week of April 8, with charting scheduled for September. Mr. Ahern and Mr. Rush advised the approach would still be a work in progress while they work on the establishment of a VDP.

When asked why the circling at night restriction was not added sometime earlier, Mr. Ahern explained that the 2 year procedural review and 540 day flight inspection review are not as intricate as a commissioning check, and mostly look for the effects of manual changes and newly constructed obstacles, in addition to navaid performance. A commissioning check, such as was being performed for the RNAV approach on March 21 is much more detailed. Mr. Ahern said he was in the mindset to be thinking about terrain avoidance and CFIT when performing the commissioning check due to the CAST project and that was what got him thinking about the VOR/DME or GPS-C approach.

Night is officially defined as the time that the center of the sun's disk is 6 degrees below the horizon. Mr. Ahern and Mr. Rush stated that the definition of the horizon is vague.

Mr. Ahern said that he may have occasionally been the flight inspection pilot that performed periodic checks on the VOR/DME or GPS-C approach between 1991 and the present. Other checks may have been done by pilots (such as Mr. Casserly) who did not necessarily know the approach was ever restricted at night. Mr. Casserly said he did not have much experience at Aspen and he agreed that he did not believe night operations from the VOR/DME or GPS-C were safe. Mr. Ahern said that present FAA policy is for flight checks to be accomplished only during daytime VFR, although that has not always been the case.

According to Mr. Jones, prior to 1989 there was a public-use VOR only approach to Aspen, which did not have the localizer back-course missed approach, and had much higher minimums. He did not know whether it was restricted at night.

The group was provided with a package containing the procedural records for the VOR/DME or GPS-C and Mr. Ahern's report. (attachments 5, 8, 11, 12, 13, 17)

FAA Northwest Mountain Region

On April 30, 2001, the Group traveled to the FAA Northwest Mountain Regional Office, Seattle, Washington, to conduct follow up interviews regarding the issuance of the March NOTAMs and history of IFR flight procedures at ASE.

Dan Boyle **Assistant Manager, Air Traffic Division, ANM-501**

Mr. Boyle was interviewed on April 30, 2001. In response to questions, he provided the following information.

Mr. Boyle first heard of the accident on the evening of March 29. He thought that it would be considered significant and began a review of Air Traffic services to the airplane. The following

day after talking to his Quality Assurance staff, the first NOTAM was brought to his attention by a member of the regional flight standards division. Mr. Boyle said he had never seen the NOTAM prior to this time. He said he "pulled up" the information on the approach and called the flight procedures branch to determine what the intent of the wording was.

He recalled that later that night on an FAA telephone conference, there was some discussion about whether or not the NOTAM meant that the approach was authorized. Mr. Boyle said that his opinion was that it meant the "approach was authorized, but [a pilot] must not proceed beyond the missed approach point." He speculated that a pilot practicing approaches may still use it. His impression of the discussion on the telecon was that the decision on finding out the intent would be postponed. He insisted that he wanted to know right away what the intent was. He said that a decision was made to issue a new NOTAM specifically saying "procedure NA at night" and that Bill Peacock (FAA Director of Air Traffic Services) was notified.

Mr. Boyle said that he had no access to the first NOTAM in the building [regional office] although normally he would receive a copy. The FDC NOTAM publication is routinely received and tracked for Air Traffic purposes. He said that it is common that a Flight Check crew will give a "heads up" to a local ATC facility if they determine there is a problem with a navaid or procedure that will soon be NOTAM'ed. He said there was no prior notification from AVN to Air Traffic in the region about the Aspen night restriction.

Mr. Boyle noted there was a great difference of opinion on the NOTAM interpretation. He said he believed it was perfectly clear, although he added, "why would anyone write it that way?" He related that other people involved in the telecon and other discussions did not have the same interpretation. He said he has seen similar NOTAMs on approach procedures that have both circling and straight-in minima established. When asked if he has ever seen guidance that would lead anyone to this sort of interpretation he said "not really", and that his background as both a pilot and controller led him to that interpretation.

Mr. Boyle was not certain if the second NOTAM was generated at the flight procedures office in the Northwest Mountain region or from the Oklahoma City headquarters. He said that the users of the special approaches were informed of the restriction to night circling maneuvers during the day on March 30.

Mr. Boyle said he has heard "grapevine" information about a new GPS approach being established for ASE, but does not know how far along it may be. He also said he has little contact with the US NOTAM Office in Virginia.

Mr. Boyle thought that proper Air Traffic Control treatment of the first NOTAM should entail putting the information on the ATIS, and clearing aircraft for approach as requested. He said the second NOTAM may be treated differently. He said that a controller may be considered as an "extension of the crew or airmen" and as such they should not issue clearance for the approach. When asked about the provisions of AIM paragraph 5-4-1d and FAA Order 7110.65 4-8-6[53], he

[53] **4-8-6 Circling Approach**
a. Circling approach instructions may only be given for aircraft landing at airports with operational control towers.
b. Include in the approach clearance instructions to circle to the runway in use if landing will be made on a runway

said his opinion was that the controller "is saying, 'you own the runway', not 'you must land straight in'." He said under normal circumstances when airplanes are conducting overhead maneuvers "ATC would know if the aircraft is VFR on the first pass" and does not believe an overhead maneuver cancels the pilot's IFR clearance.

Mr. Boyle added that he believed that changing a pilot's clearance to "cleared for the visual" after the pilot reports runway in sight on a published approach means that the pilot is now "relieved of the step-downs."

James Mast **Project Manager, Seattle Flight Procedures Office, AVN-120**

Mr. Mast was interviewed on April 30, 2001. In response to questions he provided the following information:

Mr. Mast recalled that on the morning of March 30, he first heard of the accident and knew that it would be high-visibility because of the location. He got the first NOTAM from a procedures specialist in the Seattle FPO. Mr. Mast said he normally would receive such NOTAMs from the Flight Procedures Office in OKC, but this one came through on a fax. He said he was familiar with the "night controversy" from the early nineties regarding Aspen restricting operations at night due to noise. In his recollection, FAA Flight Standards studied the issue and found there was "no problem."
After receiving the NOTAM, Mr. Mast called the Air Traffic Division and Flight Procedures in OKC (Mr. Pannell). He said they discussed the wording, and that he didn't care for it, but didn't press the issue at the time. He said Mr. Pannell related that the NOTAM was issued because of a flight check which the NFPO personnel discussed, then decided to issue as it was. Mr. Mast was asked why the Air Traffic division in the region was not aware of the NOTAM prior to the accident. He said the system "should work", in that "courtesy calls" to Air Traffic from the NFPO are "common" and the FAA U.S. NOTAM Office (USNOF) distributes NOTAMs to the field facilities, but not the regions. He said he was surprised that the mention of "night" alone did not raise high attention initially.

He said in his recollection it was the Air Traffic Division (Mr. Boyle) who first questioned the wording of the NOTAM, but he made sure that AVN was aware of the night history at ASE. Later on during the day Friday he said there was another wording discussion involving Air Traffic and AVN in OKC asking if it should be changed. He said AVN originally felt the NOTAM was "OK the way it was" but Air Traffic was starting to get stronger in the opinion that it should be changed. He said he called AVN later and spoke with Mr. Sorvig (see attachment 13) who issued the second NOTAM.

Mr. Mast felt that the first NOTAM could be interpreted to tell pilots that landing "straight in" is okay. He first tried to find if that really was the intent, but couldn't get an answer. When asked if he had seen similar NOTAMs, he replied "not really." He did not believe AVN in OKC called the SEA FPO to discuss the NOTAM. He said he did not know of any review process to

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other than that aligned with the direction of instrument approach. When the direction of the circling maneuver in relation to the airport/runway is required, state the direction (eight cardinal compass points) and specify a left or right base/downwind leg as appropriate.

determine the effect of wordings of NOTAMs. He said there should be no other interpretation of how a NOTAM effects a pilot. But he said he never received a clear answer. He stated that he understood that the second NOTAM was issued by the OKC NFPO.

In the best of his knowledge, he thought the original NOTAM was generated from a flight check that he believed was for a special approach. He is not aware of any new public use approaches being developed for ASE. He has heard of the CAST/CFIT initiatives regarding LNAV/VNAV, but does not know the status of ASE.

Mr. Mast explained his role in procedures maintenance as a liaison with Air Traffic and user groups to forward information to the NFPO for procedure amendment. He also incorporates long-term NOTAM information into procedures amendments, and participates in obstruction evaluation. He said his office does not get involved with periodic reviews, although he did say he knew that the FAA is "overloaded" with review backlog. He said an issue with an obstruction evaluation, such as a newly constructed radio tower might drive an informal review.

Mr. Mast said that amending non-precision approaches to better support a stabilized descent is FAA general policy. He said that procedures design is moving away from "dive and drive" even at the expense of the lowest possible minima. Visual Descent Points are becoming more prevalent. Mr. Mast said that the publication of a descent gradient angle on a non-precision approach is only done on procedures with straight-in minima.

John Chapman Program Manager, All Weather Operations, Northwest Mountain

Mr. Chapman was interviewed on April 30, 2001. In response to questions he provided the following information.

Mr. Chapman first became involved with the instrument approach procedure at Aspen when the LDA back course was established in the late 1980s. He said the missed approach used to bring aircraft back to the north which greatly diminished capacity at the airport. Controllers had to use a "one in-one out" method to protect for the missed approach segment. He said using the LDA back course enabled the controllers to create some sort of a flow increasing the acceptance rate. Shortly afterward when the radar was installed, the acceptance rate increased some more. However, he emphasized that the biggest problem with establishing instrument procedures to Aspen is the ridge line south of the airport, "you can't get out again." He described the terrain as such that navigation performance will not help because there is no place to go through the obstruction, only over. He mentioned that he had heard the airport manager has hired an advanced navigation consultant to attempt to find ways to develop instrument procedures. Mr. Chapman's opinion is that "he's not going to get much."

A large part of Mr. Chapman's responsibility is managing the special approaches that are established at Aspen (among other airports). He made it clear that special procedure approval is very strict, the operators must provide specific training to flight crews and meet performance standards with their aircraft.

Mr. Chapman said that the night restriction assessment is based on the flight check pilot's

experience and technique, along with other such approach chart information such as text warnings of "high terrain all quadrants." He knew of a long term controversy over night operations at Aspen dating from the mid eighties. The county airport authority wanted to restrict general aviation operators from using the airport at night, and was brought to court. He was of the opinion that the FAA was pressured to "deal with the issue" and removed the night restriction from the VOR/DME or GPS-C. He did not believe there were any assessments done, or any steps between the 1994 lawsuit and the amendment of the procedure. Mr. Chapman said he has flown into Aspen many times and added "there are few airports I wouldn't fly to at night, Aspen is one of them."

Mr. Chapman explained that the term "circling" has different meaning in a procedures design context than an operational context. When the term "circling" appears on an approach chart it is referring to protected airspace, not an aircraft maneuver. He said that after the first NOTAM was issued and attention was brought due to the accident, many operators called him asking for clarification of the meaning. He said he has never seen this type of NOTAM used this way. He added that he is responsible for disseminating NOTAM type information of this nature to the operators approved for the Special Procedure to ASE. He said that is not as controversial because straight-in minima are established on that approach.

Mr. Chapman said a lack of coordination between AVN and Air Traffic is not uncommon anymore, he said there are more and more non-pilots developing and performing quality control on instrument procedures. He was not aware of any effort to develop a public use GPS approach to ASE, but doesn't believe it would be possible to do so and establish straight-in minima.

Mr. Chapman expanded further on TERPS procedures with high minima and mountainous terrain, he said TERPS was "not really intended for high mountains." He compared the terrain of Aspen with that of Eagle, Colorado, where modern advanced navigation allows pilots to "thread the needle" between valleys. The ridge structure around Aspen does not allow for such a concept. Additionally, the "fly visual" segment of the Eagle procedure is a waivered procedure, with carefully controlled mitigating factors joining the instrument approach procedure to an IFR Departure Procedure.

Mr. Chapman added that there is no FAA guidance to pilots on operations at airports with high MDAs. He said "[the FAA doesn't] do a good job of teaching pilots about the implications of high MDA mountain operations." He said that most training material focuses on VFR flight rather than instrument procedures. He thought that it would not be a bad idea to require a "mountain flying" endorsement for pilots.

Mr. Chapman concluded by supporting the basic design of the approach procedure itself, however. With the limitations imposed by the terrain and navigational aids, the approach meets criteria and is as safe as it could be. He said "if there was something more to be done on that procedure, we would have done it."

FAA National Flight Procedures Office, Second Session

On May 1, 2001 the group reconvened at the FAA's National Flight Procedures Office (NFPO) in Oklahoma City, Oklahoma, to conduct follow-up interviews regarding the NOTAM and flight procedures issues.

John Pannell **Procedures Specialist, FAA AVN-120**

Mr. Pannell was interviewed on May 1, 2001. In response to questions he provided the following information.

During the last part of March, 2001, Mr. Pannell was serving a detail as the Manager of AVN-120, which is the section responsible for the western mountain states. He first became aware of the issue of a night NOTAM at Aspen when he overheard a discussion in one of the cubicles in the procedures office area. He said he heard Mr. Ahern talking to a specialist saying words to the effect of "shouldn't have circling at night." He then entered the conversation and observed Mr. Ahern complete a Procedural Control Form (see attachment 11) for the LNAV/VNAV approach he was working on saying "circling NA at night." He then asked Mr. Ahern "what about the other procedure?" Mr. Ahern agreed and said "that should count, too." Mr. Pannell said the specialist in the office[54] (Ms. Adams) wrote the NOTAM for the VOR/DME or GPS-C, Mr. Pannell signed it, and it was sent out through normal channels.

Mr. Pannell recalled that about a week later, on the day after the accident, he was called at home after hours by Mr. Sorvig who relayed that he had a question from the Seattle FPO. Mr. Sorvig said they were not sure about the wording of the NOTAM and "should we change it?" Mr. Pannell attempted to get in touch with higher management because he knew there would be controversy due to the accident. He could not reach anybody, so decided to authorize changing the NOTAM "if there was any chance it could be misunderstood."

Mr. Pannell said that the wording of the first NOTAM is "not a common way" to write a NOTAM of that nature. He said that there are many levels in the processing of the NOTAM where someone could amend the wording if it was wrong, but they are usually of the editorial fashion. When asked directly if the wording could be considered "wrong", he said "maybe" at least from a procedural design point of view. But, he added, there is no specific guidance on such an occasion. He said that from the point of view of a procedures designer, since the approach doesn't have any straight-in minima established "how could anybody think otherwise," i.e. that it does, in effect, make the entire procedure unauthorized.

Mr. Pannell explained the procedure for distributing NOTAMs from AVN-120 is to fax a copy to the USNOF, the regional Flight Procedures Office who provides a fax record confirmation, and internally to AVN-160 for quality control, and AVN-100. He said the USNOF and the National Flight Data Center sometimes provides feedback on NOTAMs, but most operational feedback comes from Air Traffic or user groups.

[54] Ms. Diane Adams, who was training in that position under the guidance of an instructor.

Donald P. Pate **Manager, FAA Flight Procedure Standards Branch, AFS-420**

A follow up interview with Mr. Pate was conducted on May 1, 2001 at the AFS-420 offices in Oklahoma City. Mr. Pate provided the group with the following information.

In the best of his recollection, Mr. Pate stated that the Aspen VOR/DME-C approach procedure was amended to remove the night restriction in the 1993 to 1994 time frame, thereby generating amendment 4B. The only written record behind the change that he knew of, was the series of memoranda included in the procedure file originating at the AVR-2 level. He was "pretty sure" that memos were generated due to pressure over a lawsuit involving general aviation access to the airport, and "congressional language" (see attachment 10).

Mr. Pate was asked about some general concepts regarding the FAA policy on procedural design. He acknowledged that the FAA is moving toward a philosophy of encouraging a stabilized approach concept as much as feasible. Many of the FAA CAST/CFIT initiatives are intended to support this policy. He noted that FAA studies of accidents in the approach phase of flight show a five-to-one ratio of accidents on non-precision approaches as opposed to precision approach procedures. He said that the concept of barometrically aided vertical navigation is largely an air carrier and large jet concept (see attachment 18), however it may be used by pilots of light planes. The FAA policy does not eliminate the availability of "dive and drive" or step-down, operation for light general aviation aircraft.

Mr. Pate explained that when building a new GPS or other non-precision approach procedure, FAA guidance is to "shoot for" a three degree vertical profile wherever possible. When approach procedures are amended for other purposes, changes to step-downs to conform with a three degree profile may be issued. New or amended approach charts produced by the National Aeronautical Charting Office (NACO, formerly NOS) will include a small graphic and an indication of the vertical profile gradient between final approach fix and threshold crossing height. Mr. Pate was not certain if that criteria applied to approaches without straight-in minima. He did add that Jeppeson includes the angle on many of their products of their own accord.

Mr. Pate acknowledged some controversy over the inclusion of the profile angle on approach charts. While some user groups, primarily those operating large jet airplanes, support the additional information as a useful tool, some believe it may act as an "attractive nuisance" and encourage general aviation pilots to attempt descents beyond their capability. He added that the FAA is reluctant to relent on a safety standard "just because pilots might do something stupid."

Mr. Pate also added that a broader, related initiative to encourage stabilized approach procedures is a program to build LNAV/VNAV approaches to FAR Part 139 air carrier airports. The FAA plans to establish such a procedure to each Part 139 runway end by the year 2006. He said that the project has already begun at many of the high-risk airports.

Additional FAA programs related to stabilized approaches include an education effort for general aviation pilots and a "Special NOTAM" regarding the profile angle symbology on approach charts. He mentioned some proposed AIM language is currently being formulated, also. He said that a new version of the FAA publication "Instrument Flying Handbook" (AC 61-27C) is

"almost ready to go" and acknowledged that while it has basic guidance on instrument approach procedure concepts, it could "certainly use a section on mountain flying or circling."[55] He mentioned that warnings which occasionally appear on charts indicating such items as "obstacle clearance not provided for missed approach initiated beyond [MAP]"[56] are a judgment call on the procedures specialist's part. There is some guidance in the TERPS regarding using extra protection during turns at high altitude. He said there is no specific guidance to designers regarding non-precision procedures with high HAA.

While mentioning documents and FAA publications, Mr. Pate emphasized that the TERPS manual is documentation for procedures design, not an operational guide. It is not intended to tell pilots how to fly an approach, nor how to read and interpret the charts. He said that, as an adjunct to AIM and IFH material, some explanatory material should be appearing in the NACO publications soon. He added that, while a procedures designer may follow all specified guidance, it remains up to the Flight Check pilot to provide a safety check beyond and/or below the "black lines", i.e. during the transition from MDA to landing. There are many factors addressed in TERPS when designing an approach procedure, and the manual allows a designer to "push the envelope" in varying ways. This flexibility places a burden on the designer and flight check pilots to make sure that the various factors that may be at the edges of acceptability do not "stack up" on the pilot.

Mr. Pate acknowledged that the wording of the March 27 NOTAM on the VOR/DME-C approach was not correct. His opinion is that the language in the 8260.19 manual, paragraph 813 (see attachment 13), may allow for some latitude is the expression of a certain NOTAM, but the circumstances surrounding night operations to ASE via the VOR/DME-C were not open. While he understood the reasoning behind the wording of the first NOTAM from a designers point of view, he is of the opinion that Flight Check should be "thinking operationally" and worded it in a more useful fashion for pilots.

Mr. Pate was asked about changes to TERPS in the past few years regarding the assessment of the visual area for landing from instrument approaches (TERPS paragraph 251). He stated that criteria for new LNAV/VNAV approaches have a separate set of criteria outside of the TERPS manual, however for conventional non-precision approaches paragraph 251 applies. He explained that an area approximately 10,000 feet long extending from the end of each runway is assessed for obstacles. Two different slopes are evaluated and if an obstacle penetrates the slope, visibility minima for the approaches may be increased. Contained in Change 17 to the TERPS manual, in 1998, a provision was added which would deny IFR night operations to a runway if a slope of 20:1 was penetrated by an unlighted obstacle. The FAA realized that there was a potential for a large impact to many airports who would be required to light obstacles or risk losing night IFR operations to certain runways. Mr. Pate's office issued guidance to the Flight Procedures Office delaying implementation of that passage. On July 26, 1999, further guidance was issued instructing AVN to assess the visual areas in accordance with paragraph 251, but that airports were allowed a three year "grace period" to mitigate the obstacle penetration by lighting or removal. Assessment of the visual areas should be done during biennial procedural reviews or other occasions which instigate an amendment to a procedure.

[55] The new version of the Instrument Flying Handbook was renumbered to 8083-15 and published in June of 2001.
[56] E.G. Juneau, Sitka, Ketchikan etc.

Mr. Pate acknowledged that biennial procedural reviews are falling well behind schedule. He said that the workload brought on by the establishment of new GPS and other procedures, the CAST CFIT initiatives, and the transfer of Departure Procedure responsibility from the Air Traffic Division all contribute to the backlog of biennial procedures reviews. He said the Flight Procedures Branch is examining the concept to change from a specified two year interval of review to a more flexible method. Using a "progressive maintenance" style of review would mean that while a particular procedure may not receive a full review every two years, at least a portion may be examined at some point in the cycle.

6.0 ATTACHMENTS

1. ATC Transcript - Draft 5 pp
2. Air Traffic Accident Package Items – Draft 30pp
3. Radar Overlays 2pp
4. Aspen ATCT Standard Operating Procedures and other orders 73pp
5. Procedures Package 1991-Present 13pp
6. VOR/DME or GPS-C Approach Plates 2pp
7. Photos of tower and final approach area 6pp
8. Procedures Package, documents pre-1991 21pp
9. VFR Night Flight Studies 135pp
10. H.R. 2739 Section 517 2pp
11. Reports and Forms completed by Mike Ahern 4pp
12. Powerpoint Presentation and supporting data 1 file, 3 pp
13. AVN-120 NOTAM documents and personnel statements 13pp
14. Radar Data Extractions 5 files
15. ZDV NOTAM Distribution Report 4pp
16. Memo concerning TERPS 251b 6pp
17. VOR/DME or GPS-C review records 18pp
18. Flight Safety Foundation Paper 6pp
19. FAA Order 8200.1 Excerpt 5pp
20. CAST/CFIT Presentation 1file

William English
Air Traffic Group Chairman