ARG/US

ASOS RESEARCH BRIEF

Research Request:

Dive and Drive– The Low Angle, Stepped Approach

Research Response:

According to the Aircraft Crashes Record Office (Geneva, Switzerland), approximately 80 % of all aviation accidents occur shortly before, after, or during takeoff or landing; 51% of accidents recorded occurred during landing, indicating it is obviously the most critical flight regime. The Flight Safety Foundation's (FSF) study examining approach and landing accidents discovered unstabilized approaches were one of the five prominent types of landing accident causal factors, and 36% of those were low and slow on approach. Stabilized approach parameters center around consistent approach angle and rate of descent. The FSF recommended implementation of certified constant-angle approach procedures for non-precision approaches be expedited globally. The risk during non-precision approaches is five times greater than during precision approaches, a clear indication of the value of vertical guidance. The study recommended mandates that ILS approaches must be flown within one dot of glideslope and localizer. Pilots utilizing flying techniques departing from these parameters increase the risk of controlled flight into terrain (CFIT). If the aircraft is flown below an optimum glidepath with the intent of decreasing landing ground roll by lowering threshold crossing height, one risk is transposed for another. Certainly the runway behind you is always unusable, but so is the dirt (or worse) short of the runway.

Publication Excerpts

Authors: US Department of Transportation, Federal Aviation Administration (Flight Procedures Standards Branch)
From:
www.faa.gov/library/manuals/aviation/instrument_procedures_handbook

DESCENT RATES AND GLIDEPATHS FOR NONPRECISION APPROACHES (Page 5-28)
"Maximum Acceptable Descent Rates: Operational experience and research have shown that a descent rate of greater than approximately 1,000 FPM is unacceptable during the final stages of an approach (below 1,000 feet AGL). This is due to human

perceptual limitations, independent of the type of airplane or helicopter. Therefore, the operational practices and techniques must ensure that descent rates greater than 1,000 FPM are not permitted in either the instrument or visual portions of an approach and landing operation (Page 5-28)." To verify that a plane is on an approximately 3 degree glidepath, a calculation of "300-foot-to-1 NM" should be used.

Aeronautical Information Manual 5-4-5

f. Visual Descent Points (VDPs) are being incorporated in nonprecision approach procedures. The VDP is 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 visual reference required by 14 CFR Section 91.175(c)(3) is established. The VDP will normally be identified by DME on VOR and LOC procedures and by along-track distance to the next waypoint for RNAV procedures. The VDP is identified on the profile view of the approach chart by the symbol: **V**.

1. VDPs are intended to provide additional guidance where they are implemented. No special technique is required to fly a procedure with a VDP. The pilot should not descend below the MDA prior to reaching the VDP and acquiring the necessary visual reference.

2. Pilots not equipped to receive the VDP should fly the approach procedure as though no VDP had been provided.

g. Visual Portion of the Final Segment. Instrument procedures designers perform a visual area obstruction evaluation off the approach end of each runway authorized for instrument landing, straight-in, or circling. Restrictions to instrument operations are imposed if penetrations of the obstruction clearance surfaces exist. These restrictions vary based on the severity of the penetrations, and may include increasing required visibility, denying VDPs and prohibiting night instrument operations to the runway.

h. Charting of Close in Obstacles on Instrument Procedure Charts. Obstacles that are close to the airport may be depicted in either the planview of the instrument approach chart or the airport sketch. Obstacles are charted in only one of the areas, based on space available and distance from the runway. These obstacles could be in the visual segment of the instrument approach procedure. On nonprecision approaches, these obstacles should be considered when determining where to begin descent from the MDA (see "Pilot Operational Considerations When Flying Nonprecision Approaches" in this paragraph).

i. Vertical Descent Angle (VDA) on Nonprecision Approaches. FAA policy is to publish VDAs on all nonprecision approaches. Published along with VDA is the threshold crossing height (TCH) that was used to compute the angle. The descent angle may be computed from either the final approach fix (FAF), or a stepdown fix, to the runway threshold at the published TCH. A stepdown fix is only used as the start point when an angle computed from the FAF would place the aircraft below the stepdown fix altitude. The descent angle and TCH information are charted on the profile view of the instrument approach chart following the fix the angle was based on. The optimum descent angle is 3.00 degrees; and whenever possible the approach will be designed using this angle.

1. The VDA provides the pilot with information not previously available on nonprecision approaches. It provides a means for the pilot to establish a stabilized descent from the FAF or stepdown fix to the MDA. Stabilized descent is a key factor in the reduction of controlled flight into terrain (CFIT) incidents. However, pilots should be aware that **the published angle is for information only** - it is strictly advisory in nature. There is no implicit additional obstacle protection below the MDA. Pilots must still respect the published minimum descent altitude (MDA) unless the visual cues stated 14 CFR Section 91.175 are present and they can visually acquire and avoid obstacles once below the MDA. The presence of a VDA does not guarantee obstacle protection in the visual segment and does not change any of the requirements for flying a nonprecision approach.

2. Additional protection for the visual segment below the MDA is provided if a VDP is published and descent below the MDA is started at or after the VDP. Protection is also provided, if a Visual Glide Slope Indicator (VGSI); e.g., VASI or PAPI, is installed and the aircraft remains on the VGSI glide path angle from the MDA. In either case, a chart note will indicate if the VDP or VGSI are not coincident with the VDA. On RNAV approach charts, a small shaded arrowhead shaped symbol (see the legend of the U.S. Terminal Procedures books, page H1) from the end of the VDA to the runway indicates that the 34:1 visual surface is clear.

3. Pilots may use the published angle and estimated/actual groundspeed to find a target rate of descent from the rate of descent table published in the back of the U.S. Terminal Procedures Publication. This rate of descent can be flown with the Vertical Velocity Indicator (VVI) in order to use the VDA as an aid to flying a stabilized descent. No special equipment is required.

j. Pilot Operational Considerations When Flying Nonprecision Approaches. The missed approach point (MAP) on a nonprecision approach is not designed with any consideration to where the aircraft must begin descent to execute a safe landing. It is developed based on terrain, obstructions, NAVAID location and possibly air traffic considerations. Because the MAP may be located anywhere from well prior to the runway threshold to past the opposite end of the runway, the descent from the Minimum Descent Altitude (MDA) to the runway threshold cannot be determined based on the MAP location. Descent from MDA at the MAP when the MAP is located close to the threshold would require an excessively steep descent gradient to land in the normal touchdown zone. Any turn from the final approach course to the runway heading may also be a factor in when to begin the descent.

1. Pilots are cautioned that descent to a straight-in landing from the MDA at the MAP may be inadvisable or impossible, on a nonprecision approach, even if current weather conditions meet the published ceiling and visibility. Aircraft speed, height above the runway, descent rate, amount of turn and runway length are some of the factors which must be considered by the pilot to determine if a landing can be accomplished.

2. Visual descent points (VDPs) provide pilots with a reference for the optimal location to begin descent from the MDA, based on the designed vertical descent angle (VDA) for the approach procedure, assuming required visual references are available. Approaches without VDPs have not been assessed for terrain clearance below the MDA, and may not provide a clear vertical path to the runway at the normally expected descent angle. Therefore, pilots must be especially vigilant when descending below the MDA at locations without VDPs. This does not necessarily prevent flying the normal angle; it only means that obstacle clearance in the visual segment could be less and greater care should be exercised in looking for obstacles in the visual segment. Use of visual glide slope indicator (VGSI) systems can aid the pilot in determining if the aircraft is in a position to make the descent from the MDA. However, when the visibility is close to minimums, the VGSI may not be visible at the start descent point for a "normal" glidepath, due to its location down the runway.

3. Accordingly, pilots are advised to carefully review approach procedures, prior to initiating the approach, to identify the optimum position(s), and any unacceptable positions, from which a descent to landing can be initiated (in accordance with 14 CFR Section 91.175(c)).

Transport Canada   Transports Canada

Canada

Transport Canada- Advisory Circular: Stabilized Constant Angle Non-Precision Approach

INTRODUCTION

Significant changes to the Approach Ban will come-into-force December 1, 2006, which will affect commercial operators. The aim of this *Commercial and Business Aviation Advisory Circular* (CBAAC) is to describe Stabilized Constant Descent Angle (SCDA) Non-Precision Approach (NPA) procedures. Operators, who are authorized through Operations Specification (Ops Spec) and whose operation meets the specified conditions, may conduct an approach in lower visibility conditions by using SCDA NPA procedures.

APPLICABILITY

This CBAAC is primarily applicable to operators under Subparts 703, 704 and 705 of the *Canadian Aviation Regulations* (CARs) who may be authorized through Ops Spec 019, 303, or 503 respectively to conduct SCDA NPA procedures at reduced approach ban visibility values RVR, or ground visibility at aerodromes south of 60 degrees North Latitude (60oN Lat), and to use the Minimum Descent Altitude (MDA) as a Decision Altitude (Height) DA(H).

REFERENCES

- Section 101.01 of the CARs
- Subparts 703/723(A), 704/724(A) and 705/725 of the CARs
- Canada Gazette I, Vol. 138, No. 7
- CBAAC 0237, Changes to the Approach Ban
- CBAAC 0239, Pilot Monitored Approach (PMA)

TERMINOLOGY & DEFINITIONS

- APV - Approach Procedure with Vertical guidance
- baro-VNAV - Barometric Vertical Navigation
- CFIT - Controlled Flight Into Terrain
- DA(H) - Decision Altitude (Height)
- FAF - Final Approach Fix
- FPA - Flight Path Angle
- GPS - Global Positioning System
- IAP - Instrument Approach Procedure
- ICAO - International Civil Aviation Organization
- IFR - Instrument Flight Rules
- ILS - Instrument Landing System
- LNAV - Lateral Navigation
- LPV - Localizer performance with vertical navigation
- MSA - Minimum Sector Altitude
- MDA - Minimum Descent Altitude
- MAP - Missed Approach Point
- nm - Nautical mile
- NPA - Non-Precision Approach
- Ops Spec - Operations Specification
- PMA - Pilot Monitored Approach
- PT - Procedure Turn
- RNAV - Area Navigation
- ROC - Required Obstacle Clearance
- SCDA - Stabilized Constant Descent Angle
- SOPs - Standard Operating Procedures

- VNAV - Vertical navigation
- VS - Vertical Speed
- VSI - Vertical Speed Indicator
- “SCDA Non-Precision Approach” (SCDA NPA) means stabilized constant-descent-angle non-precision approach.
- “Stabilized approach” means a final approach flown to achieve a constant rate of descent, at an approximate 3 degree descent flight path angle, with stable airspeed, power setting, and attitude, with the aircraft configured for landing.

BACKGROUND

In response to the significant number of transport category CFIT accidents, an international effort has been made to prevent these accidents. When compared with ILS, NPAs greatly increase the risk of approach and landing CFIT accidents. A Flight Safety Foundation study of accidents and available approach and landing aids determined that the accident risk while flying an NPA was 5 times greater than that associated with flying a precision approach. An NPA does not provide vertical guidance that ends at the runway. As a result, the flight crew must more actively navigate the aircraft vertically during the approach. The chance of error by the crew is greater because of increased workload and the additional need for situational awareness. The increased workload and need for situational awareness is related to when to commence a descent from, and when to level off at the published minimum IFR altitudes.

An exemption to paragraph 602.128(2)(b) of the CARs has been in place since November 1996 to permit operators to use SCDA NPA procedures allowing MDA to be used as a DA(H). The exemption is required in order to accommodate the altitude loss below MDA that will likely occur during a missed approach following a SCDA NPA procedure. With the coming-into-force of the amendments to the Approach Ban, SCDA NPA procedures will be incorporated into the CARs making an exemption unnecessary for Canadian commercial operators.

NPA – STEP -DOWN TECHNIQUE

NPAs have traditionally been flown using step-down techniques that result in an unstabilized approach. The descents and level offs result in significant changes in power settings and pitch attitudes, and in some aircraft may prevent the landing configuration from being used until landing is assured. The aircraft is flown to descend to and then level off at the minimum IFR attitudes published for the IAP. In the final segment of the IAP, the aircraft is flown to cross the FAF at the minimum crossing altitude. After crossing the FAF, the aircraft is descended at a rate-of-descent such that the aircraft can be leveled at MDA prior to the MAP. In minimum weather conditions, in order to have an effective chance of completing a normal descent and landing after reaching MDA, the aircraft should be level at the MDA at a distance equal to or greater than the published visibility minima prior to the MAP. In using the step-down technique, the aircraft flies an unstable vertical profile during the final approach segment as it descends and levels off at the minimum altitudes published for the approach, and then if visual descends from MDA to landing.

Using the step-down technique, the aircraft is flown level at minimum altitudes for extended periods of time. The aircraft descends to the initial approach minimum altitude from the enroute structure. The route flown may be a transition route, a direct routing descending to and leveling at the MSA, or using the PT for a course reversal descending to and leveling at the PT altitude. Both MSA and minimum PT altitude provide 1,000 feet ROC. Once inbound to the FAF on the intermediate segment, the aircraft is descended to and leveled at the minimum FAF crossing altitude (provides 500 feet of ROC). After crossing the FAF and on the final approach segment, the aircraft is descended to and leveled at the MDA (provides at least 250 feet of ROC.) The aircraft is flown level at MDA until the runway environment is sighted and a descent to landing can be made, or it reaches the MAP where a missed approach is commenced.

In using the step-down technique, the aircraft flies a series of unstable vertical profiles during the final approach segment as it descends and levels off at the minimum IFR altitudes published for the approach, and then if visual descends from MDA to landing. Using the step-down technique, the aircraft is flown for extended periods at the minimum altitudes, exposing the aircraft to extended periods of time at minimum altitudes above terrain and obstacles. A premature descent or a missed level off exposes the aircraft to a CFIT accident potential.

NPA – STABILIZED FINAL APPROACH

The need for a stabilized final approach during NPAs has been recognized by the International Civil Aviation Organization (ICAO) CFIT Task Force as a means to prevent CFIT accidents. The step-down technique (presumed by the procedure design) may have been appropriate to early piston transport aircraft, but most modern jet transport aircraft are much faster, heavier, have greater inertia and are less maneuverable than early aircraft. These factors make late changes in vertical profile undesirable and even dangerous. Many operators require their crews to use a stabilized technique, which is entirely different from that envisaged in the original NPA procedure design. A stabilized approach is flown to achieve a constant rate of descent, at an approximate 3-degree descent flight path angle, with stable airspeed, power setting, and attitude, with the aircraft configured for landing. The safety benefits derived from a stabilized final approach during an NPA have been recognized by most organizations including ICAO, the Federal Aviation Administration, and Transport Canada Civil Aviation.

SCDA NPA

The aim of an SCDA NPA procedure is to minimize the vertical manoeuvring required while flying most NPAs from the final approach segment through to touch down. The goal is to achieve a final approach vertical path that approximates that of a normal glide path. An SCDA NPA procedure allows certain NPAs to be flown using the MDA as a DA(H).

Using the SCDA NPA procedure, the aircraft is **not** flown at minimum altitudes for extended periods of time. If the route flown intercepts the intermediate approach segment, then a higher enroute altitude can be maintained until an approximate 3-degree vertical descent path is intercepted and a continuous descent to MDA can be made. If a course reversal using a PT is required, the aircraft can be flown at or above the minimum PT altitude until the 3-degree vertical descent path is intercepted and a continuous descent to MDA can be made. No later than crossing the FAF, the aircraft descends stabilized on the planned constant descent angle configured for landing, with stable airspeed, power setting, and attitude. The aircraft is descended towards MDA until the runway environment is sighted and the descent continued to landing, or until it reaches MDA (treated like a DA(H)) where a missed approach is commenced.

Figure 1 (Annex A) compares the vertical descent profiles of a NPA flown using a SCDA NPA technique to the traditional step-down technique. A typical NPA provides 1,000 feet of ROC in the initial segment and the procedure turn, 500 feet of ROC in the intermediate segment, and at least 250 feet of ROC in the final segment.

The SCDA NPA procedure is normally applicable to NPAs that meet the following three criteria:

- The approach is flown to straight-in minima. (SCDA is not normally applicable to circling approaches where the aircraft has to level at MDA and a circling procedure flown before a descent to landing can be made.)
- The approach design should permit a final approach segment descent angle of 2.9 to 3.5 degrees. (NPA approach design criteria permit a final approach segment with a descent gradient up to 3.77 degrees. Therefore, there are a few NPAs with steep descent gradients that exceed 3.5 degrees, for which the SCDA technique would not be appropriate. New approach design criteria for NPAs with vertical guidance limit the descent angle to 3.5 degrees or less.)
- The final approach course shall not be more than 15 degrees from runway centreline. (NPA design criteria permit straight-in minima to be published for IAPs with final approach courses up to 30 degrees from the runway centreline. The SCDA approach procedure is not normally applicable to straight-in approaches with final approach courses that exceed 15 degrees from the runway centreline, in order to reduce the requirement for lateral manoeuvring during the transition from approach to landing.)

An SCDA NPA final approach descent is flown with a planned SCDA of not less than 2.9 degrees and not greater than 3.5 degrees from the FAF to a nominal landing runway threshold crossing height of 50 feet. The angle flown is selected to ensure that minimum FAF crossing altitude and any step-down altitudes between the FAF and the MAP are respected.

The final descent path can be flown using baro-VNAV guidance, FPA guidance, VS based on groundspeed, and/or check altitudes based on distance from touch-down.

SCDA TRAINING PROGRAM

The operator should ensure that flight crews receive ground and simulator or flight training that addresses SCDA NPA procedure proficiency within their initial and recurrent training programs to include the following subjects.

The operation and use of aircraft altitude pre-selector and computer-generated approach slope systems (such as baro-VNAV or FPA) or other methods of computing SCDA NPA path to the 50 feet nominal threshold crossing height, should be thoroughly understood and trained.

The effects of horizontal position error and temperature on the vertical path, whether it is derived from baro-VNAV, inertial, or altimeter/VSI reference, should be addressed.

Temperature corrections to MDA and other published/procedural altitudes should be

made to ensure that the true vertical flight path remains between 2.9 and 3.5 degrees.
If waypoint information (position and altitude) from a navigation database is used, it should be verified against an independent source.
Any altitudes at step-down fixes between the FAF and the MAP must be respected. The planned final descent angle should take minimum altitudes at step-down fixes into account so that the approach remains stabilized in the final segment.
When flown correctly, the position where a missed approach is commenced following an SCDA NPA to MDA will occur before the published MAP. In Figure 1 (Annex A), the MDA should be reached approximately 1 nm before the published MAP. Therefore, the missed approach climb will normally occur some distance before reaching the published MAP.
It is important to note that the missed approach climb can safely begin at any point prior to the MAP; however, the requirement to commence the horizontal (lateral) navigation portion of the published missed approach procedure begins at the MAP in all cases. It may be essential for obstacle clearance to delay any turns stated in the published missed approach procedure until the aircraft crosses the MAP.
When a missed approach is commenced at MDA, the aircraft will dip below MDA as it transitions to a climb. Several factors affect the amount of altitude lost during the initiation of a missed approach from a descent. These factors include:

- Time required for a decision (reaction time);
- Rate of descent at commencement of the missed approach;
- Pilot technique;
- Aircraft performance; and
- Baro altimeter lag.

SOPs

The operator should have SOPs incorporating SCDA NPA procedures. These procedures should cover crew coordination during all phases of the approach, including reaching MDA and during the execution of a missed approach.
The SOPs should include a specified amount to be added to the MDA to compensate for the additional height loss during the go-around initiation during approaches where:

- There is a failure of an aircraft system;
- The aircraft is above normal maximum landing weight;
- The aircraft landing weight is limited by aborted landing climb performance; or
- Height loss could be expected to be larger than normal.

SUMMARY

The aim of an SCDA NPA technique is to minimize the vertical maneuvering required while flying most NPAs. The goal is to achieve a final approach vertical path that approximates that of a normal glide path. The SCDA NPA procedure can be applied to the majority of NPAs. An SCDA NPA final approach descent is flown with a planned descent angle of approximately 3 degrees from the FAF to a runway threshold crossing height of approximately 50 feet. The SCDA NPA procedure reduces pilot workload by reducing the number of positions required to commence a descent from, and when to level off at the published minimum IFR altitudes. The SCDA NPA technique's vertical flight path increases the aircraft's altitude above terrain and obstacles for most of the approach, and reduces the period of time the aircraft is flown at minimum altitudes. The need for a stabilized final approach provided by the SCDA NPA procedure during NPAs has been recognized by the ICAO CFIT Task Force as a means to prevent CFIT accidents.

In addition to the safety benefits, air operators, who are authorized through Ops Spec and whose operation meets the specified conditions, may conduct an approach in lower visibility conditions by using SCDA NPA procedures. Refer to the material in CBAAC 0237, Changes to the Approach Ban for further information.

Original signed by
D.B. Sherritt
Director
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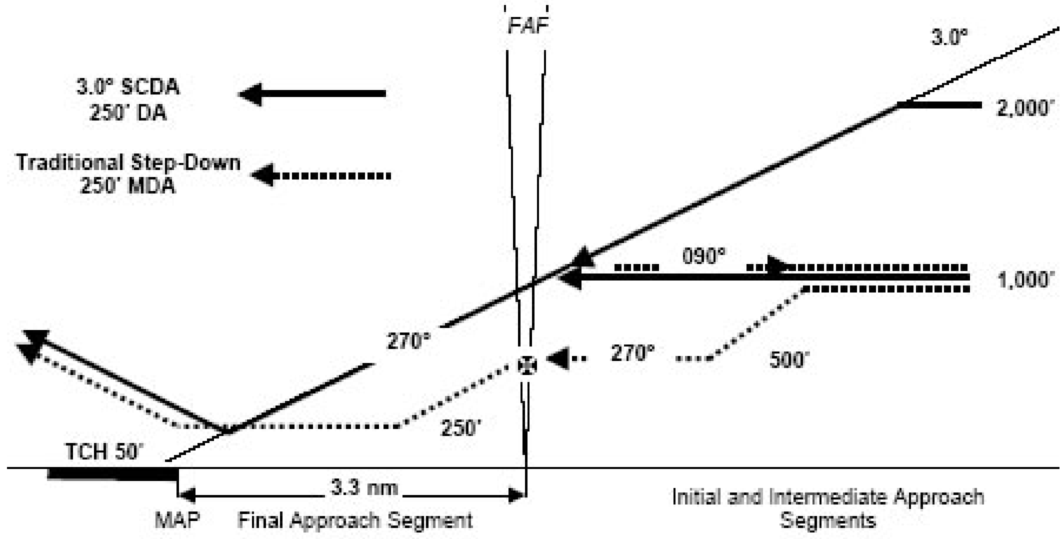
Annex A

Figure 1 – Vertical Descent Profile Comparison – SCDA to Step-Down



Sample Events

Sample ASRS report

Narrative

PF lined up on final 7+ miles out. Was configured for landing 4+ mi out, approach was stabilized by 1000 ft AGL on descent. About 1 1/2 miles from the runway, PF began to deviate below ILS glideslope. I made standard callouts, ie, '1 dot low,' '2 dots low,' 'full scale low.' after a minimal flare, aircraft touched down approx 1000 ft short of the displaced threshold for runway 9. Touchdown was firm, but within normal parameters. As PNF, I might have made an attempt to take control of the aircraft when I saw the approach path deviate from normal. Unfortunately, this was 'normal' for this pilot and others in the company, an accepted practice. Deviating **below glidepath** on short final is believed by some here to shorten the landing distance. I disagree and have for some time lobbied to change the practice, citing FAR 91.129 (*Operate that airplane at an altitude at or above glidepath between the published final approach fix and the decision altitude, or decision height, as applicable)* as well as other guidance.

NTSB Accident Synopsis:

While conducting an ils approach in ground fog and bright night conditions, the pilot-in-command failed to attain the glide slope and the copilot failed to advise him of this. Glideslope rate of descent at approach ground speed should have been approximately 360 feet per minute. The pilot descended the aircraft through the glide slope at a rate of descent of 1,215 feet per minute when 300 feet off the ground. The rate of descent at touchdown was approximaely 600 feet per minute and touchdown occurred 1,095 feet short of the runway threshold. Following initial touchdown, the aircraft became airborne followed by a second touchdown. During the ground roll the aircraft impacted 5 sets of approach lights off the end of the runway. As the aircraft rolled onto the runway threshold it again became airborne whereupon the crew abandoned the approach and proceeded to an alternate destination. Upon arrival at the alternate a fly-by was performed so the tower could assess possible landing gear damage. This was followed by a normal landing.

At 0952 local time, on November 21, 1.980, Continental Airlines/Air Micronesia, Inc., Flight 614, a Boeing 727-92C, N18479, crashed while attempting to land on runway 7 at Yap Airport, Yap, Western Caroline Islands. The aircraft touched down 13 feet short of the runway and the right main landing gear immediately separated from the aircraft. The aircraft gradually veered off the runway and came to rest in the jungle about 1,700 feet beyond the initial touchdown. Fire erupted along the right side of the aircraft as it came to a stop. All 73 occupants (67 passengers and 6 crewmembers) escaped before fire destroyed the aircraft. Three persons received serious injuries; the remainder received minor or no injuries.

The National Transportation Safety Board determines that the probable cause of this accident was the captain's premature reduction of thrust in combination with flying a shallow approach slope angle to an improper touchdown aim point. These actions resulted in a high rate of descent and a touchdown on upward sloping terrain short of the runway threshold, which generated loads that exceeded the design strength and failed the right landing gear.

Other Pertinent Accident Information

1) The first accident occurred on Nov. 11, 2007, when a three-week-old Global 5000 carrying eight passengers landed short at Fox Harb'r Resort's 4,885- by 75-foot runway in Nova Scotia. At the time of the landing, heavy snow and strong winds were reported, and the Global 5000's nosegear hit the lip of the runway and broke off. No one was seriously injured in the accident.
UPDATE TSB: A07A0134: The Jetport Inc. Bombardier BD-700 Global Express, , was on a private flight from Hamilton Airport, ON to CFH4 Fox Harbor, NS. During the landing the aircraft touched down about seven feet short of the runway, impacting the runway edge or lip, causing significant gear damage and subsequent collapse. The aircraft slid on its fuselage and right wing departing the right side of the runway surface. After crossing several low earthen berms it came to a stop approximately 1000 feet from the runway threshold. The aircraft was substantially damaged. All occupants successfully exited via the right side over-wing exit. Both passengers and crew sustained minor injuries. Emergency Services responded and both pilots were taken to hospital.

2) On December 12, a Global 5000 struck approach lights and a fence 56 feet before reaching the landing threshold at Vance W. Amory Airport in Charlestown, St. Kitts and Nevis. No one was injured and the pilots were able to taxi the damaged jet to the parking area, according to a preliminary NTSB report on the accident. The Global 5000's rear fuselage, right flap and right main landing gear were damaged.

What was found is that when pilots are following a visual approach slope indicator (VASI) or precision approach path indicator (PAPI), there is no guarantee of an assumed 50-foot threshold crossing height (TCH) when crossing the end of the runway. In other words, a pilot following a PAPI or VASI could think that at the threshold there is plenty of room between the airplane's wheels and the end of the runway, but there might not be.

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