



# FSF ALAR Briefing Note

## 4.1 — Descent-and-approach Profile Management

Incorrect management of the descent-and-approach profile and/or aircraft energy condition may result in:

- A loss of situational awareness; and/or,
- An unstabilized approach.

Either situation increases the risk of approach-and-landing accidents, including those involving controlled flight into terrain (CFIT).

### Statistical Data

The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force found that unstabilized approaches (i.e., approaches conducted either low/slow or high/fast) were a causal factor<sup>1</sup> in 66 percent of 76 approach-and-landing accidents and serious incidents worldwide in 1984 through 1997.<sup>2</sup>

The task force said that factors associated with being low/slow on approach include:

- “Inadequate awareness of automation/systems status;
- “Lack of vigilance and crew coordination, including omission of standard airspeed-and-altitude calls; and,
- “High workload and confusion during execution of nonprecision approaches.”

The task force said that factors associated with being high/fast on approach include:

- “Overconfidence, lack of vigilance and ‘press-on-itis’<sup>3</sup>;

- “Lack of crew coordination; and,
- “Accepting demanding air traffic control (ATC) clearances, leading to high-workload conditions.”

### Descent Preparation and Approach Briefing

To help prevent delaying initiation of the descent and to ensure optimum management of the descent-and-approach profile, the following procedures are recommended:

- Descent preparation and the approach briefing should be completed typically 10 minutes before the top-of-descent point (or when within very-high-frequency [VHF] communication range if automatic terminal information system [ATIS] information cannot be obtained 10 minutes before the top-of-descent point);
- If a standard terminal arrival (STAR) is included in the flight management system (FMS) flight plan but is not expected to be flown because of radar vectors, the STAR should be checked (track, distance, altitude and airspeed restrictions) against the expected routing to adjust the top-of-descent point;
- If descent initiation is delayed by ATC, airspeed should be reduced (as appropriate to the aircraft model) to minimize the effect of the delay on the descent profile;
- Wind-forecast data should be programmed on the appropriate FMS page at waypoints near the top-of-descent point and along the descent-profile path;
- If a missed approach procedure is included in the FMS flight plan, the FMS missed approach procedure should be checked against the approach chart; and,

- If FMS navigation accuracy does not meet the applicable criteria for descent, terminal area navigation or approach, no descent should be made below the minimum en route altitude (MEA) or minimum safe altitude (MSA) without prior confirmation of the aircraft position using raw data<sup>4</sup>.

## Achieving Flight Parameters

The flight crew must “stay ahead of the aircraft” throughout the flight. This includes achieving desired flight parameters (e.g., aircraft configuration, aircraft position, energy condition, track, vertical speed, altitude, airspeed and attitude) during the descent, approach and landing. Any indication that a desired flight parameter will not be achieved should prompt immediate corrective action or the decision to go around.

At the final approach fix (FAF) or the outer marker (OM), the crew should decide whether to proceed with the approach, based on the following factors:

- Ceiling and visibility are better than or equal to applicable minimums;
- Aircraft is ready (position, altitude, configuration, energy condition); and,
- Crew is ready (briefing completed, agreement on the approach).

If the required aircraft configuration and airspeed are not attained, or if the flight path is not stabilized when reaching the minimum stabilization height (1,000 feet above airport elevation in instrument meteorological conditions or 500 feet above airport elevation in visual meteorological conditions), a go-around should be initiated immediately.

The pilot not flying (PNF) should announce any flight parameter that *exceeds the criteria for any of the elements of a stabilized approach* (Table 1).

## Descent Profile Monitoring

The descent profile should be monitored, using all available instruments and chart references, including:

- FMS vertical-deviation indication, as applicable;
- Raw data; and,
- Charted descent-and-approach profile.

Wind conditions and wind changes should be monitored closely to anticipate any decrease in head-wind component or increase in tail-wind component, and the flight-path profile should be adjusted appropriately.

The descent also may be monitored and adjusted based on a *typical 3,000 feet per 10 nautical mile (nm) descent gradient* (corrected for the prevailing head-wind component or tail-wind component), while adhering to the required altitude/airspeed restrictions (deceleration management).

## Table 1 Recommended Elements Of a Stabilized Approach

All flights must be stabilized by 1,000 feet above airport elevation in instrument meteorological conditions (IMC) and by 500 feet above airport elevation in visual meteorological conditions (VMC). *An approach is stabilized when all of the following criteria are met:*

1. The aircraft is on the correct flight path;
2. Only small changes in heading/pitch are required to maintain the correct flight path;
3. The aircraft speed is not more than  $V_{REF} + 20$  knots indicated airspeed and not less than  $V_{REF}$ ;
4. The aircraft is in the correct landing configuration;
5. Sink rate is no greater than 1,000 feet per minute; if an approach requires a sink rate greater than 1,000 feet per minute, a special briefing should be conducted;
6. Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined by the aircraft operating manual;
7. All briefings and checklists have been conducted;
8. 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 feet above airport elevation; and,
9. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

*An approach that becomes unstabilized below 1,000 feet above airport elevation in IMC or below 500 feet above airport elevation in VMC requires an immediate go-around.*

Source: Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force (V1.1 November 2000)

Below 10,000 feet, flying at 250 knots, the following recommendations may be used to confirm the descent profile and to ensure a smooth transition between the various approach phases:

- 9,000 feet above airport elevation at 30 nm from touchdown; and,
- 3,000 feet above airport elevation at 15 nm from touchdown (to allow for deceleration and slats/flaps extension).

## Descent Profile Adjustment/Recovery

If the flight path is significantly above the desired descent profile (e.g., because of ATC restrictions or a greater-than-anticipated tail wind), the desired flight path can be recovered by:

- Reverting from FMS vertical navigation (VNAV) to a selected vertical mode, with an appropriate airspeed target (e.g., airspeed, heading, altitude) or vertical-speed target;
- Maintaining a high airspeed (and a steep angle of descent) as long as practical;
- Using speed brakes (as allowed by applicable SOPs, depending on airspeed and configuration, keeping one hand on the speed-brake handle until the speed brakes are retracted);
- Extending the landing gear, as allowed by airspeed and configuration, if speed brakes are not sufficient; or,
- As a last resort, conducting a 360-degree turn (as practical, and with ATC clearance). Maintain instrument references throughout the turn to monitor and control the rate of descent, bank angle and aircraft position; this will help avoid loss of aircraft control or CFIT, and prevent overshooting the localizer or extended runway centerline.

If the desired descent flight path cannot be established, ATC should be notified for timely coordination.

## Adverse Factors and Typical Errors

The following factors and errors often are observed during transition training and line training:

- Late descent, which results in rushing the descent, approach preparation and briefing, and increases the likelihood that important items will be omitted;
- Failure to cross-check target entry;
- Failure to allow for a difference between the expected routing and the actual routing (e.g., STAR vs. radar vectors);
- Distraction leading to or resulting from *two heads down*;
- Failure to resolve ambiguities, doubts or disagreements;
- Failure to effectively monitor descent progress using all available instrument references;
- Failure to monitor wind conditions and wind changes; and/or,
- Inappropriate technique to establish the descent profile.

## Summary

The following should be emphasized during transition training, line training and line audits:

- Conduct timely descent-and-approach preparation;
- Adhere to SOPs for FMS setup;
- Cross-check all target entries;
- Use the primary flight display (PFD), navigation display (ND) and FMS to support and to illustrate the approach briefing;

- Confirm FMS navigation accuracy before selecting FMS modes for the descent and approach;
- Review terrain-awareness data and other approach hazards; and,
- Monitor the descent profile and adjust the descent profile as required.

The following FSF ALAR Briefing Notes provide information to supplement this discussion:

- 1.1 — *Operating Philosophy*;
- 1.3 — *Golden Rules*;
- 4.2 — *Energy Management*;
- 5.2 — *Terrain*;
- 6.1 — *Being Prepared to Go Around*; and,
- 7.1 — *Stabilized Approach*.♦

## References

1. The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force defines *causal factor* as “an event or item judged to be directly instrumental in the causal chain of events leading to the accident [or incident].” Each accident and incident in the study sample involved several causal factors.
2. Flight Safety Foundation. “Killers in Aviation: FSF Task Force Presents Facts About Approach-and-landing and Controlled-flight-into-terrain Accidents.” *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999): 1–121. The facts presented by the FSF ALAR Task Force were based on analyses of 287 fatal approach-and-landing accidents (ALAs) that occurred in 1980 through 1996 involving turbine aircraft weighing more than 12,500 pounds/5,700 kilograms, detailed studies of 76 ALAs and serious incidents in 1984 through 1997 and audits of about 3,300 flights.
3. The FSF ALAR Task Force defines *press-on-itis* as “continuing toward the destination despite a lack of readiness of the airplane or crew.”
4. The FSF ALAR Task Force defines *raw data* as “data received directly (not via the flight director or flight management computer) from basic navigation aids (e.g., ADF, VOR, DME, barometric altimeter).”

## Related Reading from FSF Publications

Flight Safety Foundation (FSF) Editorial Staff. “Pilot Loses Control of Twin Turboprop During ILS Approach in Low Visibility.” *Accident Prevention* Volume 57 (July 2000).

FSF Editorial Staff. "Learjet Strikes Terrain When Crew Tracks False Glideslope Indication and Continues Descent Below Published Decision Height." *Accident Prevention* Volume 56 (June 1999).

FSF Editorial Staff. "Boeing 767 Descends Below Glide Path, Strikes Tail on Landing." *Accident Prevention* Volume 55 (February 1998).

FSF Editorial Staff. "Preparing for Last-minute Runway Change, Boeing 757 Flight Crew Loses Situational Awareness, Resulting in Collision with Terrain." *Accident Prevention* Volume 54 (July–August 1997).

FSF Editorial Staff. "Learjet MEDEVAC Flight Ends in Controlled-flight-into-terrain (CFIT) Accident." *Accident Prevention* Volume 54 (January 1997).

FSF Editorial Staff. "Commuter Captain Fails to Follow Emergency Procedures After Suspected Engine Failure, Loses Control of the Aircraft During Instrument Approach." *Accident Prevention* Volume 53 (April 1996).

FSF Editorial Staff. "Different Altimeter Displays and Crew Fatigue Likely Contributed to Canadian Controlled-flight-into-terrain Accident." *Accident Prevention* Volume 52 (December 1995).

FSF Editorial Staff. "Captain's Failure to Establish Stabilized Approach Results in Controlled-flight-into-terrain Commuter Accident." *Accident Prevention* Volume 52 (July 1995).

FSF Editorial Staff. "Stall and Improper Recovery During ILS Approach Result in Commuter Airplane's Uncontrolled Collision with Terrain." *Accident Prevention* Volume 52 (January 1995).

Lawton, Russell. "Moving Power Levers Below Flight Idle During Descent Results in Dual Engine Flameout and Power-off Emergency Landing of Commuter Airplane." *Accident Prevention* Volume 51 (December 1994).

Lawton, Russell. "Steep Turn by Captain During Approach Results in Stall and Crash of DC-8 Freighter." *Accident Prevention* Volume 51 (October 1994).

Lawton, Russell. "Breakdown in Coordination by Commuter Crew During Unstabilized Approach Results in Controlled-flight-into-terrain Accident." *Accident Prevention* Volume 51 (September 1994).

## Regulatory Resources

International Civil Aviation Organization (ICAO). *International Standards and Recommended Practices, Annex 6 to the Convention of International Civil Aviation, Operation of Aircraft. Part I, International Commercial Air Transport – Aeroplanes. Appendix 2, "Contents of an Operations Manual,"* 5.18, 5.19. Seventh edition - July 1998, incorporating Amendments 1–25.

ICAO. *Procedures for Air Navigation Services. Aircraft Operations. Volume I, Flight Procedures.* Fourth edition, 1993. Reprinted May 2000, incorporating Amendments 1–10.

U.S. Federal Aviation Administration. Advisory Circular 120-71, *Standard Operating Procedures for Flight Deck Crewmembers.* August 10, 2000.

Joint Aviation Authorities. *Joint Aviation Requirements – Operations 1, Commercial Air Transportation (Aeroplanes).* 1.1045 "Operations Manual – structure and contents." March 1, 1998.

## Notice

The Flight Safety Foundation (FSF) Approach-and-landing Accident Reduction (ALAR) Task Force has produced this briefing note to help prevent ALAs, including those involving controlled flight into terrain. The briefing note is based on the task force's data-driven conclusions and recommendations, as well as data from the U.S. Commercial Aviation Safety Team (CAST) Joint Safety Analysis Team (JSAT) and the European Joint Aviation Authorities Safety Strategy Initiative (JSSI).

The briefing note has been prepared primarily for operators and pilots of turbine-powered airplanes with underwing-mounted engines (but can be adapted for fuselage-mounted turbine engines, turboprop-powered aircraft and piston-powered aircraft) and with the following:

- Glass flight deck (i.e., an electronic flight instrument system with a primary flight display and a navigation display);
- Integrated autopilot, flight director and autothrottle systems;

- Flight management system;
- Automatic ground spoilers;
- Autobrakes;
- Thrust reversers;
- Manufacturers'/operators' standard operating procedures; and,
- Two-person flight crew.

This briefing note is one of 34 briefing notes that comprise a fundamental part of the FSF *ALAR Tool Kit*, which includes a variety of other safety products that have been developed to help prevent ALAs.

This information is not intended to supersede operators' or manufacturers' policies, practices or requirements, and is not intended to supersede government regulations.

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Suite 300, 601 Madison Street, Alexandria, VA 22314 U.S.  
Telephone +1 (703) 739-6700, Fax: +1 (703) 739-6708  
[www.flightsafety.org](http://www.flightsafety.org)

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