No. 18

Bonanza Air Lines Inc., Fairchild F-27A, N 745L, accident at Las Vegas, Nevada, USA on 15 November 1964. Civil Aeronautics Board (USA) Aircraft Accident Report, File No. 1-0066 released 19 November 1965.

1. - Investigation

1.1 History of the flight

Flight 114 was a scheduled domestic flight between Phoenix, Arizona, and Las Vegas, Nevada, with intermediate stops at Prescott and Kingman, Arizona. The flight departed Phoenix at 1920 hours Pacific Standard Time with an Instrument Flight Rules (IFR) clearance from Phoenix to Las Vegas via Victor Airway 105, at 10 000 ft. The flight did not attempt to land at Kingman and Prescott because of below minima weather and airport conditions. While en route to Las Vegas the flight requested and was cleared to climb to and cruise at 14 000 ft. At 2010 hours Los Angeles ARTCC issued a descent clearance to 10 000 ft. The flight acknowledged the clearance and reported leaving 14 000 ft.

One minute later ARTCC instructed the flight to turn left to a heading of 260°, to expect a VOR/DME-3 approach and to contact Las Vegas Approach Control on 121.1 Mc/s. This was acknowledged by the flight.

At 2012:48 hours Las Vegas Approach Control reported radar contact with the flight five miles west of Willow Beach Intersection, and passed the current Las Vegas altimeter setting.

At 2013:17 hours Las Vegas Approach Control broadcasted the following message: "All aircraft on approach control frequency copy, the zero four one two special weather observation, indefinite ceiling six hundred, sky obscured visibility five, light snow, over." Within seconds this special weather report was amended to "visibility south one mile."

At 2014:05 hours the flight was turned to a heading of 245° and at 2015:13 hours it was cleared to descend to and maintain 9 000 ft. It reported level at 9 000 ft at 2017:23 hours.

Shortly thereafter the flight was advised that the visibility had lowered to two miles in light snow and at 2018:26 hours that the visibility was now one mile in light snow.

Approximately two minutes later the flight was cleared to descend to and maintain 7 000 ft altitude.

At 2019:57 hours the flight was advised that the visibility had dropped to ½ mile and instructed to turn to 290° shortly thereafter.

At 2020:53 hours Las Vegas Approach Control broadcasted the latest weather observation: indefinite ceiling five hundred, sky obscured, visibility ½ light snow. Shortly thereafter the flight was instructed to turn right to a heading of three six zero,

informed that its radar position was 18 miles south of the VORTAC and was cleared for a VOR/DME-3 approach to cross the 15 mile fix at or above seven thousand feet. The flight acknowledged these instructions as it had all previous communications from Las Vegas Tower.

At 2022:53 hours Approach Control advised the flight that another F-27 ahead of it had missed its approach.

At 2024:20 hours the flight requested the latest wind conditions. This information was not given to the flight. At 2024:55 hours a transmission "Flight one fourteen" ended abruptly as did the sound of the transmitter carrier wave. This was the last communication from the flight. Radar contact was lost at 2025:05 hours following an advisory from approach control that the flight was passing the 10 mile fix.

It was subsequently found that the aircraft had crashed 9.7 nautical miles from the Las Vegas VORTAC on the 196° radial. The wreckage, confined to an area approximately 1 200 ft long and 300 ft wide, was found on the southern slope of a 3 602 ft rise at elevations from 3 575 ft up to the crest. Some portions of the wreckage sprayed over the crest and came to rest on the northern slope at an elevation of 3 570 ft.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	3	26	
Non-fatal			
None			

1.3 Damage to aircraft

The aircraft was destroyed on impact.

1.4 Other damage

There was no damage to other property.

1.5 Crew information

The pilot-in-command, aged 41, held an airline transport pilot certificate with aeroplane single and multi-engine land, instrument and F-27 ratings. He also held a valid flight instructor's certificate. In each of the six-month proficiency checks from 1961 to the last check on 8 August 1964, he was graded average to above average. He had passed a line check on 22-25 December 1963, and was scheduled for a recurrent check before 30 November 1964. Company records indicated that he had recurrent training on 8 April

1964, 4 June 1964, 3 September 1964, and 4 November 1964. The airline Operations Training Manual provided, among other things, that each type rated pilot will have a minimum of three hours' practice and necessary instructions in the synthetic trainer at each six-month check period. VOR approaches were conducted in the course of practice in the synthetic trainer but the trainer was not equipped for DME training. On 8 July 1964, during a six-month flight proficiency check, a VOR/DME-1 approach to Las Vegas was accomplished satisfactorily by the pilot-in-command. This was the only check were a VOR/DME approach was listed.

His last physical examination for a first-class medical certificate was completed on 28 September 1964. There were no limitations. He had flown a total of 11 072:49 hours, including 4 057:23 hours in F-27 aircraft. In the past 90 days he had flown 239:45 hours of which 9 hours were instrument time. In the past 30 days he had flown 63:41 hours of which 3:15 hours were instrument time. On the day of the accident he had accumulated 4 hours and 38 minutes flight time and 8 hours duty time.

The co-pilot, aged 26, held a commercial pilot certificate with aeroplane single and multi-engine land and instrument ratings. He also held a flight instructor's certificate. Company records relating to transition and instrument checks, pilot evaluation reports, and co-pilot surveys consistently rated him as above average in flying ability. Grades on VOR procedures were listed as average. A 6-month check given him on 15 June 1964, which included a DME check, listed his performance as "average." His last physical examination for a first-class medical certificate was administered on 22 August 1964. There were no waivers. He had accumulated a total of 3249:41 hours of flying time, of which 811:41 hours were in F-27 aircraft. His total flight time for 15 November 1964 was 4 hours and 38 minutes while his on-duty time was 8 hours 1 minute at the time of the accident.

Operations personnel who witnessed the departure of the flight from Phoenix indicated that the pilot-in-command was occupying the left seat and the co-pilot the right seat as the aircraft departed.

There was also a stewardess aboard the aircraft.

1.6 Aircraft information

Maintenance records revealed that the aircraft was properly inspected and maintained in accordance with existing FAA specifications and airline procedures. It had been released as airworthy on the day of the accident. There was no maintenance required on the aircraft prior to the flight and no discrepancies were reported during the flight.

The gross weight at take-off, 35 909 lb, was well under the authorized maximum of 39 400 lb, and the centre of gravity (c.g.) was within allowable limits.

The aircraft was being operated on MIL-J-5624F kerosene fuel.

1.7 Meteorological information

The U.S. Weather Bureau forecast indicated low clouds, snow and light icing conditions in the Las Vegas area for the period during which the flight would be on approach. Pilot reports from aircraft in the area near the time of the accident reflected instrument conditions below 13 000 ft, light to moderate icing, light to moderate turbulence and snow. Weather observations made at Las Vegas near the time of the accident reflected low ceilings, visibility $\frac{1}{2}$ mile in moderate snow. Weather information provided to the flight crew at Phoenix included the prognosis of the regional forecast, but the pertinent area forecast and SIGMET advisories were omitted. However, Las Vegas Approach Control informed the flight of each significant change in terminal weather conditions.

The accident occurred at night during a snow storm.

1.8 Aids to navigation

Primary navigation on an instrument approach to Las Vegas was effected by the use of the Las Vegas VORTAC, with DME providing distance from the station. Surveillance radar advisories on azimuth and distance served as a double check on the primary system. The DME monitor panel at Las Vegas was located in the Flight Service Station (FSS) approximately one mile from the operating position of the Las Vegas approach controller. Because of this and the lack of repeater alarm in the tower, the Las Vegas tower controller could only assume that the primary navigational device was functioning, unless advised otherwise by the the FSS or aircraft using the system. At 2029 hours another flight reported that it had lost the Las Vegas DME, and at 2035 hours a second one reported that it was not receiving distance information. These reports were relayed to the FSS. After a check was made, the system was declared to be malfunctioning at 2035 hours, i.e. 10 minutes after the time of the accident. A period of time of unknown duration elapsed before the tower had knowledge that the primary navigational device had malfunctioned.

1.9 Communications

At 2024:20 Flight 114 transmitted the following message: "And one fourteen request the latest wind." This request was made at the same time that the Las Vegas approach controller and the local controller were co-ordinating with each other by interphone. Consequently there was no response to the request at that time.

At 2024:55 Flight 114 transmitted the following message: "(unintelligible) flight one fourteen is." The transmission then ended abruptly.

The Las Vegas approach controller at 2025:05 advised Flight 114 as follows: "Bonanza fourteen passing the one zero mile fix remain on frequency." There was no acknowledgement. Radar contact was lost following the issuance of this advisory.

1.10 Aerodrome and ground facilities

Elevation of McCarran airport is 2 171 ft.

1.11 Flight recorder

A Fairchild flight recorder was installed in the aircraft. The static ports for the flight recorder, altitude and airspeed instruments were located on the same panel. The recorder tape was recovered intact. Readout indicated compatibility with the clearances and instructions to the 15 mile DME fix. At approximately the 15 mile DME fix, the flight commenced a descent from approximately 7 000 ft AMSL which continued with no indication of level-off except for a few seconds at 3 700 ft AMSL. After this momentary level-off, the aircraft continued its descent until it crashed at approximately 3 575 ft AMSL. (See figure 18-1).

1.12 Wreckage

The initial impact occurred on a rocky ledge at an elevation of 3 575 ft. Both main gears were in the extended position and were torn from the aircraft. The fuselage bottom anti-collision light assembly struck a ledge at an elevation of 3 578 ft and was followed immediately by impact of the lower fuselage and propellers. The first propeller impact marks found at an elevation of 3 580 ft indicated that the aircraft was in a near level attitude on a magnetic heading of 20°.

1.13 Fire

There was no major fire on impact nor was there any evidence of fire in flight.

1.14 Survival aspects

The wreckage of the aircraft was not located until dawn on the morning of 16 November 1964. Structural deformation and disintegration throughout the occupiable areas of the fuselage precluded the survival of any occupant. Anatomical examination revealed that a majority of passengers had sustained skull fractures. During and following the principal impact all 20 double passenger seats were torn from their respective attachments and thrown free of the wreckage. Attachment failures occurred equally from leg shearing at the weld points on the seat frames, seat legs to floor attach fitting failures, and floor attach fittings pulling through the honeycomb type cabin flooring.

1.15 Tests and research

No special tests or research were required.

1.16 VOR/DME approach chart

In accomplishing a DME-3 approach to Las Vegas the crew would have referred to a Jeppesen approach chart (see figure 18-2) which was used by the airline. The upper portion of the chart - the plan view - listed a series of fixes at 15, 10, 6 and 3 miles and the minimum altitudes between these fixes. The minimum altitude limitations were portrayed as 6 000 ft between the 15 and 10 mile DME fix, 4 300 ft between the 10 and 6 mile fix, and 3 100 ft between the 6 and 3 mile fix.

A profile view displayed on the lower half of the chart depicted the last 3 miles of the approach as a level altitude of 3 100 ft into the 3 mile fix then a descent to 2 800 ft to the 2 mile fix, and finally a descent to authorized minimum altitude at the airport. The 3 100 ft depicted on the profile view of the chart was indicated by numbers which were approximately twice the size of the numbers shown on the plan view.

2. - Analysis and Conclusions

2.1 Analysis

After passing the 15 mile DME fix the aircraft commenced a normal descent which continued until it struck high terrain at an altitude of approximately 3 600 ft AMSL. From a detailed examination of the wreckage, it was determined that the aircraft's powerplant, controls, and systems were operating normally prior to initial impact. No evidence of incapacitation of the crew was found.

Because of the forecast for icing conditions, the possibility of ice accumulation on the static port panels and consequential erroneous altitude and airspeed information was considered. Since the flight recorder static port was located on the same panel as the altitude and airspeed ports, ice accumulation on one and not the other would be highly improbable. Therefore, as there was no evidence of ice accumulation reflected in the readout of the flight recorder tape, it was believed that ice was not a factor. This was substantially confirmed by the readout of the flight recorder tape which showed a high degree of compatibility with the configuration and flight regime of the flight during its approach up to the point of impact. Additionally, another flight immediately ahead did not experience any icing.

The possibility that the flight received erroneous DME indications was also considered. A correlation of the flight recorder data and the communication tapes showed that the flight had just passed the 15 mile DME fix when it reported leaving 7 000 ft. This would indicate the reception of current DME information at the time. Supporting this conclusion, the mileage indicators of the DME module were recovered from the wreckage and were found seized at 9.60 and 9.65 NM, from impact damage; this corresponded to the distance from the crash site to the Las Vegas VORTAC, which was measured as being approximately 9.7 NM. Furthermore, other aircraft using the navigational facilities at that time did not report any discrepancies prior to the time of the accident. This supported the fact that the DME was operating at the time.

Based on the available evidence, there appeared to be two possibilities for explaining why the flight went below the minimum safe altitude. One would be that the descent of Flight 114 below 6 000 ft was unintentional. This would suppose that:

(1) The crew was aware of the 6 000 ft minimum altitude between the 15 and 10 mile fixes and intended to level off upon reaching it;

(2) Their attention was diverted from altitude consideration for a period of two minutes or more after initiating the descent; and

(3) Neither pilot paid any attention to the altimeters.

Since a rate of descent of 1 500 fpm was common in the airline operation of the F-27, it was unlikely that both pilots would have ignored altimeter indications for a period of two minutes when it would have been their intention to level off in approximately 30 seconds after starting the descent. There was no evidence of any distraction, and the contact with approach control at 2024:20 hours appeared completely routine. The flight recorder showed rather precise prior compliance with altitude requirements throughout the flight. The records of both pilots with respect to Company checks, FAA en-route inspections, and previous employment records argued against the probability that both pilots would have ignored the descent for so long a period at this stage of the approach if their intention had been to level off at 6 000 ft.

Therefore, the Board did not accept the conclusion that the descent of the flight to 3 600 ft was unintentional.

Evidences indicated that the descent below the 6 000 ft level at some 3 miles and two minutes prior to reaching the 10 mile fix was intentional. This was substantiated by the very uniform, continuous and normal descent shown by the flight recorder and the crew's apparent lack of concern for anything but the wind conditions that they could expect on landing, at a time when they were already nearly 2 000 ft below the prescribed minimum altitude for their position. It was highly unlikely that both pilots would have descended some 2 400 ft below the minimum altitude in mountainous terrain if they had been aware of the altitude limitations imposed. On the contrary, if they were unaware of the 6 000 ft minimum to the 10 mile fix and the subsequent altitude limitation of 4 300 ft until passing the 6 mile fix, a descent to some lower altitude, which they believed to be safe, could be expected. Such a descent was indicated by the flight recorder down to about 3 750 ft, at which time a level-off was shown for a period of approximately 8 to 12 seconds before the descent was again continued. Based upon previous altitude indicators, the altitude indication in the cockpit would have been 150 feet higher than shown by the recorder; i.e., the altimeter would have read 3 900 ft. This would be consistent with an intended descent to some predetermined altitude less than 4 000 ft, and a break in the rate of descent in

anticipation of reaching the preselected altitude. This could have been brought about by a misinterpretation of the instrument approach chart. In considering this possibility, the following interrelated and contributory factors were examined:

(1) The VOR/DME-3 procedure which became effective on 3 October 1964 was relatively new. Weather conditions at Las Vegas between the effective date of this procedure and the date of the accident were such that instrument approaches had not been necessary. Accordingly, the night of the accident was the first occasion for the crew to use this new instrument approach procedure.

(2) The airline's link trainer was not set up to give DME practice and the only training on DME approaches was received during proficiency checks. The records of the crew for the three years preceding the accident revealed the execution of several VOR, ADF and ILS approach procedures. However, the check in July 1964 was the only one during which a DME approach was executed. This was due to the fact that the airline barely met the deadline of 31 December 1963 for the installation of DME equipment in turbo-prop aircraft.

(3) The profile section of approach chart displayed no information for the segment of the approach between the 15 mile fix and the 6 mile fix, and a solid horizontal line between the 6 mile fix and the 3 mile fix, with an altitude of 3 100 ft. Further, the solid line was defined in the Chart Legend as "Flight Path," which implied that a descent to 3 100 ft was proper once the fix to which the flight has been cleared is reached.

With the exception of the DME approaches at Las Vegas, all approach charts used by the airline for all terminals it was regularly serving showed critical descent information in the profile section of the chart. Pilots conducting a DME approach at Las Vegas were therefore required to use a chart which, while similar in appearance, displayed critical descent information in a manner entirely different from all the other charts used for all other approaches (including those for conventional VOR approaches at Las Vegas).

(4) Prior to the transfer of control from Las Vegas Centre to Las Vegas Approach Control, the flight had been advised to expect a VOR/DME-2 approach. However, at about 2012 hours, the flight was advised to expect a VOR/DME-3 approach. The crew had approximately 9 minutes to study the VOR/DME-3 approach chart prior to starting the actual approach. During this 9 minutes the flight was given 7 instructions relating to changes in heading or altitude, and was in contact with the tower on 16 occasions for this and other information relating to its approach, its airspeed on final, and the rapidly deteriorating weather conditions. During this same period the crew would also have been accomplishing the pre-landing check.

The flight recorder readout showed that from the time the flight was turned over to Las Vegas Approach Control at about 2012 hours until 2018 hours the aircraft was encountering light turbulence. Since the aircraft was not equipped with an autopilot, it would have been necessary for one crew member to devote practically his entire attention to flying the aircraft. In view of this, it was concluded that there was little uninterrupted time in which the pilot-in-command could familiarize himself with the approach procedure details.

2.2 Conclusions

Findings

The flight was properly dispatched.

The crew was properly certificated and no evidence was found of incapacitation.

The aircraft's powerplants, airframe controls, and systems were operating normally prior to impact.

No icing problem was encountered and all navigational instruments, both ground and air, were operating normally.

The descent below prescribed minimum altitude was intentional. The crew were not cognizant of the limiting altitudes specified for a DME-3 approach and were therefore not aware of a premature descent.

The VOR/DME approach charts for Las Vegas portray the descent information in a manner different from all other approach charts used by Bonanza Air Lines, which could have led to misinterpretation if the charts were consulted superficially.

Cause or
Probable cause(s)

The probable cause of this accident was the misinterpretation of the approach chart by the pilot-in-command which resulted in a premature descent below obstructing terrain.

3. - Recommendations

On 25 November 1964, the Civil Aeronautics Board by letter to the Federal Aviation Agency recommended "That the depiction of altitude restriction on the plan view of the approach plates be included on the extended profile of such plates in order to more clearly identify critical height above the terrain."

The Federal Aviation Agency replied on 16 December 1964, and its letter pointed out that the profile and the plan view sections of the approach plate are to be read together and that a pilot should not execute an approach by an independent reference to either view.

The letter also indicated that the FAA had a standing committee on charting and an invitation was extended to the Civil Aeronautics Board to have a representative sit with this committee. The Civil Aeronautics Board accepted the invitation and was represented at several meetings of the Subcommittee on Instrument Approach Charts of the FAA Flight Information Advisory Committee. A unanimous recommendation of the subcommittee was to extend the approach track in the profile to at least ten miles. The work of the Committee is continuing.

ICAO Ref: AR/879

ACCIDENT TO FAIRCHILD F-27A, N 745L, OF BONANZA AIRLINES, INC., AT LAS VEGAS, U.S.A.
15 NOVEMBER 1964

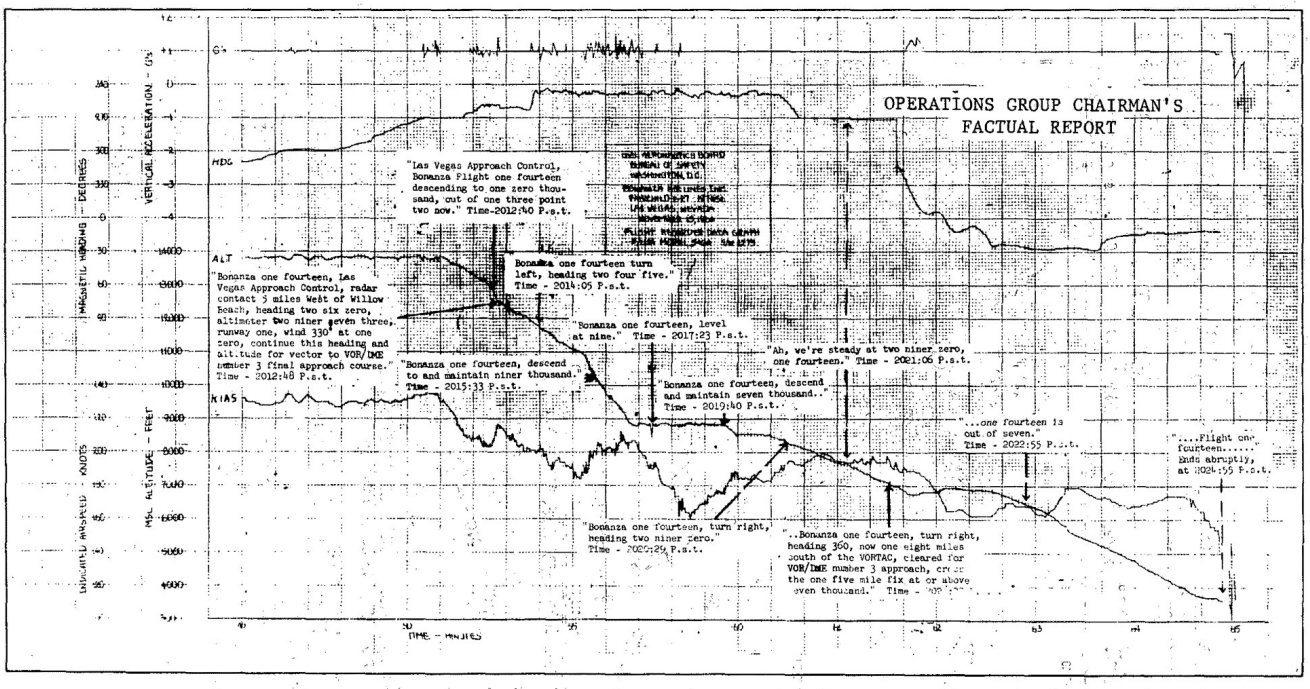

FIGURE 18-1

ACCIDENT TO FAIRCHILD F-27A, N 745L, OF BONANZA AIRLINES, INC., AT LAS VEGAS, U.S.A. 15 NOVEMBER 1964

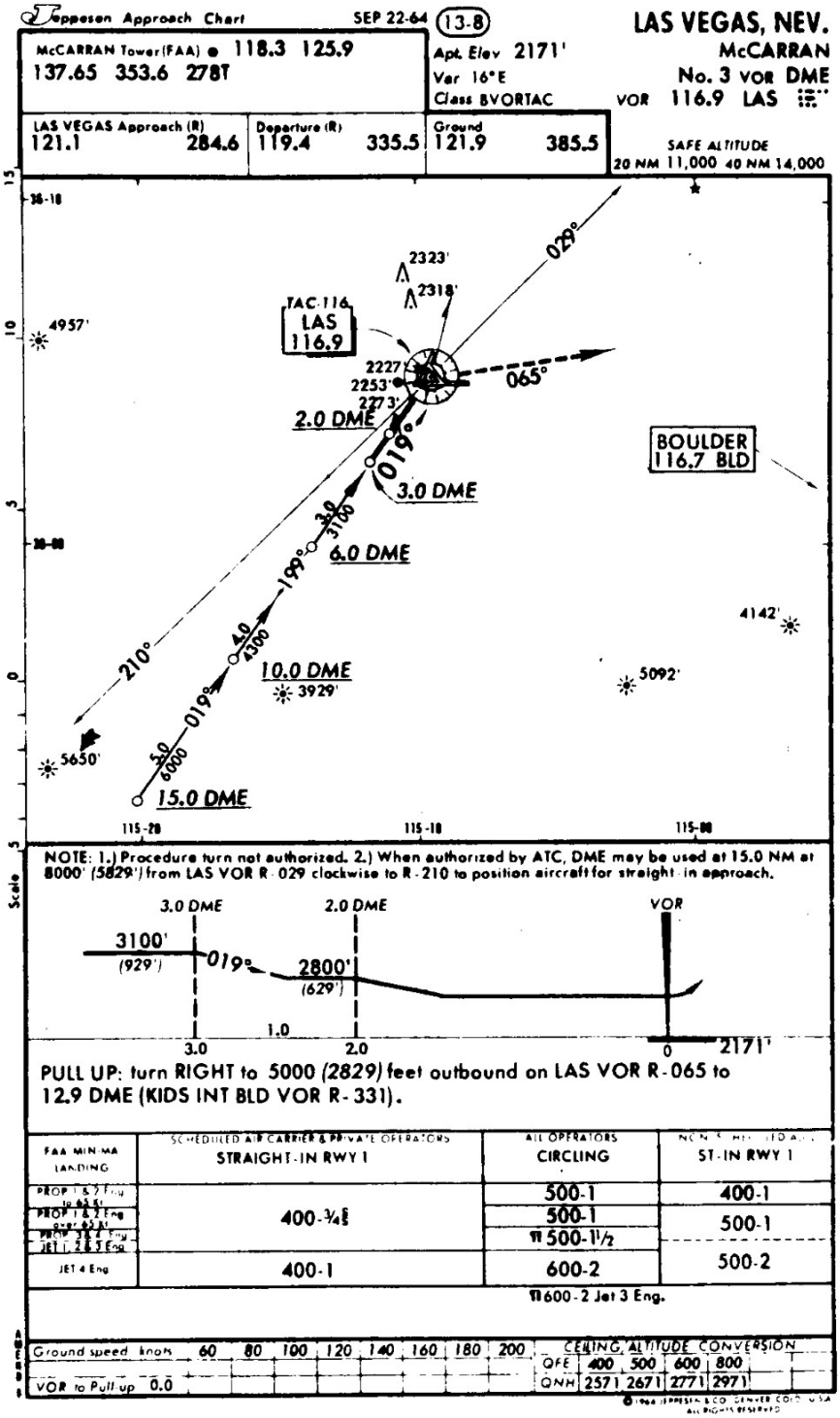

FIGURE 18-2