BOEING COMMERCIAL AIRPLANE GROUP

FLIGHT OPERATIONS TECHNICAL BULLETIN

NUMBER: 737-09-2

DATE: March 19, 2009

SUBJECT: Flight Crew Monitoring During Automatic Flight

ATA NO:

APPLIES TO: 737 All

Background Information

An erroneous Low Range Radio Altimeter (LRRA) has been identified in connection with a recent 737-800 accident.

The Digital Flight Data Recorder (DFDR) data indicates that the crew was using both the autopilot and the autothrottle during an ILS approach. The right LRRA was providing accurate data to the first officer's display and the left LRRA was erroneously providing a reading of -8 feet to the captain's display. No amber RA flag was displayed because the left LRRA system did not declare the data invalid.

On some 737s, the autothrottle logic uses left radio altimeter data regardless of the autopilot selected. In this event, when the airplane descended through approximately 1950 feet on the approach with flaps extended beyond 12 ½ degrees, the autothrottle erroneously sensed that the airplane was in landing flare. The thrust levers were retarded to the idle stop where they remained for approximately 100 seconds. For the first 70 of the 100 seconds, idle thrust was sufficient to maintain the selected airspeed. During the next 30 seconds, airspeed decreased below the selected MCP speed to approximately 40 knots below the selected approach speed.

The two LRRA systems provide height above ground data to aircraft systems which include the displays, autothrottle, autopilots and configuration/ground proximity warning.

If one LRRA provides erroneous altitude readings, the associated flight deck effects may typically include:

- Large differences between displayed radio altitude.
- Inability to engage both autopilots in dual channel approach (APP) mode.
- Unexpected removal of the Flight Director Command Bars during approach on the pilot's side with the erroneous radio altimeter display.
- Unexpected Configuration Warnings after takeoff, during approach, or during go-around.
- Inappropriate Flight Mode Annunciation (FMA) indication of autothrottle RETARD mode during approach phase with the airplane above 27 feet AGL. There will also be corresponding thrust lever movement towards the idle stop. The FMA will continue to indicate RETARD after the thrust levers have reached the idle stop rather than change to ARM.

Boeing Recommendations

Whether in automated or manual flight, flight crews must carefully monitor primary flight instruments (airspeed, attitude etc.) for aircraft performance and the FMA for autoflight modes.

The following information is taken from the Flight Crew Training Manual (FCTM) and has been adapted to provide Flight Crews and Operators with guidelines which should be followed if a flight crew encounters any of the above mentioned indications.

General Guidelines

Condition:

- *Large differences between displayed data.*

Crew Resource Management (CRM) involves the effective use of all available resources to operate a flight safely. It is important that all flight deck crewmembers identify and communicate any situation that appears potentially unsafe or out of the ordinary. Experience has proven that the most effective way to maintain safety of flight and resolve these situations is to combine the skills and experience of all crewmembers in the decision making process to determine the safest course of action.

Situational awareness, or the ability to accurately perceive what is going on in the flight deck, requires ongoing questioning, crosschecking, communication, and refinement of perception.

Condition:

- *Inability to engage both autopilots in dual channel approach (APP) mode.*
- *Unexpected removal of the Flight Director Command Bars during approach on the pilot's side with the erroneous radio altimeter display.*
- *Inappropriate Flight Mode Annunciation (FMA) indication of autothrottle RETARD mode during approach phase with the airplane above 27 feet AGL. There will also be corresponding thrust lever movement towards the idle stop. The FMA will continue to indicate RETARD after the thrust levers have reached the idle stop rather than change to ARM.*

Automatic systems give excellent results in the vast majority of situations. Faults can occur at any point during an automatic approach. Many non-normal situations or scenarios are possible. The flight deck is designed so that a quick analysis and decision can be made for virtually all non-normal or fault situations using the autopilot/autothrottle indicators, FMAs, master caution system and, for fail operational airplanes, autoland status annunciations. Deviations in intended flight path or unexpected thrust lever movement may also be an indication of an automation fault.

If the flight crew is aware of a degraded Autopilot Flight Director Systems (AFDS) mode, special recognition should be given during the Approach Briefing as to how to manage the use of the automatic features.

Note: Early intervention prevents unsatisfactory airplane performance or a degraded flight path.

When the automatic systems as described above do not perform as expected, the PF should reduce the level of automation to ensure proper control of the airplane is maintained.

The PF should not attempt to restore higher levels of automation until after aircraft control is assured.

Condition:

- *Unexpected Configuration Warnings after takeoff, during approach, or during go-around.*

Flight crew must ensure the proper configuration for the phase of flight. Time may be required in order to assess the situation, take corrective action and resolve the discrepancy; therefore a go-around, holding, or additional maneuvering may be necessary. Flight path control and monitoring of instruments must never be compromised.

Non-Normal Situation Guidelines

When a non-normal situation occurs, the following guidelines apply.

- NON-NORMAL RECOGNITION:
  - The crewmember recognizing the malfunction calls it out clearly and precisely.
- MAINTAIN AIRPLANE CONTROL:
  - It is mandatory that the Pilot Flying (PF) fly the airplane.
- ANALYZE THE SITUATION:
  - Any further action should only be initiated after the malfunctioning system has been positively identified.

Additional Information

Any occurrences of erroneous display data, even if intermittent, should be reported to maintenance.

More information can be found in the Boeing 737 Flight Crew Training Manual and Flight Crew Operations Manual. Operators may want to review the following:

737 FCTM

1. Chapter 1 - Crew Resource Management
2. Chapter 1 - Callouts
3. Chapter 1 - AFDS Guidelines
4. Chapter 5 - Approach Briefing
5. Chapter 5 - Stabilized Approach Recommendations

737 FCOM

1. NP11 - Autopilot Flight Director Systems (AFDS) Procedures
2. Chapter 4 - Automatic Flight System Description
3. Chapter 10 - Flight Instruments, Displays System Description
4. Chapter 15 -Warning Systems System Description