

# Introduction

Safe landing is based on three information the pilots have to receive from:

1. Flight controllers commands
2. Indications of NDB (Non-directional radio beacon) signals
3. GPS system

This presentation is based on analyse of information coming from these sources, in relation to awareness of the crew about the place of a plane during landing.

**From the command: “10 km before runway threshold” until the  
command: “2 km before runway threshold”  
Preliminary data**

Before we start our analysis, let me present few important facts related

**Wind speed:** 10 m/s S-E (120) at the approaching direction E-W (259)

**Automat** (autopilot) keeping reduced speed of the aircraft was switched off at 08:34:22 a.m. 3 minutes before time schedule embraced by analysed transcripts (according to published MAK and Polish government files)

08:34:21,5	Major Protasiuk	Automat
08:34:22,6	on-board technician	I automat switched off

**Last speed reduction** took place just before reaching the beginning of the approach

08:38:37,2	II pilot	I reduce 300
08:38:49,2	II pilot	I flaps 36, We have 2-8-0 (280 km/h)

Autopilot keeps reduced speed. Possible changes: +/- 10 km/h . In this we have to assume that **speed of the aircraft was equal to: 80 m/s (288 km/h)**

**From the command: “10 km before runway threshold” until the command: “2 km before runway threshold”**  
**Option from stenographic record, published by MAK and the Polish government)**

**From the command: “10 km before runway threshold” until the command: “8 km before runway threshold”**

08:39:08,7 Controller 101-st, distance 10, start of the approach  
*(all times in accordance with MAK and Polish government files)*

08:39:30,1 Controller 8 on the course and on the approach lane .(distance 8km)  
Speed between points: 288 km/h (80 m/s)  
Time (between commands “10” and “8”) : 21.4s  
Distance(speed by time) : 1712m

**Factual distance of the aircraft from the runway threshold at the time when command: “8” was delivered was approx. 8288 m**

## From the command “8 km” until the command “6 km”

08:39:30,1 Controller 8 on the course and on the approach lane.  
(distance 8 km)

08:39:49,9 Controller Approaching the outer, on the course and on the approach lane, distance 6 (*at the same time NDB marker signal 6,324km*)

08:39:50,2 Sound signal, F=845Hz. Outer marker.

Speed between points: 288 km/h (80 m/s)

Time (between commands “8” and “6”): 19.8

Distance(speed by time):1584m

**Factual distance of the aircraft from the runway threshold at the time when command: “6” was delivered and from the NDB outer marker signal (6.324 km) was approx. 6704 meters.**

## NDB outer (6.324 m) marker signal – confirmation of misleading the approach parameters

The outer marker signal (6,324 km in accordance to satellite photos)

- signal of NDB marker lasts for 8 sec.
  - moment of overflying above the marker is the middle of the signal lasting (signal has a shape of upside-town turned cone)
  - 8 of flight equals to 640 metres in distance (8 x 80 m/s)
- Sound signal should have started 320 metres before and 320 metres after the NDB marker.

What can be also transfer this information into the distances before the runway threshold.

- Sound signal should have started 6.65 km from the runway threshold.
- Sound signal should have ended 6 km from the runway threshold.

Transcripts provide us with the information that NDB marker signal started 0.3 sec after the command of airport controller. It means that controller reported misleading distance, what is confirmed by the NDB marker signal timing.

Error at this time is approx. 700 metres, what is confirmed precisely confirmed by the sound of NDB marker signal. At the same time when controller starts giving command “6 km on the course and on the approach lane” the aircraft factual position was 6.7 km from the runway threshold and 0.2 sec later (25 metres distance) At the start of the marker signal 6.65 from the runaway threshold.

**CONCLUSION:** Analysis of the commands about positioning of the aircraft starting from 10 km distance from the runaway threshold shows that command “6 km” was delivered 6.7 km from the runaway threshold.

# From command “6 km” until command “4 km”

08:39:49,9 Controller      Approaching to the outer one, on the course and on the approach lane, distance 6

08:40:13,5 Controller      4 on the course and on the approach lane. (4km)

Speed between points: 288 km/h (80 m/s)

Time (between commands “6” and “4”): 23.6

Distance(speed by time): 1888 m

**Factual distance of the aircraft from the runway threshold at the time when command: “4” was delivered was approx. 4816 m!**

# From command “4 km” until command “3 km”

08:40:13,5 Controller 4 on the course and on the approach lane (4km)

08:40:26,6 Controller 3 on the course and on the approach lane.(3km)

Speed between points: 288 km/h (80 m/s)

Time (between commands “4” and “3”): 13.1 s.

Distance(speed by time): 1048 m

**Factual distance of the aircraft from the runway threshold at the time  
when command: “3” was delivered was approx. 3768 m!**

# From command “4 km” until command “2 km”

08:40:26,6 Controller 3 on the course and on the approach lane.(3km)  
08:40:38,7 Controller 2 on the course and on the approach lane (distance 2km)

Speed between points: 288 km/h (80 m/s)

Time (between commands “3” and “2”): 12.1 sec.

Distance(speed by time): 968 m

**Factual distance of the aircraft from the runway threshold at the time when command: “3” was delivered was approx. 2800 m.**

That was the last command ever performed by Smolensk airport flight controllers. Subsequent errors in measuring the distance from the runway threshold by the Tu-154 crew has it's source in misleading commands and might have had its consequences in later flight phases.

**After the command “2 km. On the course and on the approach lane” the crew was expected the sound of the inner NDB marker signal (located 1.05 km from runaway threshold), where they were to take decision about either landing or retracting to the second circle AFTER AROUND 10 SECONDS from the command.**

It's approx 08:40:50, (at this point the crew was approx.1.8 km from runway threshold)

**Assuming an error airport flight controller, the crew might have been expected the runaway threshold 800 meters before its factual position.**



# NDB system

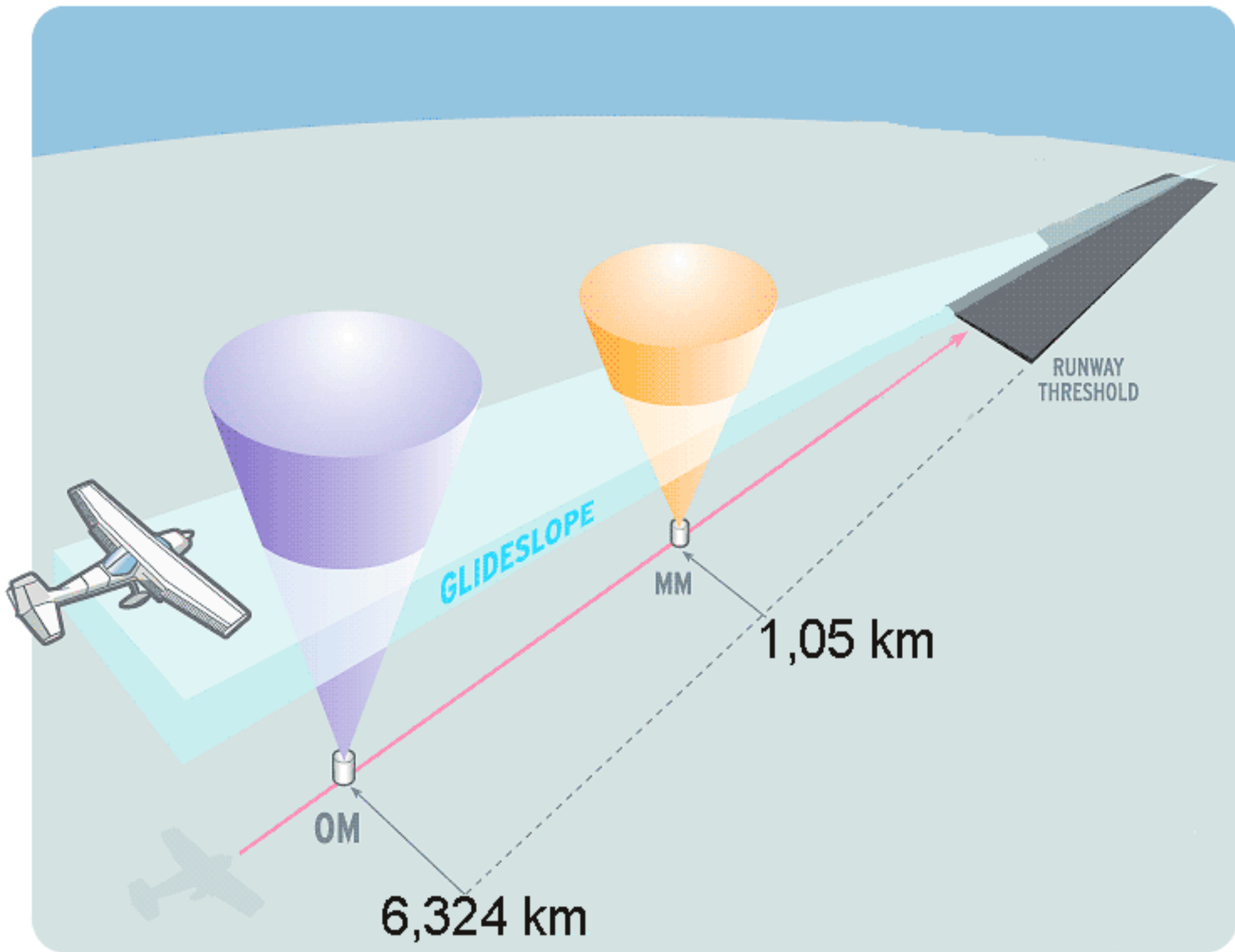
Next slide picture picture shows a plane landing using NDB system, which helps the crew to stay on a proper way and be aware of distance from the the runway.

This is fundamental for making decision about landing or refusing landing, which takes place above the closer NDB (1,1km from the runway).

The crew is informed about it by the control lamp in a plane and “beep” signal.

The time of audio signal from NDB's marker is strictly connected with the image of marker NDB, which sends this signal. It has a shape of UNTURNED CONE. His peak is touching the antenna. The higher plane is flying, the time of signal is longer and the cone - bigger.

Audio signal of NDB allows to indicate the height of a plane in a moment of flying above the marker.



**From the command: “2 km before runway threshold”  
until first contact with trees.**

This is extremely mysterious flight phase. There is a lot of contradictions between parameters of the aircraft position and its factual position, especially:

- horizontal speed of the aircraft
- descending speed of the aircraft
- switching off autopilot channels timing
- length of NDB marker signal sound

# Horizontal speed of the aircraft on the stretch between “2 km” and inner NDB marker. (1.05 km from runway threshold)

08:40:38,7 Controller 2 on the course and on the approach lane (distance 2km)

08:40:56 - 08:40:58,1 Sound signal  $F=400$  Hz, inner NDB marker) (1,05km – assuming the middle of a signal length)

**Speed between points “2km “and 1,05 km:  $52$  m/s =  $187$  km/h**

**Minimal airspeed of Tu-154m –  $225$  km/h**

# Horizontal speed of the aircraft on the stretch between “2 km” and inner NDB marker. (1.05 km from runway threshold)

From the height of 100 metres down to 90 metres = 11.1 m/s (QNH)/ 11 m/s (LRRH)

From 90 metres to 80 metres = 25.0 m/s (QNH) / 15 m/s (LRRH)

from 80 metres to 60 metres = 11 m/s (QNH) / 5.6 m/s (LRRH)

from 60 metres to 50 metres = 20 m/s (QNH) / 10 m/s (LRRH)

from 50 metres to 40 metres = 14 m/s (QNH) / 10 m/s (LRRH)

from 40 metres to 30 metres = 6 m/s (QNH) / 4 m/s (LRRH)

from 30 metres to 20 metres = 14 m/s (QNH) / 10 m/s (LRRH)

08:40:55,2-08:40:56 Navigator 20

The command of height 20 metres was the last command of the navigator. According to MAK committee 1 sec after displaying this command switching off autopilot channels was performed what confirms the start of ascent.

QNH – pressure altimeter

LRRH- low range radio altimeter

# Switching off autopilot channels timing

08:40:55,2-08:40:56 Navigator 20

According to MAK committee According to MAK committee 1 sec after displaying this command switching off autopilot channels was performed what confirms the start of ascent.

08:40:56 – 08:40:58,2 sound signal F=400 Hz, ABSU (switching off autopilot)

08:40:56-08:40:58,1 sound signal F=400 Hz, inner NDB marker

08:40:56,6-08:40:57,7 sound signal F=400 Hz, ABSU (switching off autopilot)

08:40:56,6-08:40:58,2 TAWS Pull up, Pull up

08:40:57,9-08:40:59,0 sound signal F=400Hz, ABSU switching off autopilot)

**Considering trees damage MAK committee suggests that switching off autopilot channels was performed 10 meters above ground with the speed of descending at the level of 8-10 m/s.**

**Autopilot channels used to be switched off on occasion of sudden shift to the second circle – button „TOGA switch” (Take off/Go Around switch) or rapid pulling of the steres.**

# MAK committee experiment on „Take off/Go around” procedure

In September 2010 Polish media informed that MAK committee handed on the results of experiment on simulator performed at June and July breakthrough 2010

*Among other documents handed down to colonek Klich, Polish representative to MAK, there are results of experiment performed on flight simulators on modelling Tu-154 M landing on Smolensk airport.*

*- „This experiment were performed in June or July – I cannot recall percisely the exact date. They were performed at Szeremietievo airport. There were simulations of four landing attempts, using different parametres, different conditions. While 20 metres of „Take off/Go around” probe the aircraft hit the ground” as mr Klich revealed to the press.\**

**Experiment clearly showed that „Tak off/Go around” procedure which is followed by switching off autopilot channels below the level of 20 metres above the ground, causes immediate crach to the ground.**

# Descending of the aircraft after „Go Around” command depending on the speed of descend – technical Tu-154m data.

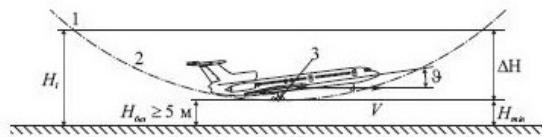


Рис. 6.9. Траектория движения самолета Ту-154М при уходе на второй круг:

1 – точка принятия решения об уходе на второй круг и дачи взлетного режима;  
2 – точка выхода двигателей на максимальный режим и начало искривления траектории; 3 – самая низкая точка траектории

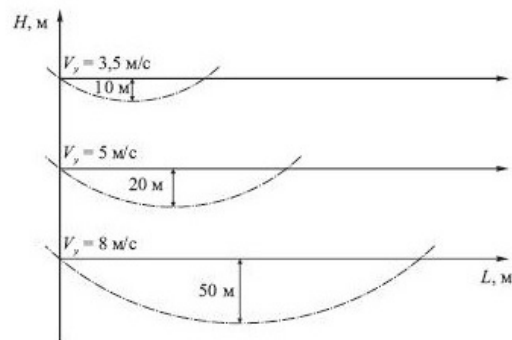


Рис. 6.10. Просадка самолета Ту-154М при уходе на второй круг

Instruction says:

- In case of ascending at the speed of 3.5 m/s after strating ascending manouvre Tu-154m descendes 10 metres before it starts to ascend.
- In case of ascending at the speed of 5 m/s after strating ascending manouvre Tu-154m descendes 20 metres before it starts to ascend.
- In case of ascending at the speed of 8 m/s m/s after strating ascending manouvre Tu-154m descendes 50 metres before it starts to ascend.

According to calculations Tu-154m should be descending at the speed of 5,5 – 6,6- m/s what should be causing, switching off autopilot channels should happen below the level of 25-30 metres above the ground.

According to MAK transcripts the aircraft was descending at the speed of 9-14 m/w, what leads to conclusion that switching off autopilot channels must not happen belof the height of 50-80 metres above the ground.

Terrain topography of the approach from the East shows that terrain ascendes 5 m/sec. To the detriment of the aircraft, and for that account minimal height fors witching off the chanelns should have been assumed higher.



# „Take off/Go around” procedure summary

MAK committee transcripts say that the crew start to rescue the aircraft while being 1.2 km distance from the airport, at the level of 10 metres above the ground.

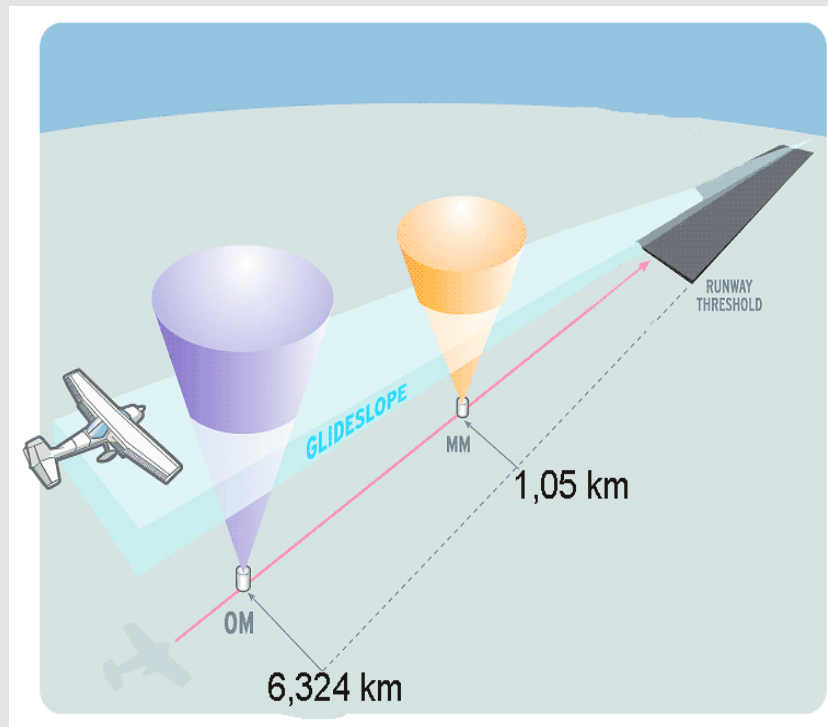
Committee suggests that the aircraft performed 6000 metres flight before colliding with the ground. Damage made by the aircraft to trees shows the aircraft ascended 20 metres up.

Experiment performed by the very same committee says, it's impossible to avoid immediate crash to the ground, if take off/Go around procedure is performed below the level of 20 metres.

**THIS INFORMATION CLEARLY CONTRADICTS**

\* Terrain ascended towards the aircraft with the speed of 5m/sec. Even if the crew switched off autopilot at the height of 20 metres they would have 2 secs for changing the direction of vertical speed from descending to ascend.

# NDB marker signals timing



This is remodelled drawing of the ILS system. This drawing explains general concept of markers used in NDB technology, which has a shape of turned upside down cone.

This shape means that the higher the aircraft is, the longer the signal lasts. At the height of antenna the signal either cannot be received or should not be lasting longer than a split of a second.

In accordance with MAK committee transcripts time of inner NDN marker lasts for 2.1 sec.

08:40:56-08:40:58,1 sound signal F=400 Hz, inner marker

This timing means that the aircraft was at the height of 80-100 metres. The aircraft was 1.7-2.0 km from the runway threshold

MAK committee suggest that the aircraft received 2.1 sec lasting signal while flying at the height of 6 metres, at the NDB marker antenna height.

# SUMMARY

Smolensk Airport Controller produced command „2 km on the course and on the approach lane” while:

- the crew was in fact 2.8 km from the runway threshold, 8000 metres farther than they were expecting

- the crew was also 40-50 m. below the approach line and controller did not inform them about this fact

- MAK committee informs that the crew was also not on the course. About this fact the crew was not informed

We should know that the crew used few different sources of information:

- Flight controller command

- NDB signal receivers indications

- GPS system indications

For to mislead the crew the error must occur in all information sources and the error should have the same range, as different indications WOULD ALARM THE CREW.

We should focus on the stage of flight starting from „2 km” command until inner marker signal, having a closer look at the command of switching off autopilot and NDB marker signal timing. We will see that this part of stenographic record could not have exist in place suggested by MAK committee.

Obvious CONTRADICTIONS are:

- Unreal timing of switching off autopilot channels

- NDB inner marker signal timing.

# The last moment of FLIGHT

It can be worth to mention that apart from „Take off/Go around” procedure autopilot channels should be also switched off at point and decision heights. In this case we could believe that it also took place misleading the crew through false information from NDB navigation system. The range of error of false signal was agreed with error from runway controllers.

System GPS, according to navigation experts, is easy to mislead. Probably, the meaconing complemented the tragedy of Polish pilots, who did not have ANY CHANCE to know about correct position of the plane, which crashed 10.04.2010 in Smolensk.

Stenographic records show that a fragment relating to switching off autopilot channels and NDB inner marker signal timing has been pasted in a different place by MAK committee.