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AUTORIDADE DE AVIAÇÃO CIVIL
CIVIL AVIATION AUTHORITY

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SAFETY NOTICE

SUBJECT: **Flying Stabilized Approaches**

GENERAL: Safety Notices (SNs) are issued by the Civil Aviation Authority – Macao, China to convey advisory information to Macao aviation entities to enhance safety. SNs contain safety-related recommendations, guidance and/or industrial best practices to specific subjects which may or may not have been addressed by established requirements and regulations.

RELATED REGULATIONS: Aeronautical Circular AC/OPS/002 Appendix 1 Paragraph 5.3.20

APPLICABILITY: This SN applies to all Macao AOC holders.

CANCELLATION: This SN is the first SN issued on this subject.

REFERENCES: The following material was referred to for the development of this SN:

- Airbus Flight Operations Briefing Notes – Approach Techniques - Flying Stabilized Approaches
- UK CAA Safety Notice SN-2012/001

1. Introduction

1.1 This Safety Notice is issued to enhance operator's safety awareness on stabilized approaches by providing recommendations, guidance and/or industrial best practices related to the subject.

1.2 Modern turbo-jet and turbo-prop aircraft are designed to have highly efficient low drag aerodynamic characteristics. This helps reduce fuel consumption but does result in such aircraft needing longer distances for descent and deceleration. Aircraft in flight, particularly large aircraft, possess a great deal of energy that must be dissipated appropriately during descent, landing and rollout. Aircraft must meet certain criteria on approach to be able to land safely, and managing an aircraft during the descent and approach phases essentially becomes a task of energy management. Landing long or landing at excessive speeds can result in an over-run and excessive sink rates or failure to capture the correct vertical profile can contribute to hard landings or Controlled Flight into Terrain (CFIT). In an unstabilized approach, the rapidly changing and abnormal condition of the aircraft may lead to loss of control.

1.3 Continuing an unstabilized approach is a causal factor in 40% of all approach-and-landing accidents.

1.4 In 75% of the off-runway touchdown, tail strike or runway excursion/overrun accidents, the major cause was an unstable approach.

2. Technical Background

2.1 According to Aeronautical Circular AC/OPS/002, a stabilized approach is one of the key features of safe approaches and landings involving transport category aircraft. Operators are to include in their operations manual the minimum Height Above the Threshold (HAT) (stabilization height) acceptable for a stabilized approach. At the minimum HAT published, the flight must be stabilized and all briefings and checklists completed. In all meteorological conditions, except special cases (i.e. circling and some engine inoperative approaches etc.), the minimum HAT for a stabilized approach is to be no lower than 1000' HAT.

2.2 An approach is considered stabilized only if all the following elements are achieved before or when reaching the applicable stabilization height:

a) The aircraft is on the correct flight path;

b) Only small changes in heading/pitch are required to maintain the correct flight path;

c) The aircraft speed is not more than V_{REF} + 20 kt indicated airspeed and not less than V_{REF};

d) The aircraft is in the correct landing configuration;

e) Sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted;

f) Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined by the aircraft operating manual;

g) All briefings and checklists have been conducted;

h) Specific types of approaches are stabilized if they also fulfill the following: instrument landing system (ILS) approaches must be flown within one dot of the glideslope and localizer; a Category II or Category III ILS approach must be flown within the expanded localizer band; during a circling approach, wings should be level on final when the aircraft reaches 300 ft above airport elevation; and,

i) Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

3. Benefits of a Stabilized Approach

3.1 Conducting a stabilized approach increases the flight crew's overall situational awareness, including:

a) Horizontal awareness - by monitoring the horizontal flight path;

b) Vertical awareness - by monitoring the vertical flight path and the rate of descent;

c) Airspeed awareness - by monitoring the airspeed trends; and

d) Energy-condition awareness - by maintaining the engine thrust at the level required to fly a three-degree approach path at the target final approach speed (or at the minimum ground speed, as applicable). This also enhances go-around capability.

3.2 A stabilized approach also enhances the readiness for go-around.

3.3 In addition, a stabilized approach provides the following benefits:

a) More time and attention are available for the monitoring of ATC communications, weather conditions and systems operation;

b) More time is available for effective monitoring and backup by the PNF (Pilot-Not-Flying);

c) Defined flight-parameter-deviation criteria and minimum stabilization height support the decision to land or to go around;

d) Landing performance is consistent with published performance; and,

e) Situational awareness is increased.

4. Best Practices

4.1 Throughout the entire flight a next target should be defined to stay ahead of the aircraft at all times. The defined next target should be any required combination of:

a) A position;

b) An altitude;

c) A configuration;

d) A speed;

e) A vertical profile (vertical speed or flight path angle); and,

f) A power setting (e.g., thrust is stabilized, usually above idle, to maintain the target approach speed along the desired final approach path).

4.2 If it is anticipated that one or more element(s) of the next target will not be met, the required corrective action(s) should be taken without delay.

4.3 During the approach and landing, the successive next targets should constitute gates that should be met for the approach to be continued.

4.4 The Final Approach Fix (FAF), the Outer Marker (OM) or an equivalent fix (as applicable) constitute an assessment gate to confirm the readiness to proceed further; this assessment should include the following:

a) Visibility or RVR (and ceiling, as appropriate) – better than or equal to applicable minimums;

b) Aircraft readiness – Position, altitude, configuration and energy; and,

c) Crew readiness – Briefing completed and agreement on approach conditions.

4.5 The minimum stabilization height constitutes a particular gate along the final approach.

4.6 If the aircraft is not stabilized on the approach path in landing configuration, at the minimum stabilization height, a go-around must be initiated unless the crew estimates that only small corrections are necessary to rectify minor deviations from stabilized conditions due, amongst others, to external perturbations.

4.7 Following a PNF flight parameter exceedance callout, the suitable PF (Pilot Flying) response will be:

a) Acknowledge the PNF callout, for proper crew coordination purposes;

b) Take immediate corrective action to control the exceeded parameter back into the defined stabilized conditions;

c) Assess whether stabilized conditions will be recovered early enough prior to landing, otherwise initiate a go-around.

5. Factors Involved in Unstabilized Approaches

5.1 The following circumstances, factors and errors are often cited when discussing rushed and unstabilized approaches:

a) Fatigue;

b) Pressure of flight schedule (making up for delays);

c) Any crew-induced or ATC-induced circumstances resulting in insufficient time to plan, prepare and conduct a safe approach. This includes accepting requests from ATC to fly higher/faster or to fly shorter routings than desired;

d) ATC instructions that result in flying too high/too fast during the initial approach;

e) Excessive altitude or excessive airspeed (e.g., inadequate energy management) early in the approach;

f) Late runway change (lack of ATC awareness of the time required by the flight crew to reconfigure the aircraft for a new approach);

g) Excessive head-down work (e.g., flight management system reprogramming);

h) Short outbound leg or short downwind leg (e.g., because of traffic in the area);

i) Late takeover from automation (e.g., because the autopilot fails to capture the glideslope);

j) Premature descent or late descent caused by failure to positively identify the final approach fix (FAF);

k) Inadequate awareness of wind conditions, including:

i) Tail wind component;

ii) Low-altitude wind shear;

iii) Local wind gradient and turbulence (because of terrain or buildings); or,

iv) Recent weather along the final approach path (e.g., wind shift or downdrafts caused by a descending cold air mass following a rain shower);

l) Incorrect anticipation of aircraft deceleration characteristics in level flight or on a three-degree glide path;

m) Failure to recognize deviations or failure to adhere to the excessive-parameter-deviation limits;

n) Belief that the aircraft will be stabilized at the minimum stabilization height or shortly thereafter;

o) Excessive confidence by the PNF/PM that the pilot flying (PF) will achieve a timely stabilization;

p) PF-PNF/PM too reliant on each other to call excessive deviations or to call for a go-around; and,

q) Visual illusions.

6. Typical Deviations Observed in Unstabilized Approaches

6.1 The following procedure deviations or flight path excursions often are observed, alone or in combination, in rushed and unstabilized approaches (figures provided between brackets reflect extreme deviations observed in actual unstabilized approaches, worldwide):

a) Full approach flown at idle down to touchdown, because of excessive airspeed and/or altitude early in the approach;

b) Steep approach (i.e., above desired flight path with excessive vertical speed up to -2200 ft/min, flight path angle up to 15 % gradient / 9-degree slope). Steep approaches appear to be twice as frequent as shallow approaches;

c) Shallow approach (i.e., below desired glide path);

d) Low airspeed manoeuvring (i.e., inadequate energy management);

e) Excessive bank angle when capturing the final approach course (up to 40-degree);

f) Activation of a GPWS warning:

i) Mode 1: SINK RATE;

ii) Mode 2A: TERRAIN (not full flaps);

iii) Mode 2B: TERRAIN (full flaps).

g) Late extension of flaps or flaps load relief system activation (as applicable), resulting in the late effective extension of flaps;

h) Flight-parameter excessive deviation when crossing the stabilization height:

i) Excessive airspeed (up to V_{REF} + 70 kt);

ii) Not aligned (up to 20-degree heading difference);

iii) Excessive bank angle (up to 40-degree);

iv) Excessive vertical speed (up to -2000 ft/min);

v) Excessive glide slope deviation (up to 2 dots);

i) Excessive bank angle, excessive sink rate or excessive manoeuvring while performing a side-step;

j) Speedbrakes being still extended when in short final (i.e., below 1000 ft above airfield elevation);

k) Excessive flight-parameter deviation(s) down to runway threshold;

l) High runway-threshold crossing (up to 220 ft);

m) Long flare and extended touchdown.

7. Operator's Preventive Strategies and Personal Lines-of-Defense

7.1 Operator's prevention strategies and personal lines-of-defense to reduce the number of unstabilized approaches should identify and minimize the factors involved and provide recommendations for the early detection and correction of unstabilized approaches. The following four-step is proposed:

a) Anticipate;

b) Detect;

c) Correct; and,

d) Decide.

7.2 Anticipate

7.2.1 Some factors likely to result in a rushed and unstabilized approach can be anticipated. Whenever practical, flight crews and controllers should avoid situations that may result in rushed approaches. The descent-and-approach briefing provides an opportunity to identify and discuss factors such as non-standard altitude or speed restrictions requiring a careful energy management:

a) An agreed strategy should be defined for the management of the descent, deceleration and stabilization (i.e., following the concepts of next targets and approach gate);

b) This strategy will constitute a common objective and reference for the PF and PNF.

7.3 Detect

7.3.1 Defined excessive-parameter-deviation criteria and a defined stabilization height provide the PF and PNF with a common reference for effective:

a) Monitoring (i.e., early detection of deviations); and,

b) Back-up (i.e., timely and precise deviation callouts for effective corrections).

7.3.2 To provide the time availability and attention required for an effective monitoring and back-up, the following should be avoided:

a) Late briefings;

b) Unnecessary radio calls (e.g., company calls);

c) Unnecessary actions (e.g., use of ACARS); and,

d) Non-pertinent intra-cockpit conversations (i.e., breaking the sterile-cockpit rule).

7.3.3 Reducing the workload and cockpit distractions and/or interruptions also provides the flight crew with more alertness and availability to:

a) Cope with fatigue;

b) Comply with an unanticipated ATC request (e.g., runway change or visual approach);

c) Adapt to changing weather conditions or approach hazards; and,

d) Manage a system malfunction (e.g., flaps jamming or gear failing to extend or to downlock).

7.4 Correct

7.4.1 Positive corrective actions should be taken before deviations develop into a challenging or a hazardous situation in which the only safety action is a go-around. Corrective actions may include:

a) The timely use of speed brakes or the early extension of landing gear to correct an excessive altitude or an excessive airspeed; and,

b) Extending the outbound leg or downwind leg.

7.5 Decide

7.5.1 If the aircraft is not stabilized on the approach path in landing configuration, at the minimum stabilization height, a go-around must be initiated unless the crew estimates that only small corrections are necessary to rectify minor deviations from stabilized conditions due, amongst others, to external perturbations.

7.5.2 Following a PNF flight parameter exceedance callout, the suitable PF response will be:

a) Acknowledge the PNF callout, for proper crew coordination purposes;

b) Take immediate corrective action to control the exceeded parameter back into the defined stabilized conditions;

c) Assess whether stabilized conditions will be recovered early enough prior to landing, otherwise initiate a go-around.

7.5.3 The following behaviours often are involved in the continuation of an unstabilized approach:

a) Confidence in a quick recovery (i.e., postponing the go-around decision when parameters are converging toward target values);

b) Overconfidence because of a long and dry runway and/or a low gross-weight, although airspeed and/or vertical speed are excessive;

c) Inadequate readiness or lack of commitment to conduct a go-around (A change of mindset should take place from “we will land unless…” to “Let’s be prepared for a go-around and we will land if the approach is stabilized and if we have sufficient visual references to make a safe approach and landing”);

d) Go-around envisaged but not initiated because the approach was considered being compatible with a safe landing; and,

e) Absence of decision due to fatigue or workload (i.e., failure to remember the applicable excessive deviation criteria).

8. Summary of Key Points

8.1 Three essential parameters need to be stabilized for a safe approach:

a) Aircraft track;

b) Flight path angle; and,

c) Airspeed.

8.2 Depending on the type of approach and aircraft equipment, the most appropriate level of automation and visual cues should be used to achieve and monitor the stabilization of the aircraft.

8.3 When breaking-out of the cloud overcast and transitioning to visual references, the pilot's perception of the runway and outside environment should be kept constant by maintaining:

a) Drift correction – to continue tracking the runway centerline, resisting the tendency to prematurely align the aircraft with the runway centerline;

b) Aiming point – to remain on the correct flight path until flare height, resisting the tendency to move the aiming point closer and, thus, descend below the desired glide path (i.e., "duck-under"); and,

c) Final approach speed and ground speed – to maintain the energy level.

9. Recommended Actions

9.1 Operators are encouraged to note and disseminate the information promulgated in this SN to its flight crew members;

9.2 Directors of Flight Operations, Chief Pilots and Training Manager are encouraged to review their company's policies, procedures, and training programme to reflect the safety issues contained in this SN.

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