MINISTRY OF INFRASTRUCTURE
STATE COMMISSION ON AIRCRAFT ACCIDENT INVESTIGATION

FINAL REPORT

Serious Incident No: 122/08

CFIT marginally avoided during visual approach caused by the flight crew of Boeing 737, registration: EI-DPO on 10 March 2008 CTR Katowice – Pyrzowice (EPKT).

This report is a document presenting the position of the State Commission on Aircraft Accident Investigation concerning circumstances of the air occurrence, its causes and safety recommendations.

The report is the result of the investigation carried out in accordance with the applicable domestic and international legal provisions for prevention purposes only. The investigation was conducted without the need of application of legal evidential procedure.

In connection with the Article 134 of the "Aviation Law" Act (Journal of Laws 2006, No. 100, item. 696 with amendments), the wording used in this report may not be considered as an indication of the person guilty or responsible for the occurrence.

The Commission makes no judgments about fault and responsibility.

In connection with the above, any form of use of this report for any purpose other than air accidents and serious incidents prevention, can lead to wrong conclusions and interpretations.

This report was drawn up in Polish. Other language versions may be drawn up for information purposes only.

Warsaw 2011

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GENERAL INFORMATION

Type and model of aircraft :	**Boeing 737-800**
Aircraft registration marks:	**EI-DPO**
Aircraft commander :	**Airline Transport Pilot Licence**
Flight organizer :	**Ryanair Limited**
Aircraft user :	**Ryanair**
Aircraft owner :	**Ryanair Ltd**
Place of the incident :	**Katowice - Pyrzowice (EPKT) CTR**
Date of the incident :	**10 March, 2008, 08:45 UTC**
The degree of damage to the aircraft :	**No damage**
Injuries to persons :	**No injuries**

SYNOPSIS

Note: all times in the report are expressed in UTC (local time= UTC + 1 hour)

On 10 March 2008 Boeing 737, registration marks: EI-DPO performed a flight from Bristol (EGGD) (take off time 06:42 UTC), to Katowice – Pyrzowice (EPKT). Upon arrival at EPKT aerodrome the flight crew received clearance for visual straight-in approach and landing on runway 09. With full ground contact the crew began a visual descent to what they had mistakenly determined as EPKT aerodrome. At the altitude of 500 feet RALT, with full visual contact with the ground, the flight crew realized their mistake and executed a Go Around. During the Go Around, the EGPWS system generated "TERRAIN" and "PULL UP" alerts. The crew reacted properly, and after reaching the altitude of 6000 feet asked air traffic control unit for the clearance for ILS approach to RWY 27, where they landed safely at 08:57 UTC.

Investigation of the occurrence was conducted by the SCAAI Investigating Team in the following composition:

MSc.Eng. Bogdan Fydrych - Investigator-in-Charge– SCAAI Member;

MSc.Eng. Waldemar Targalski – SCAAI Member;

MSc.Eng. Piotr Lipiec – SCAAI Expert

Mirosław Rzeźnicki – SCAAI Expert

Based on analysis of the involved persons statements and evidence gathered during the investigation, the SCAAI Investigating Team determined the following causes of the serious air incident:

1. Probably inadequate monitoring of FMS indications.
2. Probably inadequate CRM by the flight crew in the cockpit.
3. Continuation by the crew of the approach procedure without visual contact with the runway evironment.
4. Contributing factor:

Poor radionavigation aids infrastructure on approach to runway 09 at EPKT aerodrome.

SCAAI has made 4 safety recommendations upon conclusion of the investigation.

1. FACTUAL INFORMATION

1.1. History of the flight.

On 10 March 2008 Boeing 737, registration marks: EI-DPO performed a flight from Bristol (EGGD) (take off time 06:42 UTC), to Katowice–Pyrzowice (EPKT). After establishing communications with approach control EPKK TMA, the flight crew were asked whether they accepted visual approach on runway 09 at EPKT. The crew accepted the approach and received clearance to fly from navigation point MAPIK direct to EPKT. They then received clearance to descend to 4000 feet AMSL. At the distance of approximately 30 NM the flight crew were asked to establish communication with the aerodrome control authority EPKT TWR.

After switching to the EPKT TWR controller, the crew received weather conditions and the clearance to continue a visual straight-in approach to runway 09. Record of the flight data allowed to reconstruct individual phases of the approach.

The initial average vertical speed was approximately-2500 [ft/min]. Between FL220 and FL130 the rate of descent was greatest and reached over -4500 [ft/min]. From FL120 to FL100 the aircraft descended at a rate of approximately-400 [ft / min]. At a distance of approximately 26 [NM] from EPKT the aircraft changed heading by 17 [deg] for HDG = 97 [deg]. Then the descent from the initial -2000 [ft/min] was reduced to about-1400 [ft/min]. The engines were at flight idle from FL 240 to approximately 500 ft. Leaving 6960 ft in the descent flaps were gradually extended and the aircraft was in the full landing configuration passing 1050 ft. The crew performed the approach into the sun, which restricted forward visibility. At an altitude of approximately 500 feet, the crew realized that they had mistakenly determined the location of EPKT aerodrome and executed a Go Around.

In the preparation phase for Go Around EGPWS system warned about possible collision with terrain. After abandoning of approach at RALT = 247 [ft] the airplane began to climb and at altitude of 6000 feet the crew asked the air traffic control unit for clearance to approach RWY 27 by ILS. The landing was completed without any difficulties at 08:57 UTC.

1.2. Injuries to persons - no injuries

1.3. Damage to aircraft - no damage

1.4. Other damage - none

1.5. Personnel information

1.5.1. **Captain**

- Male, aged 58 ;
- Total flight time: 21800 hrs;
- Flight time on B 737: 4800 hrs;
- Flight duty time over the last 24 hrs: 11 hrs 55 min;
- Flight duty time over the last 28 days: 121 hrs 2 min;
- Medical examinations valid until: 16.08.2008.

1.5.2. **Co-pilot**

- Male, aged 24;
- Total flight time: 1020 hrs;
- Flight time on B 737: 600 hrs;
- Flight time over the last 24 hrs: 0 hrs;
- Flight duty time over the last 28 days: 125 hrs 10 min;
- Medical examinations valid until: 12.06.2008.

1.6. Aircraft information.

Type: Boeing 737 – 800;

- Serial number : 33612;
- Registration marks: EI-DPO;
- Maximum Take off Weight (MTOW): 74990 kg;
- Year of manufacture: 2007.

1.7. Meteorological information.

Weather conditions at the time of issuing clearance for approach and during landing at EPKT.

From TWR controller.

- Wind speed: 7 knots (3,6 m/s);
- Wind direction:180 deg;
- CAVOK;
- Temperature: 9 C^o;
- Dew point: 3 C^o;
- QNH: 1006 hPa.

From AWOS database.

- Wind speed: 7,91 knots (4,06 m/s);

- Mean wind direction: 197 deg;
- Visibility: 10000 m.

The crew performed approach against the sun, which limited visibility from the cockpit.

1.8. Aids to navigation.

Radio navigation, radar and landing aids installed in the area of EPKT

Type of aid, CAT of ILS/MLS (VOR/ILS/MLS declination)	ID	Frequency	Hours of operation	Position of transmitting antenna coordinates (WGS-84)	Remarks
NDB	KTC	285 kHz	H24	50°28.26.67.N 019°09.01.21.E	086°, 3.99 km FM THR 27.
L	KTW	326 kHz	H24	50°28.27.08.N 019°06.27.19.E	086°, 0.96 km FM THR 27.
ILS LLZ	KAT	109.900 MHz	H24	50°28.27.53.N 019°02.56.43.E	CAT I RWY 27. 266°, 0.42 km FM THR 09.
ILS GP	-	333.800 MHz	H24	50°28.32.08.N 019°05.20.93.E	GP 3°, 0.15 km N FM RCL 0.35 km W FM THR 27 RCL RDH 15.9

No concerns regarding aids to navigation were raised.

1.9. Communications

No concerns regarding communications were raised.

1.10. Aerodrome information

- Geographical coordinates and ARP localization: 50°28.27.31.N 019°04.48.07.E
  1000 m from THR 27 on the central line
- Elevation 303,5 m.

RUNWAY PHYSICAL CHARACTERISTICS

Designations RWY/NR	TRUE&MAG BRG	Dimensions of RWY (M)	Strength (PCN) and surface RWY and SWY	THR coordinates (WGS-84)/ THR geoid undulation(M)	THR elevation and highest elevation of TDZ for precision approach (M)
09	090°GEO 086°MAG	2800 x 60	PCN 50/R/A/W/T concrete(1)	50°28.27.50.N 019°03.16.71.E 40.4	295.6 296.8
27	270°GEO 266°MAG	2800 x 60	PCN 50/R/A/W/T concrete(1)	50°28.27.19.N 019°05.38.65.E 40.4	303.2 301.7

Remarks: 1)- Runway shoulders 5 m wide – CONC/ASPH surface, PCN 46.

RWY	Approach lighting type, length, intensity	THR light colour, WBAR	VASIS (MEHT) PAPI	TDZ, LGT LEN
09	Simplified approach lighting system „cross" with axis length 420m and bar 300m from THR.	THR (inset); green LIH – five stages INTST. WBAR (elevated); green LIH – five stages INTST	PAPI 3°, 320 m from THR 09, on the left side of RWY. LIH – five stages INTST	None.

27	Precision approach category I lighting system (Calvert system). LIH – five stages INTST Flashing lights (30 lamps): 0 - 900 m from THR 27. Three stages INTST	THR (inset); green LIH – five stages INTST. WBAR (elevated); green LIH – five stages INTST	None.	None.
	RWY centre line LGT, LEN, sparing, colour, INTST	**RWY edge LGT, LEN, spacing, colour, INTST**	**RWY end LGT colour, WBAR**	**SWY LGT, LEN (M), colour**
09	None.	2800 m, 60m FM 0 - 2200 m white FM 2200 - yellow, LIH – five stages INTST	red, LIH – five stages INTST WBAR: none.	None
27	None.	2800 m, 60m FM 0 - 2200 m white FM 2200 - yellow, LIH – five stages INTST	red, LIH – five stages INTST WBAR: none.	None.

1.11.Flight recorders

1.11.1. Source file from WQAR.

The source file from aircraft EI-DPO recorded by Teledyne DVR Wireless Ground Link QAR was delivered for analysis in its original format. A file named “raw.dat" had a length 8923648 B. Its content is a binary sequence of data from flight data recorder WQAR. The binary data was supplemented by a text file "KTW_incident.txt" with data from FOQA system with a set of 1775 frames of data recorded on EI-DPO. The data set included the following parameters: Frame-Sf, Time, Status, Event, Radio Height, Pressure Alt ,Heading, Computed Air, Pres Position Latitude, Pres Position Longitude, Vertical Accel, Lateral Accel, Longitudinal Accel, Capt Display Pitch, Capt Display Roll Att, GPWS Dont Sink, Gpws Glideslope, GPWS Pull Up, GPWS Sink Rate, GPWS_Terrain, GPWS Too Low Flap, GPWS Too Low Gear, GPWS Too Low Terrain, GPWS Warning Discrete, GPWS Windshear Warning, Flap Handle Pos, Flap Setting (Config), Left Gear Down, Nose Gear Down, Right Gear Down, N1 Indicated #1, N1 Indicated #2, N2 Actual #1, N2 Actual #2, A/T Engaged, GMT (Hr/Min/Sec). The time period covered by the text file: from 8:32:18 to 9:01:53.

1.12. Wreckage and impact information

Not applicable

1.13. Medical and pathological information

Not applicable

1.14. Fire.

Fire did not occur.

1.15. Survival aspects

Not applicable.

1.16. Tests and research.

The SCAAI Investigating Team analyzed flight recorders records, statements of the airplane pilots, air traffic controllers and evidence gathered during the investigation.

1.17. Organizational and management information.

On 13 March 2008 at 12:26 local time SCAAI was notified about the occurrence by the Air Accident Investigation Unit, Ireland (AAIU). The record of a cockpit voice recorder (CVR) of the Boeing 737 was "overwritten" by a new soundtrack.

On 14 March 2008 SCAAI notified the Irish Air Accident Investigation Unit, International Civil Aviation Organization (ICAO) and the interested parties about the occurrence and instituting of investigation, in accordance with the recommendations of Annex 13 (Aircraft Accident and Incident Investigations) to the Convention on International Civil Aviation.

The Commission received the WQAR record of flight parameters from the AAIU.

1.18. Additional information.

Directly after abandoning of approach by the Boeing 737 and during further procedure two other airplanes landed on the runway 09 and their flight crews did not raise any concerns regarding the weather conditions provided by the EPKT TWR controller. Draft of the Final Report was sent to the AAIU, the Polish Air Navigation Services Agency and Manager of EPKT aerodrome.

1.19. Useful or effective investigation techniques.

Not applied.

2. ANALYSIS

2.1. Occurrence analysis

Crew operations.

Taking into account the reported weather (item 1.7), the Captain made a decision to execute a visual approach. The decision to accept a visual approach was taken before the aerodrome was in sight.

The recommended approach procedure (according to *Boeing Flight Crew Training Manual*) is described below.

Descent planning

Crew workload increases as the airplane descends and approaches the aerodrome area. Possibility of distraction must be minimized therefore necessary actions related to descent and approach planning must be completed earlier so more time is available during the

critical approach and landing phases. Operational factors and/or traffic requirements in the aerodrome area may not allow execution of the optimal descent profile. ATC, weather conditions, icing and high intensity of traffic may require changes to the planned descent. Proper descent planning is necessary to arrive at the required altitude at the proper speed and configuration. The distance required for the descent is approximately 3 NM per 1000 feet altitude loss. The recommended method of the proper descent planning and controlling (for straight-in approach) is that to be at the required altitude at the distance about 12 NM from runway at the speed for „clean configuration" (flaps and landing gear up). The proper crosscheck is to be at 10000 feet (AGL), 30 NM from the aerodrome, at the speed of 250 knots.

Descent procedure

The descent procedure should be prepared before the descent start point (TOD) is reached, approximately 100 NM from TOD (which allows receiving ATIS or in the case of lack thereof, to obtain in advance from ATC information about weather conditions and the runway in use). At that time, the pilot flying (PF) passes control of the airplane to the pilot monitoring (PM) and carries out the so-called „approach briefing". It should be noted that all safe approaches have some basic features in common. These include proper descent planning, careful analysis of the approach procedure and weather conditions, accurate flying and good cooperation within a crew. Proper planning is the key to a safe and professional approach.

Before commencing an approach the Pilot Flying (PF) should brief the pilot monitoring (PM) of his intentions in conducting the approach. Both pilots should analyze the planned approach procedure. All significant approach information, including minima and missed approach procedures should be reviewed and articulated. Alternate courses of action should be considered (e.g. diversion to a designated alternate aerodrome).

The approach briefing should include at least the following:

- Weather conditions and NOTAMs at destination and alternate aerodromes;
- Type of approach and validity of the charts to be used;
- Navigation aids and ATC frequencies to be used;
- Minimum sector altitude of the aerodrome (MSA);
- Approach procedure with the proper headings;
- Vertical profile including minimum altitudes, altitudes crossing points and minimum approach altitudes (MDA and MDH);

- Determination of the Missed Approach Point (MAP) and the missed approach procedure;
- Other crew actions such as: setting of navigation aids (ILS, VOR, NDB), setting of communication and ATIS frequencies, setting of courses or other actions as required;
- Analysis of taxi route to parking including routes for vacating runway;
- Any other information related to non-standard procedures;
- Use of Automatic Flight Direction System (AFDS).

Approach

When cleared for an approach and on a published segment of that approach, the crew commander is authorized to descend to the minimum altitude for that segment. When cleared for an approach and not on a published segment of that approach, the crew commander maintains assigned altitude until crossing the initial approach fix or maintains altitude established on a published segment of that approach.

Criteria of stabilized approach

Maintaining a stable speed, stable descent rate, vertical and lateral flight path in landing configuration is commonly referred to as the stabilized approach concept. Any deviation from planned flight path, air speed or descent rate should be reported (by PM).

NOTE: Do not attempt to land from an unstable approach!

Recommended elements of a stabilized approach

The following recommendations are consistent with criteria established by the Flight Safety Foundation. All approaches should be stabilized by 1 000 feet above airport elevation in IMC and by 500 feet above airport elevation in VMC.

An approach is considered stabilized when all of the following criteria are met:

- The airplane is on the correct flight path;
- Only small changes in heading and pitch are required to maintain the correct flight path;
- The airplane indicated speed is not greater than VREF + 20 knots and not less than VREF;
- The airplane is in the correct landing configuration;
- Sink rate is not greater than 1 000 feet/min; if an approach requires a sink rate greater than 1 000 feet/min, a special briefing should be conducted;
- Engines power setting is appropriate for airplane configuration, above the "idle" setting.
- All briefings and checklists were conducted and executed.

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

NOTE: An approach which is unstabilized by 1000 feet above airport elevation in IMC or by 500 feet above airport elevation in VMC requires an immediate go-around.

The crew created approach path in FMC.

„The RWY09 was selected in the FMC with an extended centre line. The RWY ALT is defined in the FMC and the VNAV system will compute a 'G/Path' from this. There were no Nav Aids appropriate to RWY 09 that could have be used during this approach."

Explanation given in the paragraph above showed that the declared visual approach was performed based on FMC G/Path (the approach path created by the FMC). The automatic creation of approach path in the VNAV mode should have brought the airplane along a three degree glide path to the runway 09 threshold.

According to the Investigating Team the occurrence could have been caused by:

- Inadequate monitoring of altitude and distance of the airplane from the runway 09 threshold;
- Execution of a manual approach without accurate maintaining of flight parameters and profile.

The crew performed a visual approach to what they believed to be the runway. In doing so they descended below the correct glide path for the approach to runway 09 at EPKT. At approximately 500 feet the flight crew realized their mistake and executed a Go Around.

The crew could not benefit from DME indications (lack of such aid to navigation on EPKT on the day of the occurrence) which could allow to verify relationship between the altitude and distance from runway threshold. The flight management system of Boeing 737-800 allows the crew to get a fairly accurate information about the distance to the selected runway threshold and on this basis to monitor the correct descent profile on a 3 degree glide path.

After acceptance of a visual approach the crew should have executed all or part of instrument approach procedures with constant visual reference to the terrain.

Due to lack of data from the CVR, the Investigating Team was not able to reproduce the flight crew exchanges in the cockpit or CRM.

The Team assumed that an important factor in the analyzed occurrence could have been the flight crew cooperation due to diversification of the pilots experience (Captain - total flight time 21 800 hours, on the type: 4800 hours, F/O - 1020 hours, on the type - 600

hours). Cooperation within the crew with a high diversity of experience is subject to specific rules. Relationship: "Authority" - "Apprentice" is extremely delicate. Accepting by the "Authority" possible controversy from "Apprentice" with no adverse consequences for the latter is a very important factor from a safety standpoint.

Improper relationship may lead to lack of criticism in the assessment of the current situation. The flight crew works in a specific environment, which is the aircraft cockpit. Being in a specific relation with each other (Captain and First Officer), they must jointly implement the priority actions that allow safe execution of air operations. This task can not be completed in isolation in such a dynamically changing environment. Both pilots should be in constant interaction, which means that behavior and actions of one of them in some way affect the operations of the other. Pilots, by the proper cooperation, exchange information on their actions, coordination of these actions, are shaping their activities in the aircraft cockpit, for which they assume common responsibility. Understanding interdependence and shared responsibility for the task is crucial not only for the quality of an executed task, but above all for flight safety.

In a situation where the Pilot Flying (PF) was an experienced Captain and First Officer was inexperienced, the Team considered the following scenarios:

- The First Officer did not question the Commander's decision to commence or continue the visual approach;
- The First Officer (PM) failed to monitor the progress of the approach by reference to the flight instruments;
- The crew could have been surprised by the visibility worse than expected (the flight against the sun).

As a consequence of the above the approach was continued below the safe altitude.

It is probable that the crew CRM was not adequate to the current situation during approach. The result of improper CRM could have been incomplete exchange of information on actions of the Pilot Flying (PF) and/or improper monitoring of his actions by the Pilot Monitoring (PM). The factors affecting cooperation of the crew with a high diversity of experience should be addressed during the periodic training sessions.

The presented incident was classified as CFIT marginally avoided, since it had met the following criteria:

- the aircraft was controlled by the pilots;
- there were no defects that would have affected the normal execution of the flight;

- the crew had little or no awareness of the immediate risk of collision with the terrain.

CFIT marginally avoided in VMC conditions usually take place when the final approach sector has no visible ground features or navigation infrastructure is poor. This was the case in the presented occurrence.

The crew responded properly to the warning generated by EGWPS system and avoided an air accident.

The crew did not inform the air traffic services that the cause of missed approach was the PULL UP warning generated by EGWPS system.

Course of event reconstructed on the basis of the flight recorder data

The recorded flight data allowed to reconstruct individual phases of the flight from starting engines to their shutdown.

The airplane EI-DPO performing flight FR8226 entered FIR Warsaw at FL410. The initial average vertical speed was approximately -2500 [ft/min]. Between FL220 and FL130 the descent rate was greatest and reached over -4500 [ft/min]. From FL120 to FL100 the aircraft descended at a rate of approximately -400 [ft / min]. At a distance of approximately 26 [NM] from EPKT the airplane changed heading by 17 [deg] for HDG = 97 [deg]. Then the descent from the initial -2000 [ft/min] was reduced to about -1400 [ft/min]. In the course of descent flaps were gradually extended which was accompanied by constant reduction of the horizontal speed. Then the crew extended landing gear and at the RALT = 1050 [ft] extended the flaps to landing position. The airplane was in landing configuration, and from FL240 engines were on "idle" setting, which was inconsistent with the criteria of stabilized approach. ***(Engines power setting is appropriate for the airplane configuration, above the "idle" setting).***

When the plane was at RALT = 440 [ft], the AT was disengaged, which indicates that the entire descent procedure was performed on "idle" setting.

08:38:47 – AT disengaged, RALT=440[ft],

08:38:49 – beginning of G/A procedure, power increasing by moving thrust lever, PITCH=0,0[deg],

08:38:53 – engines power: N11=70[%], N12=71,88[%],PITCH=3,5[deg],

08:38:59 – minimum terrain clearance RALT=247[ft], CAS=127,75[kts],

08:39:02 – engines power: N11=90,38[%], N12=90,62[%], end of EGPWS warning

Therefore, the engines reached 90 % of power after 13 seconds.

Flight Safety Foundation in its publication (ALAR) draws pilots attention to the fact that when approaching with power setting at "idle", they should be aware of the specifics of the jet engine acceleration. Characteristics of the jet engines show that in the case of necessity for Go Around procedure acceleration from the "idle" setting **is a few seconds longer** than from the above "idle". In the analyzed occurrence, during Go Around procedure the crew led the airplane to temporary loss of altitude below a dangerous value. It was due to extended time necessary to achieve proper engines power.

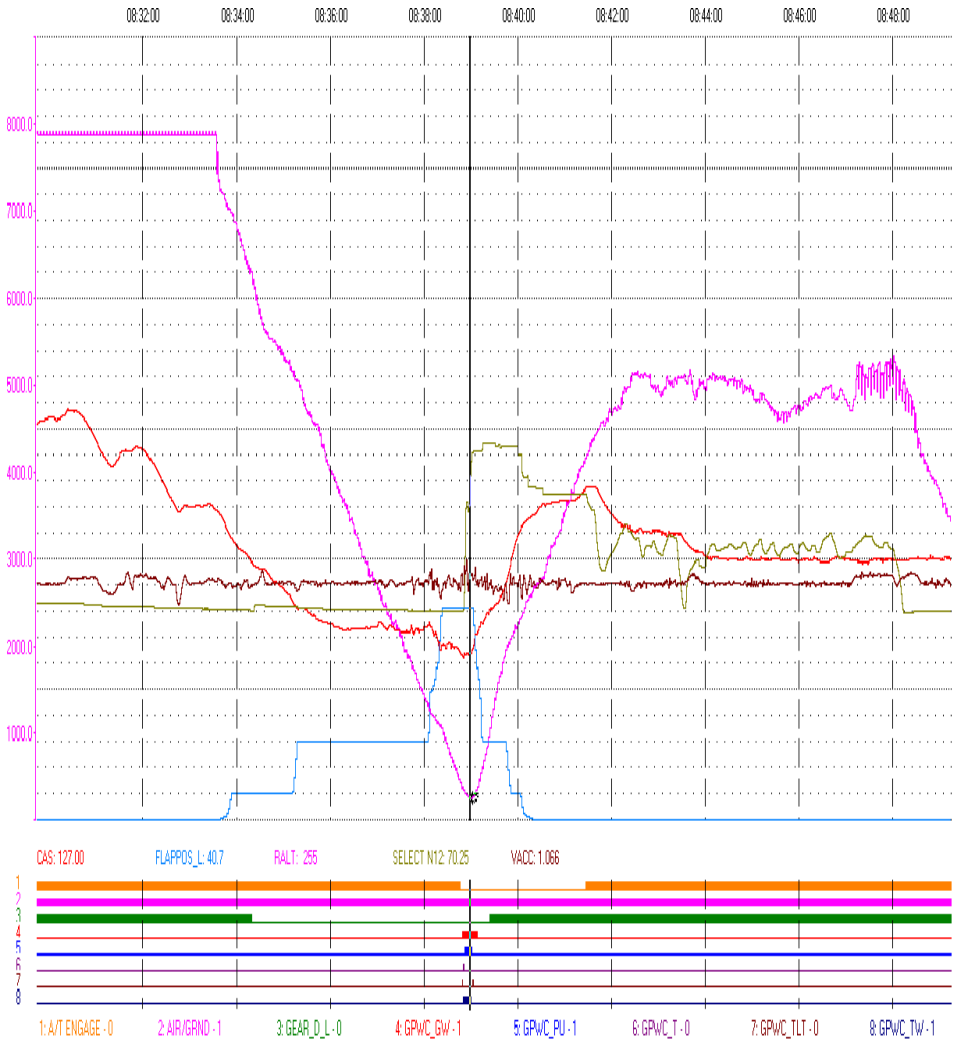
At RALT = 370 [ft] at a distance of about 3 [NM] from EPKT aerodrome EGPWS system was activated and generated PULL UP warning. The crew performed a Go Around procedure. The lowest recorded RALT was 247 [ft]. The airplane climbed to PRALT = 6200 [ft], and after passing EPKT aerodrome at the distance of approximately 12 [NM] made the procedure turn for approach. After the turn ILS signal was intercepted and the airplane was stabilized on 267 degrees LOC, approximately 18 [NM] from the aerodrome.

About 14 [NM] from the aerodrome, the crew extended flaps at 5 [deg] and continued the flight at PRALT = 4200 [ft]. About 12 [NM] from the aerodrome while still under glide path the airplane started to descend. About 6 [NM] from the aerodrome the flaps and landing gear were extended. About 4 [NM] from the aerodrome the airplane was already in landing configuration with flaps at 40 [deg]. At RALT = 709 [ft] LOC and G/S signals disappeared, probably as a result of ILS receiver turning off or changing its frequency. Approach and landing on EPKT aerodrome RWY27 was performed without problems. After roll the airplane vacated RWY27 and taxied to a parking stand.

WQAR recorder data.

06:36:15 – (timing in UTC) start of WQAR record, engines starting,
06:42:28 – take off CAS=147.25[kts], FLAPPOS_L=5[deg],
07:05:33 – reaching cruise FL410,
08:12:14 – entering FIR Warsaw, FL410, HDG=110[deg],
08:20:37 – leaving FL410, beginning of descent to approach KTW,
j.w. ÷ 08:26:26 – descent, VERT_SPEED=(2200÷3496)[ft/min],
08:26:39 – approaching FL250, VERT_SPEED=1000[ft/min],
08:27:21 – further descent from FL250, VERT_SPEED=~2200[ft/min],
08:28:56 ÷ 08:31:02 – increased descent rate, VERT_SPEED=~4800[ft/min],
08:31:24 ÷ 08:32:18 – increased descent rate, VERT_SPEED=~4100[ft/min],
08:32:12 – change of heading to HDG=97[deg],
08:32:19 – reaching FL100, decreased descent rate to VERT_SPEED=200[ft/min],
08:32:40 – leaving FL100,
08:32:45 ÷ 08:34:35 – descent, VERT_SPEED=~2000[ft/min],
08:33:35 – flaps extension, FLAPPOS_L=5[deg], RA=6960[ft], CAS=213.25[kts],
08:34:20 – landing gear extension, RA=6161[ft], CAS=196[kts],
08:35:17 – flaps extension, FLAPPOS_L=14.9[deg], RALT=5058[ft], CAS=162[kts],
08:35:19 ÷ 08:34:35 – descent, VERT_SPEED=(1250÷1500)[ft/min],

08:38:23 – flaps extension to landing position, FLAPPOS_L=40.7[deg], RALT=1050[ft], CAS=134.25[kts],
08:38:47 – AT disengaged, RALT=440[ft],
08:38:49 – EGPWS WARNING: TOO LOW TERRAIN, RALT=370[ft],
08:38:49 – beginning of G/A procedure, power increasing by moving thrust lever, PITCH=0,0[deg],
08:38:50 – EGPWS TERRAIN WARNING: TERRAIN, RALT=337[ft],
08:38:52 – beginning of EGPWS WARNING: PULL UP, RALT=302[ft],
08:38:53 – engines power: N11=70[%], N12=71,88[%],PITCH=3,5[deg],
08:38:59 – minimum terrain clearance RALT=247[ft], CAS=127,75[kts],
08:39:02 – engines power: N11=90,38[%], N12=90,62[%], end of EGPWS WARNING: PULL UP, RALT=272[ft], PITCH=6,7[deg],
08:39:03 – beginning of flaps retraction to FLAPPOS=15[deg], RALT=273[ft], PITCH=6,5[deg],
08:39:44 – beginning of flaps retraction to FLAPPOS=5[deg], RALT=1955[ft],
08:40:03 – beginning of flaps retraction to FLAPPOS=0[deg], RALT=2305[ft],
08:40:43 – flight over KTW aerodrome, RALT=3011[ft], PRALT=4154[ft],
08:41:27 - AT engaged, RALT=4150[ft], PRALT=5345[ft],
08:42:29 – end of climb at PRALT=6200[ft],
08:43:32 – beginning of procedure turn to approach KTW, direction RWY27,
08:50:33 – stabilization on runway heading LOC_DEV=0.009[dot], GS_DEV=0.470[dot], RALT=2591[ft],
08:51:33 – flaps extension, FLAPPOS_L=5.0[deg], RALT=2837[ft], CAS=198[kts],
08:52:48 – beginning of final approach, RALT=2952[ft] without crossing of the glide slope GS_DEV=0,338[dot],
08:54:41 – flaps extension FLAPPOS_L=15.0[deg], RALT=1716[ft], CAS=158,25[kts],
08:54:47 – landing gear extension, RA=1669[ft], CAS=160,50[kts],
08:54:59 – flaps extension FLAPPOS_L=24,9[deg], RALT=1557[ft], CAS=152[kts],
08:54:59 – flaps extension to landing position, FLAPPOS_L=40,7[deg], RALT=1416[ft], CAS=144,75[kts],
08:54:59 – flaps in landing position, RALT=1294[ft], CAS=132,25[kts],
08:55:58 - EGPWS WARNING: GLIDESLOPE, RALT=972[ft],
08:56:13 – AT disengaged, RALT=855[ft], GS_DEV=0,25[dot],
08:56:27 – ILS receiver turned off, RALT=709[ft],
08:57:42 – first touchdown, CAS=122.25[kts], PITCH=2,6[DEG],
08:57:43 – second touchdown, CAS=117.25[kts], PITCH=2,3[DEG],
08:57:47 – reversers engaged, CAS=107,75[kts],
08:58:01 – reverser of engine #2 disengaged, CAS=55,75[kts],
08:58:02 – reverser of engine #1 disengaged, CAS=58,75[kts],
08:58:17 – vacating of RWY27,
09:07:01 – taxiing to a parking stand, engines shutdown.



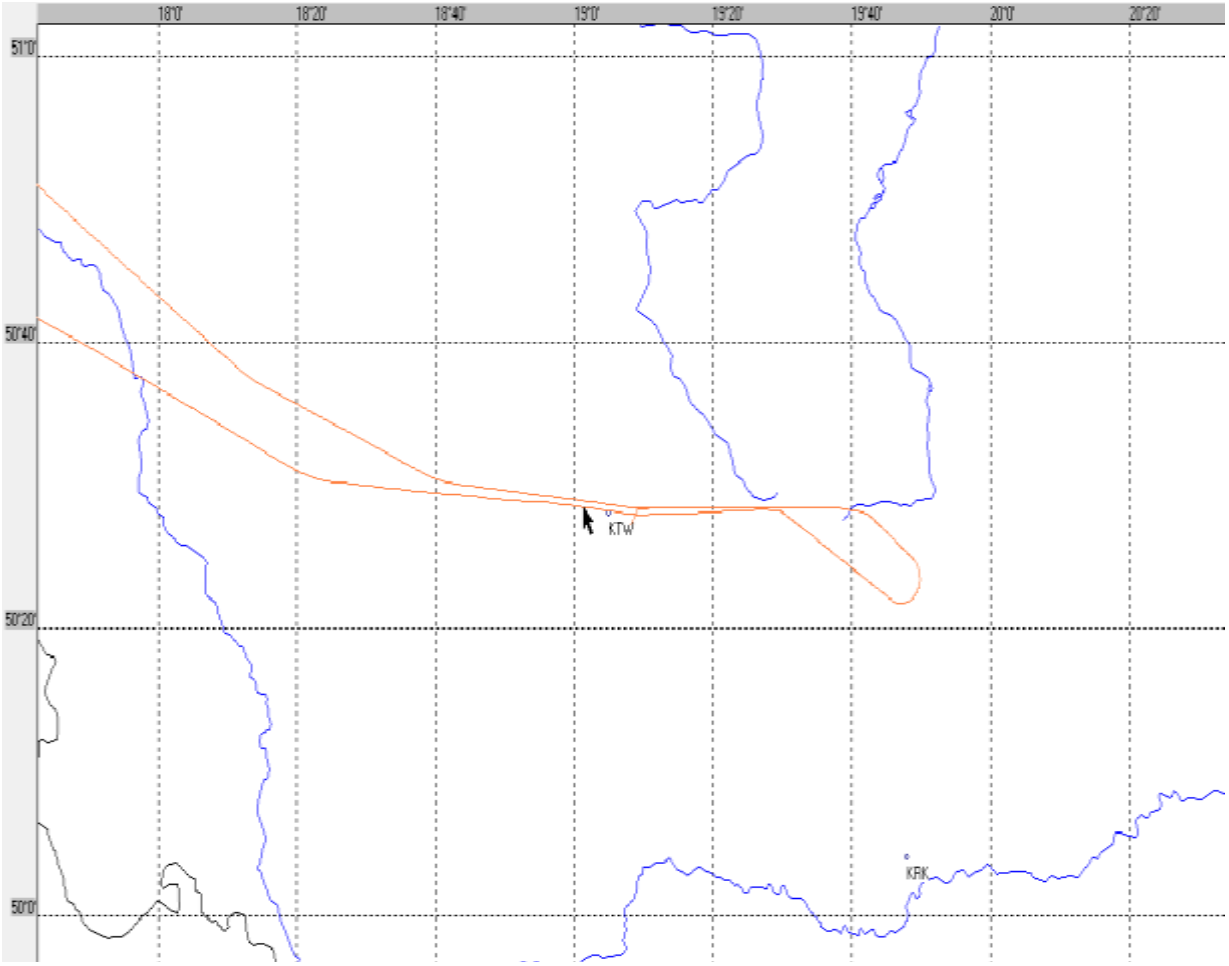
Approach to landing from WQAR record

CAS	127.75	COMPUTED AIRSPEED
FLAPPOS_L	40.7	T.E. FLAP POSN-LEFT
RALT	247	RADIO HEIGHT
SELECT N12	81.38	SELECTED N1 INDICATED #2

1: A/T ENGAGE	0	A/T ENGAGE
2: AIR/GRND	1	AIR/GROUND
3: GEAR_D_L	0	LEFT GEAR DOWN
4: GPWC_GW	1	GPWS WARNING
5: GPWC_PU	1	PULL UP
6: GPWC_T	0	TERRAIN
7: GPWC_TLT	0	TOO LOW TERRAIN
8: GPWC_TW	1	TERRAIN WARNING

1: A/T ENGAGE	1	A/T ENGAGE
2: AIR/GRND	1	AIR/GROUND
3: GEAR_D_L	0	LEFT GEAR DOWN
4: GPWC_GA	0	GPWS ALERT
5: GPWC_GS	0	GLIDESLOPE
6: GPWC_TLT	0	TOO LOW TERRAIN
7: GPWC_TW	0	TERRAIN WARNING
8: T/R FULL 1	0	T/R FULL DEPLOY #1
9: T/R FULL 2	0	T/R FULL DEPLOY #2
10: T/R INTRA1	0	T/R INTRANSIT #1
11: T/R INTRA2	0	T/R INTRANSIT #2

Description of flight parameters mnemonics of B737-8AS



EI-DPO approach on the map.

ATC work

If there is a need to land on an alternate runway this change should be communicated to the flight crew with care in the form of proposal, without even the shadow of an order, request or recommendation. The reason for it is that the flight crew is usually mentally and procedurally prepared for the originally planned approach. Pilots usually even a request or suggestion of the controller treat as a necessary condition of appropriate cooperation ATC - PILOT.

In the name of good cooperation the pilots accept this kind of ATC proposal, even at the cost of their workload increased. Therefore, alternative solutions must be proposed with great care, especially in the situations where it may expose the flight crew to work in the deficit of time.

Controllers have no experience in observation of terrain from the aircraft flight deck and there are no recommendations in the ICAO documents concerning runway lighting in specific local conditions. This situation should result in incorporation into "Operating Instructions" of the Airport Control Authorities regulations about obligatory

switching on the runway lights during visual approaches and informing flight crews accordingly.

In the process of theoretical preparation and practical on-job training, it is necessary to take into account the specificities of visual approach (especially in the case of poor navigation aids) and the principles of the runways lighting operations, which may be crucial for the rapid establishment of the visual contact with runway by the flight crew.

It is recommended, as it was practiced in the past, to incorporate into training programs for air traffic controllers, in consultation with the airlines, so-called "familiarization flights" allowing the controllers better understanding of pilot work and develop the proper level of cooperation.

Aerodrome infrastructure.

A factor which could influence the occurrence of this event was poor infrastructure of radio- navigation aids at EPKT aerodrome. There was only visual system PAPI 3° and a simplified approach lighting system („cross" with axis length of 420m and a bar 300m from THR) on the approach to runway 09.

In the area of EPKT aerodrome NDB navigational aid and ILS CAT I only at the direction of 27 had been installed. On the day of occurrence there was no navigational aid allowing determination of distance (e.g. DME).

- Given the number of air operations in passenger and cargo traffic at EPKT aerodrome, it is recommended to expand infrastructure by installing radio-navigation aids allowing determination of distance and bearing, such as VOR, more universal and more accurate than NDB. Due to the reliability, simplicity and popularity throughout the world, VOR is still the basic radio-navigation system for medium and short range navigation. Combination of VOR with DME would enable to develop a procedure for non-precision approach to runway 09.**2.2.**

Evacuation action

Not applicable.

3.CONCLUSIONS

3.1. Commission findings

1. Pilots of the airplane had the required qualifications and authorization to perform the air activities.
2. The airplane was controlled by the flight crew.

3. The aircraft had a valid certificate of airworthiness.
4. It is probable that CRM was not adequate during approach.
5. Inadequate CRM probably contributed in a lack of information exchange regarding the actions of the Pilot Flying and inappropriate monitoring of his actions by the Pilot Monitoring.
6. Due to lack of the cockpit voice recording (CVR), the Commission was not able to determine how the flight crew cooperation (CRM) was actually implemented during the approach.
7. The crew did not inform the air traffic services that the reason of the Go Around was the warning generated by EGPWS system.
8. Two-way radio communication was maintained between the flight crew and air traffic controllers.
9. During the occurrence all equipment supporting the flow of air traffic were turned on and functioning.
10. Air traffic controllers did not enter into their shift report any information about Go Around because they did not know its cause and assumed that it was a normal procedure.
11. Controllers had the required qualifications and authorization to perform the air activities.
12. Lack of VOR/DME navigation aid at EPKT aerodrome.

3.2. Causes of the serious air incident:

1. Probably inadequate monitoring of FMS indications.
2. Probably inadequate CRM by the flight crew in the cockpit.
3. Continuation by the crew of the approach procedure without visual contact with the runway evironment.

Contributing factor:

Poor radionavigation aids infrastructure on approach to runway 09 at EPKT aerodrome.

4. Safety recommendations:

<u>Air operator</u>

1. Examine the probable inadequate CRM within the flight crew with regard to the high diversity of flight experience.
2. Examine the proficiency of the involved flight crew concerning approach procedures.

Polish Air Navigation Services Agency/Management of EPKT aerodrome

3. Consider development of EPKT aerodrome infrastructure by installing VOR.
4. In the process of theoretical preparation and practical on-job training for ATC personnel, focus their attention on specificities of a visual approach, especially in the case of poor navigation aids, and the principles of the runway lighting operations.

END OF THE REPORT

Investigator-in-Charge

Signature illegible

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