TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2010-073-4P
SERIOUS AVIATION INCIDENT

Budapest-FIR
23 March 2010

MCDONNELL-DOUGLAS MD-11F
N612FE

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents, incidents or irregularities and to initiate the necessary technical measures and make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to investigate or apportion blame or liability.

This present investigation was carried out on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 to ICAO Convention on Civil Aviation, put in force in Hungary by MTCW (Ministry of Transport, Communications and Water) Decree 20/1997. (X. 21.) on the declaration of the annexes of the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- MET Decree 123/2005 (XII. 29.) on the regulations of the technical investigation of aviation accidents, incidents and irregularities.

In absence of other related regulation of the Kbvt., the Transportation Safety Bureau of Hungary carried out the investigation in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service.

The Kbvt. and the MET Decree 123/2005 (XII. 29.) jointly serve the compliance with Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation, with the exception of its Annex I and Annex II.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree 278/2006 (XII. 23.).

Under the aforementioned regulations

- The Transportation Safety Bureau of Hungary shall investigate the aviation accidents and the serious aviation incidents.
- The Transportation Safety Bureau of Hungary may investigate aviation incidents and irregularities which - in its judgement - would have resulted in accidents under other circumstances.
- The technical investigation is independent of any administrative, infringement or criminal procedures initiated in connection with the transport accident or incident.
- In addition to the aforementioned laws, throughout the technical investigation ICAO Doc 6920 and Doc 9756 Manual of Aircraft Accident Investigation is applicable.

No conflict of interest has arisen in connection with any member of the investigating committee. Persons participating in the technical investigation shall not act as experts in other procedures concerning the same case.

The IC shall safe keep the data having come to their knowledge in the course of the technical investigation. Furthermore the IC shall not be obliged to make the data – regarding which its owner could have refused the disclosure of the data pursuant to the relevant act – available to other authorities.

DEFINITIONS AND ABBREVIATIONS

AML	Aircraft Maintenance Log
ATP AMEL	Airline Transport Pilot Aircraft Multi Engine License
ATPL	Airline Transport Pilot License
Budapest-FIR	Budapest Flight Information Region
FAA	Federal Aviation Administration
FL200 (example)	20000 feet, Flight Level (in 100 feet)
IC	Investigating Committee
ICAO	International Civil Aviation Organization
Kbvt.	Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents
Master Caution	central warning system
MAYDAY	emergency call, for asking for help
MEL	Minimum Equipment List
MET	Ministry of Economy and Transport (Gazdasági és Közlekedési Minisztérium)
NTA DAT	National Transport Authority, Directorate for Air Transport (as of 1st January 2007)
TSB	Transportation Safety Bureau

BRIEF DESCRIPTION OF THE OCCURENCE

Occurrence category		Serious aviation incident
Aircraft	**manufacturer**	MCDONNELL-DOUGLAS
	type	MD-11F
	registration	N612FE
	serial number	48605
	owner	FedEX Express
	operator	FedEX Express
Occurrence	**date and time**	23 March 2010
	location	Hungarian Airspace
Number of	**fatalities**	0
	seriously injured persons	0
Aircraft damage		Not damaged
State of registry		United States of America
Registering authority		FAA
Authority supervising manufacturing		FAA
Competent investigating organization		TSB

Reports and notifications

The occurrence was reported to the dispatcher of the TSB at 14:17, 23 March 2010 by the personnel on duty of HungaroControl Plc.

THE DISPATCHER OF THE TSB

- notified the duty personnel of NTA DAT at 14:21, 23 March 2010.

Investigating committee

On 23 March 2010 the Director-General of the TSB assigned the following investigating committee (hereinafter referred to as IC) for the investigation of the accident:

Investigator-in-Charge	János HORVÁTH	investigator
Member	György HÁY	investigator

During the investigation Mr. Horvath left TSB therefore the Director-General assigned investigator Mr. Laszlo Grez as IIC.

Overview of the investigation process

The designated IC was present at the site during the fire-fighting/emergency management activities, interviewed the crew after landing, took photographs, and collected the necessary data. Upon request from the IC the operator downloaded the FDR data and made it available for the IC.

The operator also provided the IC with a report on the findings of the internal occurrence investigation. The report contained a detailed description of the aircraft's fuel system and its main components.

The IC studied the FDR data, the information gathered during the site survey, and the report provided by the operator.

The interested parties had no substantial reflections on the draft therefore TSB HU issues the report without changes.

A short summary of the occurrence

The crew of FedEX Express airways, performing flight FDX3 (Dubai – Paris) with the aircraft type MD-11F, registered N612FE, observed a rapid decrease of fuel in the Hungarian airspace. Announcing MAYDAY, it declared emergency and asked clearance to land at Budapest-Ferihegy. The aircraft performed an overweight landing at runway 31R at 14:36, and then taxied to parking place No. 18. There were no personal injuries and the aircraft did not get damaged. The arriving fire-fighters had to cool down the wheels of the landing gear. Having successfully done so, airport emergency was cancelled at 15:25.

The IC does not suggest to issue a safety recommendation.

1. FACTUAL INFORMATION

1.1 History of the flight

The cargo flight FDX3 with destination airport Charles de Gaulle, started at 08:00 (UTC), 23 March 2010 with the MD-11F type aircraft, registered N612FE from Dubai International Airport. Around 13:15 (UTC) at cruise altitude the message "Level2", "Tank 2 Quantity Low" came on, in parallel with the "Master Caution". The commander controlled the amount of fuel and found the following [the values indicated in pounds (abbrev. as lbs)]: according to the display, the tanks contained 0 (Tank 2), 800 (Tank 1), 700 (Tank 3) and 13,200 (tail tank) lbs fuel. The total amount displayed was 15,300 lbs. According to the planned amount, it should have been 60,000 – 64,000 lbs of fuel on-board, with a distribution of 15,000 – 17,000 lbs per each main tank. The amount calculated by the crew proved that the difference between the two values may have originated only due to some error, as since take-off, the aircraft had consumed 108,000 lbs of fuel from the 168,500 lbs tanked in Dublin. Thus, approx. 60,000 lbs should have still been available. When the crew perceived the message indicating low fuel levels, the aircraft was approximately 110 nautical miles from Budapest-Ferihegy airport. The commander, observing the extensive loss in fuel not backed up by his calculations, ordered back the first officer from his rest period, while the back up first officer kept the contact with the FedEx centre.

The crew switched the fuel consumption to "manual control" at the fuel control panel, but there was no change in the values displayed. Subsequently, they tried the back up fuel control unit, but again there was no change. There were no means and there was no time to seek out the reasons of the extensive fuel loss, thus the commander decided to land immediately, at the closest airport. He declared "MAYDAY" and asked for clearance to land at Budapest-Ferihegy.

Under manual control, the first officer intended to feed all the engines from the tail tank. However, he could not do so, as the crew received the error message: "Do Not Use Cross Feed System", indicating the failure of the fuel control unit. Thus it was not possible to feed all the three engines from the tail tank.

As the reason for the loss in the displayed fuel values could not be determined on board, and the engines could not be fed from the tail tank, the crew descended intensively from FL200 and approaching by radar vectoring, landed at runway 31R of Budapest Ferihegy International Airport. There were no personal injuries and the aircraft did not get damaged during landing.

As a consequence of braking during landing roll, the temperatures of two wheels of the left landing gear reached 400-500°C, but there was no landing gear overheat warning.

After landing, during landing roll the fuel display system resumed slowly indicating the real fuel levels (60,000 lbs). The display indicated the fuel value gradually, first 30,000 lbs, and then finally nearly 60,000 (58,800) lbs was shown.

Having stopped at the parking position, the aircraft was checked by the airport fire-fighters by thermal imaging. Intensive cooling was applied due to the detected high temperature on the left main landing gear. After cooling, the emergency situation was cancelled.

The fuel level display having meanwhile recovered, the crew established that the true landing weight was 505,700 lbs. The maximum landing weight that had been determined in the flight plan was 481,500 lbs. The actual landing value and the fact of overweight landing was documented by the crew in the maintenance log of the aircraft (AML Sheet 1645840).

The crew recorded on AML sheet No. 1645838 the amount of fuel (per tank) observed during the flight after having received the error message, and also the declaration of emergency.

On request of the IC, the operator sent a flight data recorder to Ferihegy from their regional centre in Paris along with a technician charged with troubleshooting.

1.2 Personal injuries

Injuries	Crew		Passengers	Other
	Cockpit	Cabin		
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	3	0	0	

1.3 Damage to aircraft

The incident did not cause financially relevant damage in the given aircraft.

1.4 Other damage

The IC had not received any information on further damage by the completion of the investigation.

1.5 Information on the personnel

1.5.1 Data of the commander of the aircraft

Age, citizenship, gender		59 year old American man
Licence data	**Licence type**	ATPL
	Professional valid until	13 January 2011
	Medical valid until	28 July 2011
	Certificates	ATP AMEL
	Ratings	MD11, A310, B727, DC10
Hours flown	**Total**	15353 hours
	In the previous 30 days	45 hours 36 minutes
	In the previous 24 hours	5 hours 36 minutes
	On the given type in total	2653 hours 28 minutes

1.5.2 Data of the first officer

Age, citizenship, gender		55 year old American man
Licence data	**Licence type**	ATPL
	Professional valid until	15 September 2010
	Medical valid until	11 September 2010
	Certificates	ATP AMEL
	Ratings	MD11, A310
Flying experience, hours/takeoffs	**Total**	14300 hours
	In the previous 30 days	45 hours 55 minutes
	In the previous 24 hours	5 hours 36 minutes
	On the given type in total	3282 hours 12 minutes

1.5.3 Date of the first officer in the second shift

Age, citizenship, gender		40 year old American woman
Licence data	**Licence type**	ATPL
	Professional valid until	26 October 2010
	Medical valid until	8 March 2011
	Certificates	ATP AMEL
	Ratings	MD11
Flying experience, hours/takeoffs	**Total**	9280 hours 37 minutes
	In the previous 30 days	13 hours 58 minutes
	In the previous 24 hours	5 hours 36 minutes
	On the given type in total	3380 hours 37 minutes

1.6 Aircraft data

1.6.1 General

Class	Fixed wing aircraft
Manufacturer	McDonnell Douglas
Type/subtype (type number)	MD-11F
Date of manufacturing	1993
Serial number	48605
Hours flown/No. of landings since manufacture (since last maintenance)	17601 hours / 2340 cycles („B" Check: 685 hours / 91 cycles)
Registration	N612FE
State of registry, (authority)	United States of America, (FAA)
Owner	FedEx Corporation
Operator	FedEx Corporation
Call sign at the given flight	FDX3

Validity of airworthiness certificate: valid

1.6.2 Aircraft engine data

Type	Large, bypass turbojet engines		
Version	CF6-80C2		
Manufacturer	General Electric		
Position	Engine No. 1.	Engine No. 2.	Engine No. 3.
Serial number	704302	704388	702913
	Hours flown		
Since manufacturing	46587	40574	51865
Since last overhaul	12905	892	8083

After landing in Ferihegy, failure detection and repair was needed.

Empty mass	253.500 lbs
Mass of fuel at take-off	168.500 lbs
Commercial load	190.000 lbs
Take-off mass	612.000 lbs
Mass at the time of the occurrence	**505.700** lbs
Maximum allowed takeoff mass	630.500 lbs
Maximum allowed landing mass	**481.500** lbs

Due to overweight landing (the weight being approx. 24,000 above maximum landing weight), the technician carried out the contents of point 05-51-04-6 of the maintenance manual applicable to the aircraft. He found no failure.

In the process of failure detection regarding the faulty fuel level display, the compensator of tank No. 2. and its capability to transmit signals was found defective. The task of the failed equipment was to create a modifying signal, depending on the temperature and type of fuel, to be forwarded to the standard electric module (SEM) installed into the fuel level measurement system. If the compensator is producing a deficient signal (or if signal transmission to the electric module is not faultless), then data processing and display will fail. Point 28-01-01-02 of MEL was applied to the unit found deficient, and, along with recording the deferred item, the technician proclaimed the aircraft to be airworthy.

On request of the IC, to be able to analyse the recorded flight data, the operator replaced the flight data recorder on board, and transported it to their regional centre. The processed data were delivered to the IC in an electronic format. The data recorded therein showed clearly the way the flight was carried out, and they corresponded to what had been told by the crew and to the data recorded in the on-board documentation.

The failure was definitively repaired at the Memphis base of FedEx. During repair, SEM was demounted, because its pin showed deformations attributable to electronic fire. The relevant part of the electronic network was checked during the repair work. The fuel tank was tested for leakproofness. As the final step of repair, the operability of the fuel measurement system was checked. No failure was detected, the aircraft was declared airworthy.

Name of the failed (replaced) equipment/part	Standart Electronic Module – SEM
Place of instalment	Middle section of the aircraft
Manufacturer	unknown
Type (P/N)	397-040-085
Serial number (S/N)	1219

1.7 Meteorological data

The meteorological conditions had no effect on the course of events, their analysis was not required.

1.8 Aids to navigation

The navigational instruments had no effect on the course of events therefore their analysis was not required.

1.9 Communication

The communications equipment had no effect on the course of events therefore their analysis was not required.

1.10 Aerodrome information

The parameters of the aerodrome had no effect on the course of events therefore their analysis was not required.

1.11 Flight recorders

The required flight recording systems were operative on the aircraft, the data recorded by the flight data recorder have been downloaded. The downloaded and analysed data confirmed the information given by the crew.

1.12 Wreckage and impact information

The incident did not result in a wreckage.

1.13 Data of the medical investigations

There was no pathological or medical investigation in connection with the incident.

1.14 Fire

There was no fire.

1.15 Chances of survival

There were no personal injuries.

1.16 Tests and research

Tests and researches were not initiated by the IC.

1.17 Organisational and management information

The characteristics of the organizational and management environment had no effect on the course of events therefore their analysis was not required.

1.18 Additional information

The IC does not find any other data than the factual data described above relevant to making the conclusions and developing the safety recommendations, thus it does not intend to publish further data.

1.19 Useful or effective investigation techniques

The investigation did not require techniques differing from the traditional approach.

2. ANALYSIS

Considering that the technical failure was the determining condition affecting the flight, the IC focuses in its analysis on its findings relevant to the repair.

The aircraft had to abandon its planned flight path and land at Budapest-Ferihegy airport due to the fuel level displayed. The crew could not determine the displayed and real fuel amounts as a consequence of the failure of the measurement and display system. The commander decided to declare emergency as based on the data available to him. The fact that the decision could not be postponed was also underpinned by a failure also occurring in the fuel display and fuel management system. It could not be determined during the flight whether fuel was indeed lost, and what the reason might have been for the displayed fuel loss (eg. technical causes).

There are no objections raised against the conduct of the crew during the failure of the fuel display and the fuel control system.

3. CONCLUSIONS

3.1 Factual findings that can be directly linked to the occurrence

As based on the data available, the IC judges the conduct of the crew to be appropriate. The data displayed when the failure occurred and also the symptoms of the failure were analysed by the crew, and there was no means for them to avert these failures in the given phase of flight.
The unplanned abruption of the flight and landing at Budapest-Ferihegy was caused by the technical failure of the fuel measurement display system and the fuel control unit.

4. SAFETY RECOMMENDATIONS

The IC has not revealed any circumstance which would have called for a safety recommendation.

5. APPENDICES

None.

Budapest, 21 May 2014

Laszlo GREZ IIC	Gyorgy HAY Member of the IC

NOTE:
The present document is the translation of the Hungarian version of the final report. Although efforts have been made to translate it as accurately as possible, discrepancies may occur. In this case, the Hungarian is the authentic, official version.