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NATIONAL TRANSPORTATION SAFETY BOARD

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Attachment 28 – EGPWS Alerts
(11 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
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Attachment 28 – EGPWS Alerts

OPERATIONAL FACTORS

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02.01.02 GPWS/EGPWS ALERT PROCEDURES

02.01.02.01 GENERAL

When any GPWS/EGPWS alert is activated, regardless of its duration, or if any situation is encountered resulting in unacceptable flight towards terrain, take immediate and positive corrective action.

COMBINED GPWS/EGPWS ALERT RESPONSE SUMMARY

ALERT LEVEL	AURAL ALERTS	CREW RESPONSE
WARNING ALERTS	"TERRAIN, TERRAIN PULL UP" --- "WHOOP, WHOOP PULL UP" --- "TERRAIN AHEAD, PULL UP" --- "OBSTACLE AHEAD, PULL UP"	Perform CFIT Recovery Maneuver*
CAUTION ALERTS	"TERRAIN AHEAD" --- "OBSTACLE AHEAD" --- "CAUTION TERRAIN"	Adjust the Flight Path; Stop Descent; Climb and/or Turn as Necessary Based on Analysis of all Available Instruments and Information
	"TOO LOW GEAR" --- "TOO LOW FLAPS" --- "TOO LOW TERRAIN"	Perform a Go Around
	"TERRAIN, TERRAIN" --- "TOO LOW, TERRAIN"	Adjust Flight Path or Initiate a Go Around
	"DON'T SINK" --- "DON'T SINK, GEAR" Followed by "TOO LOW"	Adjust Pitch Attitude and Thrust to Maintain Level or Climbing Flight
	"SINK RATE"	Adjust Pitch Attitude and Thrust to Silence the Warning
	"GLIDESLOPE"	Establish Aircraft on G/S The "GLIDESLOPE" deviation aural alert may be cancelled or inhibited under the following conditions: • Conducting an ILS (G/S out) approach • Circling from an ILS approach • Conditions require a deliberate approach below glideslope • Unreliable glideslope signal
	"BANK ANGLE"	Correct the Bank Angle

*All WARNING ALERTS require that the crew immediately perform the CFIT recovery maneuver except under the following conditions:

- The Terrain Alert occurs during Day Visual Meteorological Conditions.

AND

- The Flight Crew can IMMEDIATELY and UNEQUIVOCALLY determine that terrain clearance is not a factor.

[1] Enhanced Ground Proximity Warning System.

02.01.02.02 CFIT RECOVERY MANEUVER

The following must be immediately performed whenever the threat of inadvertent contact with terrain or an obstacle exists.

PILOT FLYING	PILOT MONITORING
Simultaneously: • Disengage autopilot and autothrottles. • Rotate to 20 degrees nose up, initial pitch attitude. • Aggressively apply max thrust. • Roll wings level • Retract speedbrakes • If terrain remains a threat, continue rotation (Pitch limiter) to stick shaker or initial buffet. Flight at intermittent stick shaker may be required to obtain positive terrain separation. Smooth, steady control will avoid a pitch overshoot and stall. **CAUTION**: **PITCH ATTITUDE THAT RESULTS IN INTERMITTENT STICK SHAKER OR INITIAL BUFFET IS THE UPPER PITCH LIMIT.** • Maintain a maximum climb attitude until the warning ceases and the radio altimeter indicates clear of terrain or obstacles.	• Ensure max thrust. • Verify speedbrakes retracted. • Callout radio altitudes and vertical speed. • The PM should advise ATC when the situation allows.
Do not follow Flight Director commands.	
Do not change flap or gear configuration until terrain/obstacle separation is assured.	
Monitor radio altimeter for sustained or increasing terrain/obstacle separation.	
When clear of the terrain/obstacle, slowly decrease pitch attitude and accelerate.	

02.01.02.03 KNOWN GPWS/EGPWS ALERTS

Certain airports have terrain features that may cause a momentary GPWS/EGPWS terrain alert to be activated during a normal, stabilized approach. These airports are identified on the Jeppesen 10-10 or 20-10 page. These situations should be anticipated and briefed prior to commencing an approach to these airports. Additionally, all altitudes on the approach should be verified by the PM to ensure the GPWS/EGPWS warning is not valid and that no danger exists. This does not alleviate the crew's responsibility to take immediate action if the GPWS/EGPWS alert continues or if there is any doubt concerning the safety of the aircraft.

02.01.02.04 EGPWS SYSTEM CONSTRAINTS

The EGPWS terrain display serves only as a situational awareness tool and not as the sole means to determine terrain/obstacle avoidance. Any FMC map shift due to inadequate position updating will cause the terrain display and alerting function to be in error by the same amount. The GPWS/EGPWS database only contains cataloged, man-made obstacles located in the continental North America and is not all-inclusive. If there is no terrain/obstacle data in the database for a particular area, terrain/obstacle alerting and display is not available for that area. These areas are highlighted on the display using medium dot density and are currently referred to as "purple haze."

02.01.02.05 CONDITIONS REQUIRING EGPWS TERR SWITCH TO BE SELECTED OFF

The EGPWS TERR MODE pushbutton switch can be used to disable the Enhanced GPWS terrain display and alerting. Conventional GPWS alerts are still available with EGPWS TERR MODE pushbutton switch in OFF.

The EGPWS TERR MODE pushbutton switch must be selected to OFF under the following conditions:

- Before takeoff or within 15 NM of landing at an airport not contained in the GPWS database where errors have been identified in the terrain database. These airports are identified in the Flight Departure papers for affected flights.
- FMC position does not accurately update.
- Captain's FMC in IRS ONLY navigation.

2.0 UPS A300 Pilot Training Guide Guidance

03.01.01 ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

03.01.01.01 GENERAL

All UPS A300 aircraft are equipped with the Enhanced Ground Proximity Warning System (EGPWS). The EGPWS provides all of the functions of conventional GPWS along with a worldwide terrain and runway database to provide terrain displays on the NDs and more precise terrain alerts. The EGPWS database also contains cataloged man-made obstacles. However, only obstacles located in North America are included, and the obstacle database is not all-inclusive. For the purposes of this section, the abbreviation "EGPWS" is used to denote the functions of both conventional GPWS and the advanced functions of Enhanced GPWS. The term "Alert" is used to denote both EGPWS cautions and warnings. See the A300 Systems Manual for a detailed description of EGPWS alert modes and functions.

03.01.01.02 NORMAL OPERATION

UPS A300 normal procedures require that one pilot have EGPWS terrain information displayed during takeoff and landing anytime terrain may be a factor. The Captain will determine which pilot will display terrain information.

Displaying terrain information on NAV Display:

- Select associated ND Mode selector to ARC or MAP mode.
- Select associated Terrain Display switch to the ON position. TERR annunciation is displayed on ND.
- The other pilot should ensure that their TERR ON ND switch is selected to STBY to allow weather radar information to be displayed on the respective ND.

NOTE: Weather radar and terrain display information cannot be simultaneously displayed on an ND. It is not necessary to have the weather radar ON to display EGPWS terrain information.

Conventional GPWS warnings are operational with EGPWS TERR switch OFF.

03.01.01.03 CONDITIONS REQUIRING EGPWS TERR SWITCH TO BE SELECTED OFF

- FMC position does not accurately update when TOGA lever is selected for takeoff.
- Captain's FMC position accuracy in question.
- Before takeoff or within 15 NM of landing at an airport not contained in the EGPWS database or where errors have been identified in the terrain database. These airports are identified in NOTAMs.

03.01.01.04 TERRAIN DISPLAY POP-UP MODE

If neither Terrain Display switch is selected ON, terrain information will be automatically displayed on both NDs if a potential terrain conflict is identified. This "Pop Up" mode is only active if the EGPWS TERR switch is not OFF and at least one ND is in ARC or MAP mode.

03.01.01.05 EGPWS SYSTEM CONSTRAINTS

The EGPWS terrain display serves as a situational awareness tool only, and may not provide the accuracy and fidelity on which to solely base terrain avoidance and maneuvering decisions.

Any FMC map shift due to inadequate position updating will cause the terrain display and alerting function to be in error by the same amount.

The EGPWS database only contains catalogued obstacles located in continental North America, and is not all-inclusive.

If there is no terrain/obstacle data in the database for a particular area, terrain/obstacle alerting and display is not available for that area. These areas are highlighted on the display using medium dot density magenta and are referred to as "purple haze."

03.01.01.06 EGPWS ALERTS

EGPWS alerts consist of caution alerts, warning alerts and a Terrain Clearance Floor (TCF) alert. EGPWS provides all of the functions of conventional GPWS along with a terrain/obstacle alerting function. The terrain/obstacle alerting function "looks ahead" of the aircraft and provides alerts based on aircraft position and the predicted flight path toward terrain or obstacles. These alerts are issued in advance of the "reactive" conventional Mode 2 alert.

EGPWS Caution Alert

Approximately 40 to 60 seconds prior to a potential terrain/obstacle conflict, the aural alert "TERRAIN AHEAD" or "OBSTACLE AHEAD" repeats every 7 seconds until clear of the conflict. In addition, TERR annunciates on both NDs in amber, the red GPWS light illuminates and the terrain display "pops-up" on each ND if not previously selected on. All terrain at or above the reference (aircraft) altitude is displayed in yellow and/or red.

EGPWS Warning Alert

Approximately 20 to 30 seconds prior to a potential terrain/obstacle conflict, the aural alert "TERRAIN AHEAD, PULL UP" or "OBSTACLE AHEAD, PULL UP" repeats continuously until clear of the conflict. In addition, TERR annunciates on both NDs in red, the red GPWS light illuminates, and the terrain display "pops-up" on each ND if not previously selected ON. All terrain at or above the reference (aircraft) altitude is displayed in yellow and/or red.

Terrain Clearance Floor Alert

If the aircraft radio or barometric altitude conflicts with the TCF, a TCF alert is activated. The TCF alert is activated even if the aircraft is in the landing configuration. The TCF alert consists of the aural alert "TOO LOW TERRAIN," activated at TCF penetration and each time radio altitude decreases by 20%. In addition, the red GPWS and amber G/S lights illuminate.

03.01.01.07 TERRAIN/OBSTACLE ELEVATION DISPLAY

Obstacle elevation information is displayed on the ND when the terrain display is manually selected or if it automatically "pops up" due to a terrain/obstacle caution or warning alert. Terrain and obstacle elevation information consists of two numbers displayed on the left side of the ND. The top number represents the highest terrain or obstacle within the selected map display. The bottom number represents the lowest terrain or obstacle within the selected map display. If there is no appreciable difference between the highest and lowest terrain/obstacle within the selected map range or all terrain/obstacles within the selected range are within 400 feet of the elevation of the nearest airport, only the number indicating the highest terrain is displayed. The elevation numbers are expressed in hundreds of feet above sea level (e.g., 125 is 12,500 feet MSL). The color of the elevation numbers match the color of the terrain and/or obstacles that are displayed.

03.01.01.08 PILOT RESPONSE TO EGPWS ALERTS

Anytime an EGPWS alert (caution, warning or TCF alert) occurs, the PF MUST TAKE IMMEDIATE POSITIVE CORRECTIVE ACTION. The importance of immediate pilot action in response to EGPWS alerts cannot be overemphasized.

All EGPWS alerts may not require the accomplishment of the CFIT Recovery Maneuver described in this section. If a Terrain alert occurs during day Visual Meteorological Conditions (VMC), and the pilot can immediately and positively determine that terrain clearance is not a factor, the flight may be continued normally. If a flight is operating at night or during Instrument Meteorological Conditions (IMC) or the pilot cannot absolutely ensure safe terrain clearance when an EGPWS alert occurs, the CFIT Recovery Maneuver must be IMMEDIATELY executed. If the EGPWS issues a caution alert, "TERRAIN AHEAD," "OBSTACLE AHEAD," or "CAUTION TERRAIN," the flight crew must adjust flight path to silence the alert. This may include stopping descent or climbing on turn as necessary based on analysis of all flight instruments and information.

If the EGPWS caution alert "SINK RATE, SINK RATE" occurs during a VMC approach, the PF must immediately alter the flight path sufficiently to stop the alert. If the alert continues, or the flight is operating in IMC conditions, the PF must execute a go-around or the CFIT Recovery Maneuver as appropriate. Be advised that using an excessive rate-of-descent above 1000 feet AGL, such as on a non-precision approach, can activate an EGPWS Alert.

Known EGPWS Warnings

Certain airports within the UPS system have terrain features that may cause a momentary EGPWS terrain warning to be activated during a normal, stabilized approach. These airports are identified on the associated UPS/Jeppesen "10-10" page. These situations should be anticipated and briefed prior to commencing an approach to one of these airports. Additionally, all altitudes on the

approach should be verified by the PM to ensure that the EGPWS warning is not valid and that no danger exists to the aircraft. This does not alleviate the crew's responsibility to take immediate action if the EGPWS warning continues or if there is any doubt concerning the safety of the aircraft.

03.01.01.09 "CFIT" RECOVERY MANEUVER

The following is immediately accomplished whenever the threat of inadvertent contact with terrain or obstacles exists. Any of the following conditions are regarded as presenting a potential for terrain/obstacle contact:

- Activation of the "WHOOP WHOOP, PULL UP," "TERRAIN, TERRAIN, PULL UP," "TERRAIN AHEAD, PULL UP" or "OBSTACLE AHEAD, PULL UP" warning.
- Other situations resulting in unacceptable flight toward terrain or obstacles.

PILOT FLYING	PILOT MONITORING
Simultaneously: Disengage autopilot. Disconnect autothrottles. Aggressively apply maximum thrust. Roll wings level. Rotate to 20° nose up, initial pitch attitude. Ensure speedbrakes retracted. If terrain remains a threat, continue rotation up to stick shaker or initial buffet. Maintain a maximum climb attitude until the warning ceases and the radio altimeter indicates clear of terrain/obstacles.	Verify maximum thrust. Verify all required actions have been completed and call out any omissions. Call out radio altitude and vertical speed.
Do not change flap or gear configuration until terrain/obstacle separation is ensured.	
Monitor radio altimeter for sustained or increasing terrain/obstacle separation.	
When clear of the terrain/obstacles, slowly decrease pitch attitude and accelerate.	

WARNING: THE PITCH ATTITUDE THAT RESULTS IN INTERMITTENT STICK SHAKER OR INITIAL BUFFET IS THE UPPER PITCH ATTITUDE LIMIT.

Do not use terrain/obstacle display for navigation or as the sole means of escape guidance in response to terrain or obstacle warnings.

Aft control column force increases as the airspeed decreases due to stall trim. Flight at intermittent stick shaker may be required to obtain positive terrain separation. Smooth, steady control will avoid pitch attitude overshoot and stall.

DO NOT follow Flight Director commands.

Sustained pitch attitudes in excess of 20° may be required to silence the EGPWS warning and/or avoid terrain. If the EGPWS warning continues, maintain an appropriate pitch attitude while monitoring radio altitude and vertical speed.

Sustained climbs at speeds slower than maneuvering speeds do not result in an appreciable climb gradient improvement. However, if required to avoid terrain or obstacles, continue to increase pitch until stick shaker or buffet occurs, then reduce the pitch attitude just enough to silence the shaker or fly out of buffet.

Do not attempt to regain lost airspeed until terrain/obstacle contact is no longer a factor. The pilot monitoring should advise ATC when the situation allows.