STATE COMMISSION ON AIRCRAFT ACCIDENTS INVESTIGATION

FINAL REPORT

Serious Incident

Occurrence No: 800/12

Aircraft:

a) Saab 340, registration marks: SP-KPZ

and

b) Boeing 737-300, registration marks: OO-TNB

12 July 2012

EPWA TMA airspace

This Report is a document presenting the position of the State Commission on Aircraft Accidents 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 provisions of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (EU Journal of Laws L. 2010.295.35), the wording used in this Report may not be considered as an indication of a person guilty or responsible for the occurrence.

The Commission does not apportion blame or liability.

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 the Polish language. Other language versions may be drawn up for information purposes only.

Warsaw 2014

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Abbreviations and symbols

↑/↓	Climbing/Descending aircraft
a/c	Aircraft
ACAS	Airborne Collision Avoidance System
AMS2000+	Air Traffic Management System
AMSL	Above Mean Sea Level
APP	Approach Control Service
APW	Area Proximity Warning
B733 (TAY016G)	Boeing 737-300 airplane
CA	Collision Alert
CB	Cumulonimbus
CFMU	Central Flow Management Unit
Cleared Level	FL for which a clearance was issued
DCT	DIRECT – clearance for direct flight to indicated Waypoint
EAM2/GUI8	Guidelines on the systemic occurrence analysis methodology (SOAM)
EPMM	Mińsk Mazowiecki military aerodrome
EPSC	Szczecin-Goleniów aerodrome
EPWA	Warsaw Chopin Airport
ESARR2	EUROCONTROL Safety Regulatory Requirement: "Reporting and assessment of safety occurrences in ATM"
EUROCONTROL	European Organization for the Safety of Air Navigation
EPWA FIR	Warsaw Flight Information Region
FL	Flight Level
ft	Feet
HAND-OFF	Transfer of control over an aircraft between sectors
MATZ	Military Air Traffic Zone
NM	Nautical Mile
PANSA	Polish Air Navigation Services Agency
Pegasus_21	Polish Enhanced Generation ATM System for Unified Solutions of 21st Century
RA	Resolution Advisory
REP	Airway Navaid/Reporting Point
RCW	Radar Controller Workstation
SF34 (SNR701)	Saab 340 airplane
S/N	Signal/Noise ratio
SPi	Special Position Indicator – SQUAWK IDENT function
STCA/CAW	Short Term Collision Alert/ Collision Alert Warning
STS	Flight Status
TDB	Track data block
TMA	Terminal Control Area
TRACK	Aircraft symbol on a radar screen
UTC	Universal Coordinated Time

GENERAL INFORMATION

Category and type of aircraft :	**a) airplane, Saab 340 (SF34)** **b) airplane, Boeing 737-300 (B733)**
Aircraft registration marks:	**a) SP-KPZ** **b) OO-TNB**
Aircraft commanders :	**ATPL(A)**
Flight organizers :	**c) Sprintair S.A.** **d) TNT AIRWAYS**
Aircraft users :	**a) Sprintair S.A.** **b) TNT AIRWAYS**
Aircraft owners :	**Lack of data**
Place of occurrence :	**EPWW FIR, EPWA TMA**
Date and time of the incident :	**12 July, 2012, 20:05 hrs UTC**
Damage to the aircraft :	**No damage**
Injuries to persons :	**No injuries**

SYNOPSIS

Note: All times in the Report are expressed in UTC (LMT = UTC + 2 hours)

On 12 July 2012, at 20:05 hrs a dangerous proximity of two airplanes occurred in the airspace of EPWA TMA.

The crew of SF34 (SNR701) performing a flight from EPSC aerodrome to EPWA aerodrome and bypassing a storm cloud (CB) reported to EPWA APP and received clearance to descend to FL100 and the instruction: DCT REP LAVMO after completion of the bypassing.

After takeoff the crew of B733 (TAY016G) reported to EPWA APP and received clearance to climb to FL80. Then TAY016G was permitted to climb to FL100. Tens of seconds later

TAY016G asked for and received the clearance to fly DCT REP LOLSI due to the need to bypass a CB cloud.

STCA (CAW) between SRN701 and TAY016G was activated.

The distance between the two aircraft was about 11 NM; SRN701 passed FL110 and TAY016G passed FL79. Then SRN701 passed FL106.

Controller instructed SRN701 to climb to FL110 immediately. The airplanes were approximately 6 NM and 700 ft from each other.

At the same time the crews of both aircraft received Resolution Advisory generated by their ACASs - (SRN701 – to climb and TAY016G – to descend).

At the moment of the closest proximity the aircraft were at the lateral distance of 2,69 NM and the vertical distance of 700 feet from each other.

Investigation into the occurrence was conducted by:

MSc (Eng.) Bogdan Fydrych - Member of the State Commission on Aircraft Accidents Investigation.

In the course of the investigation the SCAAI determined the following **cause of the serious incident:**

Errors in ATM work, which led to a dangerous aircraft proximity.

After conclusion of the investigation SCAAI has formulated 10 safety recommendations.

1. FACTUAL INFORMATION

1.1 History of the flight.

Chronology of events:

1. Time: 19:50:48 hrs - SRN701 reported to EPWA APP and received clearance for descent to FL 100.
2. Time: 19:51:43 hrs – „FL110" was entered in the box: "Cleared Level" in TDB of SRN701.
3. Time: 19:58:06 hrs - SRN701 bypassing CB cloud received the instruction: DCT REP LAVMO after completion of the bypassing.
4. Time: 19:58:19 hrs - after takeoff TAY016G reported to EPWA APP Controller and received clearance for climb to FL 80.
5. Time: 19:58:56 hrs and 19:59:06 hrs – a flight crew of another airplane twice mistook REP to which received clearance (DCT DIBED), which required additional involvement of the APP Controller.

6. Time: 19:59:34 hrs - TAY016G received clearance for further climbing to FL 100. Tens of seconds later TAY016G asked for and received the clearance to fly DCT REP LOLSI due to the need to bypass a CB cloud.
7. Time: 20:01:35 hrs – STCA (CAW) between SRN701 and TAY016G was activated. The distance between the two aircraft was about 11 NM; SRN701 passed FL110 and TAY016G passed FL79. At that time other warnings were visible on APP RCW (STCA between airplanes in EPMM MATZ and HAND-OFF of KLM1369).
8. Time: 20:01:58 hrs – a crew of another (the third) airplane mistook the assigned frequency. It required repetition of the frequency by the APP Controller and listening to the readback from the crews.
9. Time: 20:02:07 hrs – a crew of another airplane which entered EPWA TMA informed about necessary deviation from an assigned route due to bypassing of CB clouds.
10. Time: 20:02:21 hrs - SRN701 passed FL106. Controller instructed SRN701 to climb to FL110 immediately. The lateral distance between the airplanes was approximately 6 NM and the vertical one approximately 700 feet.
11. At that time the SRN701crew got visual contact with TAY016G and performed the left turn to avoid a collision. At the same time the crews of both aircraft received Resolution Advisory from their ACASs: (SRN701 – to climb and TAY016G – to descend).
12. Time: 20:03:00 hrs – the airplanes bypassed each other.
13. At the moment of the closest proximity the aircraft were at the lateral distance of 2,69 NM and the vertical distance of 700 feet from each other.

1.2 Injuries to persons.

None.

1.3 Damage to aircraft.

None.

1.4 Other damage.

None.

1.5 Personnel information.

<u>EPWA APP Controller</u>

- Male, aged 48;
- 1988 - basic course for candidates for Air Traffic Controller License;
- 1990 – received Air Traffic Controller License with the ratings of EPWA aerodrome control and APP;

- 1991 – course for Controllers applying for Approach Control Surveillance rating;
- 1992 – received Approach Control Surveillance rating;
- 2009 - received certificate of airport station radio operator valid for an unlimited period;
- Valid APS/RAD EPWA operational rating;
- Aero-Medical Certificate confirming the ability to perform the duties of an Air Traffic Controller, valid until 02 August 2013;
- 02 September 2014 – expiration date of the Air Traffic Controller License;
- 13 May 2013 – expiration date of the ELPAC rating;
- 16-20 April 2012 – training on procedures for unusual and emergency situations.

1.6. Aircraft information

Both aircraft were equipped with ACAS systems in accordance with the applicable regulations.

1.7. Meteorological information.

Areas of bad weather with CB clouds were present in the vicinity of Warsaw. It required bypassing of the clouds by aircraft.

8:00 PM	16°C	13°C	82%	1011 hPa	-	SW	9.3 km/h/ 2.6 m/s	N/A		clear
	METAR EPWA 121800Z 22005KT 190V260 CAVOK 16/13 Q1011 NOSIG									
8:30 PM	16°C	13°C	82%	1011 hPa	-	SW	7.4 km/h / 2.1 m/s	N/A		clear
	METAR EPWA 121830Z 22004KT 190V250 CAVOK 16/13 Q1011 NOSIG									
9:00 PM	16°C	13°C	82%	1011 hPa	-	SSW	9.3 km/h / 2.6 m/s	N/A		clear
	METAR EPWA 121900Z 21005KT CAVOK 16/13 Q1011 NOSIG									
9:30 PM	16°C	13°C	82%	1011 hPa	-	SSW	9.3 km/h / 2.6 m/s	N/A		clear
	METAR EPWA 121930Z 21005KT 180V240 CAVOK 16/13 Q1011 NOSIG									
10:00 PM	15°C	13°C	88%	1011 hPa	-	variable	5.6 km/h / 1.5 m/s	N/A		clear
	METAR EPWA 122000Z VRB03KT CAVOK 15/13 Q1011 NOSIG									
10:30 PM	15°C	12°C	82%	1011 hPa	10.0 km	variable	5.6 km/h / 1.5 m/s	N/A	thunderstorm	little cloud cover

1.8. Aids to navigation.

Operational.

1.9. Communications.

During the occurrence the radio communication with the pilots was maintained.

1.10. Aerodrome information.

Not applicable.

1.11. Flight recorders.

The flight recorders were not read out.

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 Investigator-in-Charge analyzed the radar and audio recordings of the occurrence course and information from B733 pilot and carried out explanatory conversations with the involved APP Controller and SF34 Pilot-in-Command.

1.17. Organizational and management information.

SCAAI was notified about the occurrence on 13 July 2012 by the SF340 Pilot-in-Command via telephone and by the Polish Air Navigation Services Agency via e-mail.

1.18. Additional information.

The occurrence was categorized as a serious incident.

In accordance with the recommendations of *Annex 13 to the Convention on International Civil Aviation* and *Regulation of the European Parliament and of the Council* SCAAI notified about the occurrence ICAO, EASA, European Commission, the State of Manufacture and the State of Registry of the involved airplanes.

Based on the available evidence and the PANSA Final Report the SCAAI elaborated the Final Report according to the recommendations of Annex 13.

1.19. Useful or effective investigation techniques.

Not applied.

2. ANALYSIS

2.1. Occurrence analysis.

Two airplanes were involved in the occurrence:

- SRN701 descending to FL100 (in TDB was entered FL110) to land at EPWA;
- TAY016 climbing to FL100 after takeoff from EPWA.

Both aircraft were under control of EPWA APP. In the period of two hours preceding the occurrence the traffic volume was very high and at the time of the incident medium to high (11

aircraft in TMA). In the vicinity of Warsaw there were areas of severe weather conditions with CB clouds. It required bypassing the clouds by aircraft.

At the time of the occurrence the Controller was ending the second hour of continuous activity at his Workstation and his shift. It was the third consecutive shift preceded by one day of rest after a night shift, and the ninth working day over the last twelve days. During the two hours preceding the occurrence, the traffic volume in EPWA APP was respectively 39 and 34 operations per hour. TMA sector capacity was specified for 33 operations per hour.

Based on discussions with the Controller involved in the occurrence, analysis of the available source material and on the recommendations of Eurocontrol to ESARR 2 - EAM2/GUI8 Eurocontrol (Systemic Occurrence Analysis Methodology), as well as on general practices and models in the field of Human Factors, the context, external and organizational factors of the occurrence, as well as missing or inoperative systemic barriers were described below.

The taking off TAY016G airplane received clearance to climb to FL100, which was in accordance with the procedure practiced in EPWA TMA for years. The procedure consisted in allocation the even intermediate levels (typically 6000 ft altitude AMSL, FL80, FL100) for the departing aircraft and the odd levels (typically FL110, FL90, 7000 ft altitude) for the arriving aircraft.

In this light, the allocation of FL100 to descending SRN701 raises the question of the grounds for such a decision. In the week preceding the occurrence the involved Controller participated in ATC simulator training, introducing in EPWA TMA new rules and procedures required by the commencement of operations at the Warsaw - Modlin (EPMO) aerodrome. As part of these new rules (and thus throughout the program) a new pattern of allocation of intermediate flight levels was introduced. According to the new pattern the taking off aircraft were assigned the flight levels up to FL 90 while the descending ones down to FL100.

In addition, it must be emphasized that due to the number and extent of the changes and the short time remaining until the commencement of the air traffic services at EPMO aerodrome (less than 2 weeks), the simulator training was much more intensive than the previous ones (6 exercises per day for each participant). During this training the clearances for descent to FL 100 (and no longer FL 110) and for climb to FL 90 (and no longer to FL 100) were repeated many times, preparing APP staff to the new procedures.

The allocation of specific pairs of flight levels to provide vertical separation i.e. (↓FL110 – ↑FL100) or (↓FL100 - ↑FL90)) when both aircraft and clearances are in the hands of the same Controller (not at the boundary between sectors) is not and can not be regulated by any specific provisions, because it depends on too many variables. So the decision depends on APP Controller.

In the analyzed occurrence the clearance for SRN701 to descend to FL100 was issued in accordance with the pattern repeated many times during the above mentioned simulator training (a few seconds later another arriving airplane which reported to APP received a similar clearance).

Before entering the cleared level (for SRN701) into AMS2000+ system the Controller's attention was briefly diverted (another aircraft reported) and after approximately 40 seconds after issuance of the clearance the Controller entered "Cleared Level" according to the pattern which had been used for many years (↓FL110). Subsequent clearances were issued in accordance with this particular pattern (KLM 1369↓ FL150, SPMXI↑ FL140, TAY016G↑ FL100, KLM1369↓ FL110, LOT3826↓ FL90). Conviction about application of this pattern remained in the situational awareness of the Controller (it was confirmed by pointing out to the SRN701 pilot that he crossed the cleared flight level - FL110).

This situation is characteristic for making decisions based on different strategies (Rassmussen S(skills) R(rules) K(knowledge) model). The decision on clearance for descent to FL100 was made at the level of knowledge (K- deliberate retrieval of the training content from memory), while further decisions were based on the strategies of the lower levels (S,R - more automatic).

The transition between the levels of decision-making strategies is caused by various factors. Actions at the level of knowledge require significant cognitive resources, a retained, non-diverted attention and longer data processing necessary for reaching the decision.

At the level of rules and skills decisions are made in a more automated and faster manner. It is possible to process more data and always obtain a solution. To the contrary, on the level of knowledge incomplete resources lead to lack of a solution and return to strategies of lower levels where the solution, automatic and intuitive, is always found.

These mechanisms have been developed in the process of evolution and they are functioning in the same way for all people.

The same conclusion arises from analysis of the above decision-making processes based on 1-2 Systems of Kahneman's model.

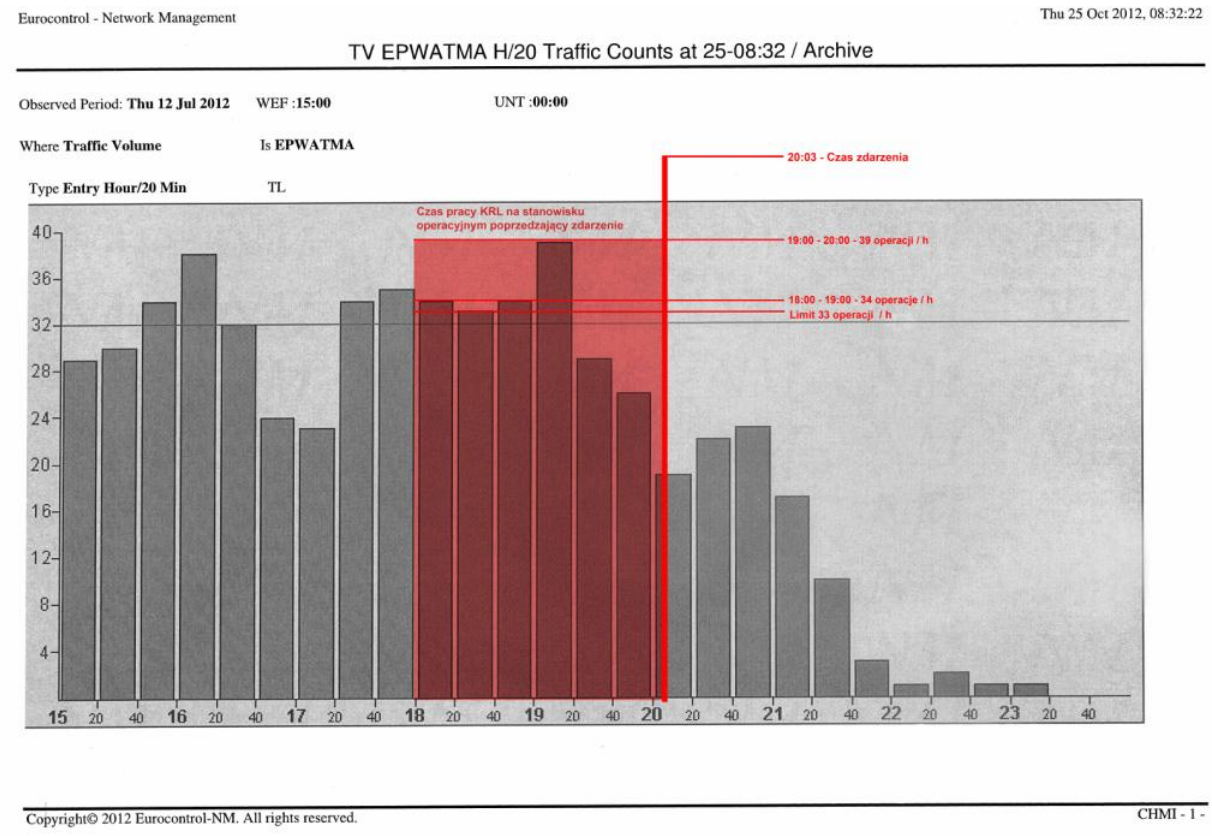
This, what causes that decisions are made more automatically (level S or R according to Rasmussen or System 1 according to Kahneman) is primarily lack of resources essential for processing information:

- Reduction of cognitive abilities (e.g. by fatigue, too long time in a state of excessive or extremely low stimulation, daily cycle decreased activity);
- Time pressure (the need to make many decisions in a short time);
- The substantial amount of information requiring selection of relevant information (low S/N ratio).

All of the above factors occurred in the analyzed situation.

Reduction of cognitive abilities

Clearance for SRN701 to descend to FL100 was issued by the Controller in the last 10 minutes of his two-hour work at his Workstation and the last minutes of his shift. During the two hours immediately preceding the occurrence the volume of air traffic in the EPWA TMA was high (39 operations in the first hour and 34 operations in the second hour). TMA sector capacity in the determined configuration was specified for 33 operations per hour (based on FMP INOP). CFMU regulations have not been applied. There was also lack of transparent criteria regulating introduction of CFMU for EPWA APP. Work in the described traffic conditions definitely contribute to acceleration of the degradation of cognitive abilities of a Controller working on his Workstation.

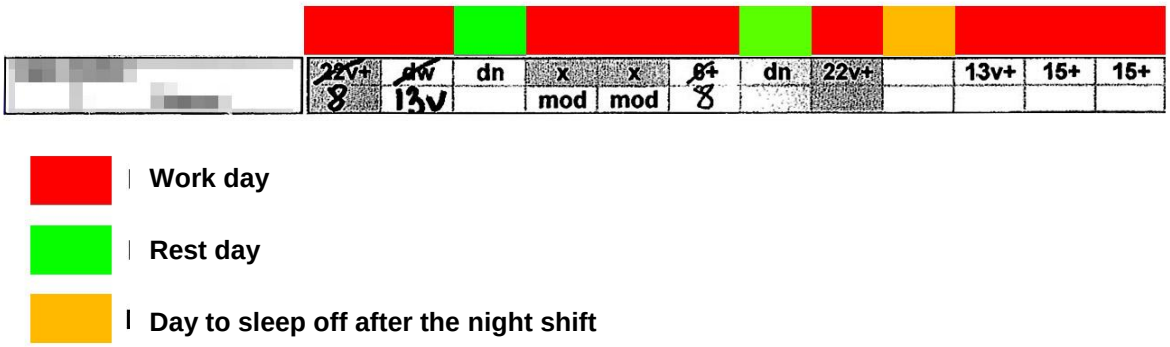


The occurrence took place on the ninth working day over the last twelve days. Since the beginning of the month the Controller had a limited time for resting and regeneration of his cognitive abilities. In the preceding days he commenced his work at different times (see the Table below); W – day off, DO – day for sleep off after the night shift.

Day	01.07	02.07	03.07	04.07	05.07	06.07	07.07	08.07	09.07	10.07	11.07	12.07
Time	8.00-15.30	13.30-21.00	W	6.00-14.00	6.00-14.00	8.00-15.30	W	22.30-6.00	DO	13.30-21.00	15.00-22.30	15.00-22.30

Prior to the sequence of shifts in which the incident took place (the third day), the Controller had a night shift from 22:30 hrs to 6:00 hrs. After that night shift the Controller had only one day off to sleep off and on that day he left his workplace after 6:00 hrs. a.m. There is no doubt that a sleepless night causes a strong circadian rhythm disorder which requires additional time to recover and stabilize the rhythm. In the analyzed situation the Controller commenced the next sequence of shifts (from 10 July 2012) without such a regeneration.

Extract from the work schedule of Warsaw APP.
Illustration of the work and the rest days in the period from 1 to 12 July 2012.



ATC simulator training which took place a few days before the occurrence was very intensive (intensity exceeding allowable level of normal operational work). Taking into account the cognitive abilities, training of new procedures in the simulator is as much demanding or even more demanding than operational work.

The above factors may have influenced the fact that at the time of the occurrence the cognitive abilities of the Controller were significantly reduced, which justifies the possibility of changing the decision-making strategies.

Organizational factors causally related to decreased cognitive abilities of the Controller, which should be noted were: the work scheduling system that allows the accumulation of many shifts in a short term, no day off after a night shift, variable shift start time, irregular schedule and simulator training intensity higher than normal.

Time pressure

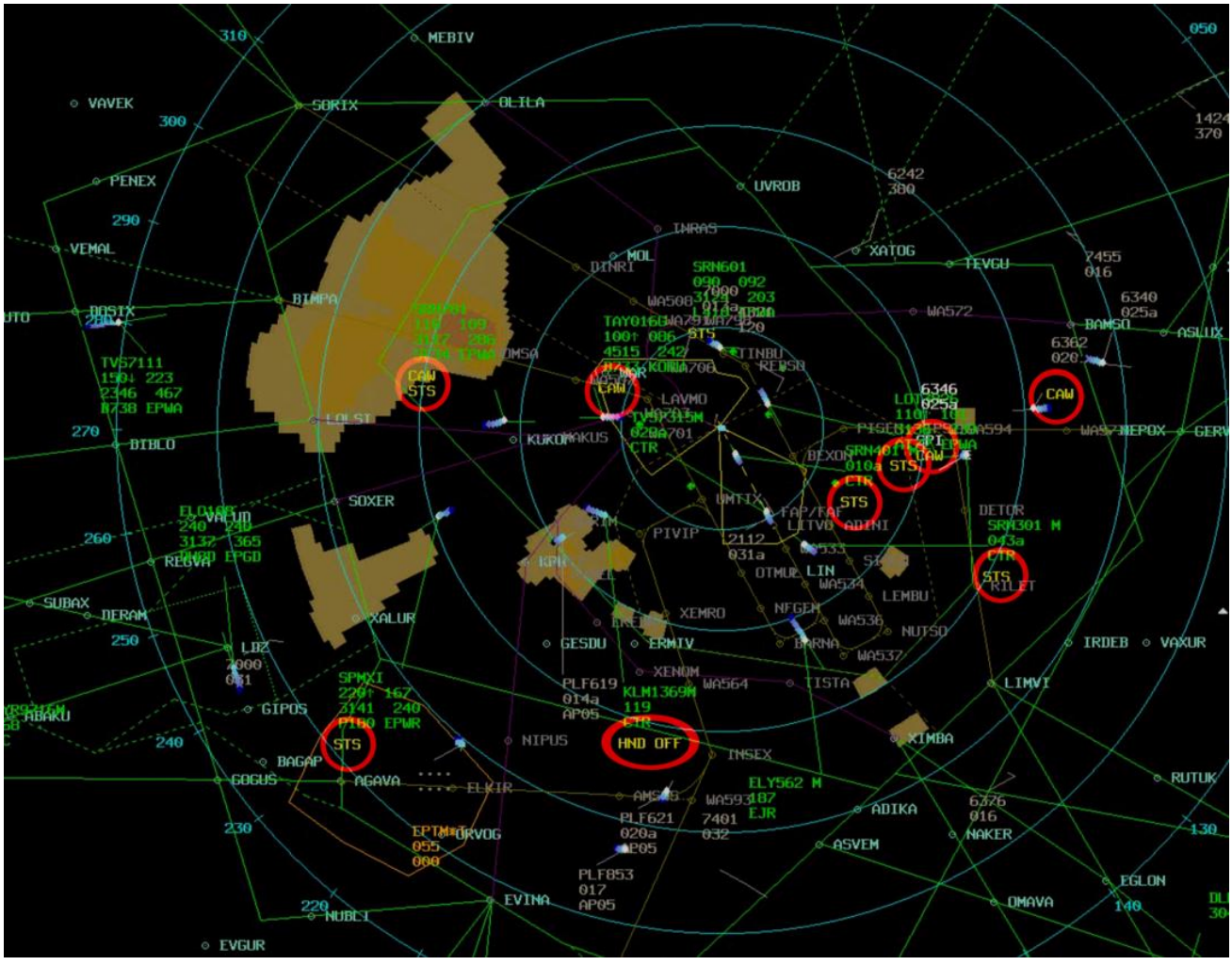
The occurrence took place in a high intensity of traffic. At that time the storm clouds were in the vicinity of Warsaw, which required bypassing them by aircraft. It resulted in the situation that none of the aircraft moving to/from the west to/from the EPWA aerodrome flew its planned route. In these cases, instead of lateral separation, which would enable easy arrangements of arrival and departure routes, aircraft performed flights directly to each other, forcing the application of vertical separation and further vertical maneuvers only after passing each other.

This situation required significantly higher attention to be paid by the Controller where usually the need for his involvement is much lower (in respect to space and phase of the flight). The time available in relation to the time required to perform each activity was also reduced by a number of repetitions caused by erroneous readback by aircrews communicating with APP Controller and simultaneous transmissions of crews of several aircraft.

Substantial amount of information

In this part separation of the relevant information from the irrelevant one (information noise) is described.

At the time immediately preceding the occurrence alerts appeared very frequently on the Controller screen. They were irrelevant to the proper operation of the Controller in his area of responsibility (except for the one concerning the analyzed proximity). For a dozen minutes such alerts were displayed on the screen. Each of these alerts was a piece of information which the Controller had to process and make a decision as to its meaning. For example, during the 10 minutes preceding the occurrence there were numerous STCAs, APWs, STSs and HAND OFFs.



Each of these warnings was visualized in a color attracting attention (yellow or red, and SPi – white flashing) which means that at the same time they diverted the Controller's attention from other elements shown on the screen.

In order to increase the safety of flight operations AMS 2000+ radar system had elements of the ground-based safety net:

- STCA (Short Term Collision Alert) designed to prevent collision between aircraft by generating, in a timely manner, warning of potential or actual breach of separation minima;
- APW (Area Proximity Warning) designed to alert the Controller when an aircraft is or is expected to enter the airspace of hazardous or prohibited areas, with limited access, and about unauthorized entrance into controlled airspace.

The role of such warnings is to draw a Controller's (or another responsible person's) attention to a probably abnormal situation requiring immediate intervention to ensure safety. Therefore, the graphical representation of activation of these systems meets the requirement of drawing of Controller's attention: the colors associated with increased vigilance and danger (yellow and red) and flashing (which greatly improves peripheral vision perception when Controller's attention is focused on another part of a radar screen). In contrast - plots and descriptions representing aircraft are shown in the green and blue colors.

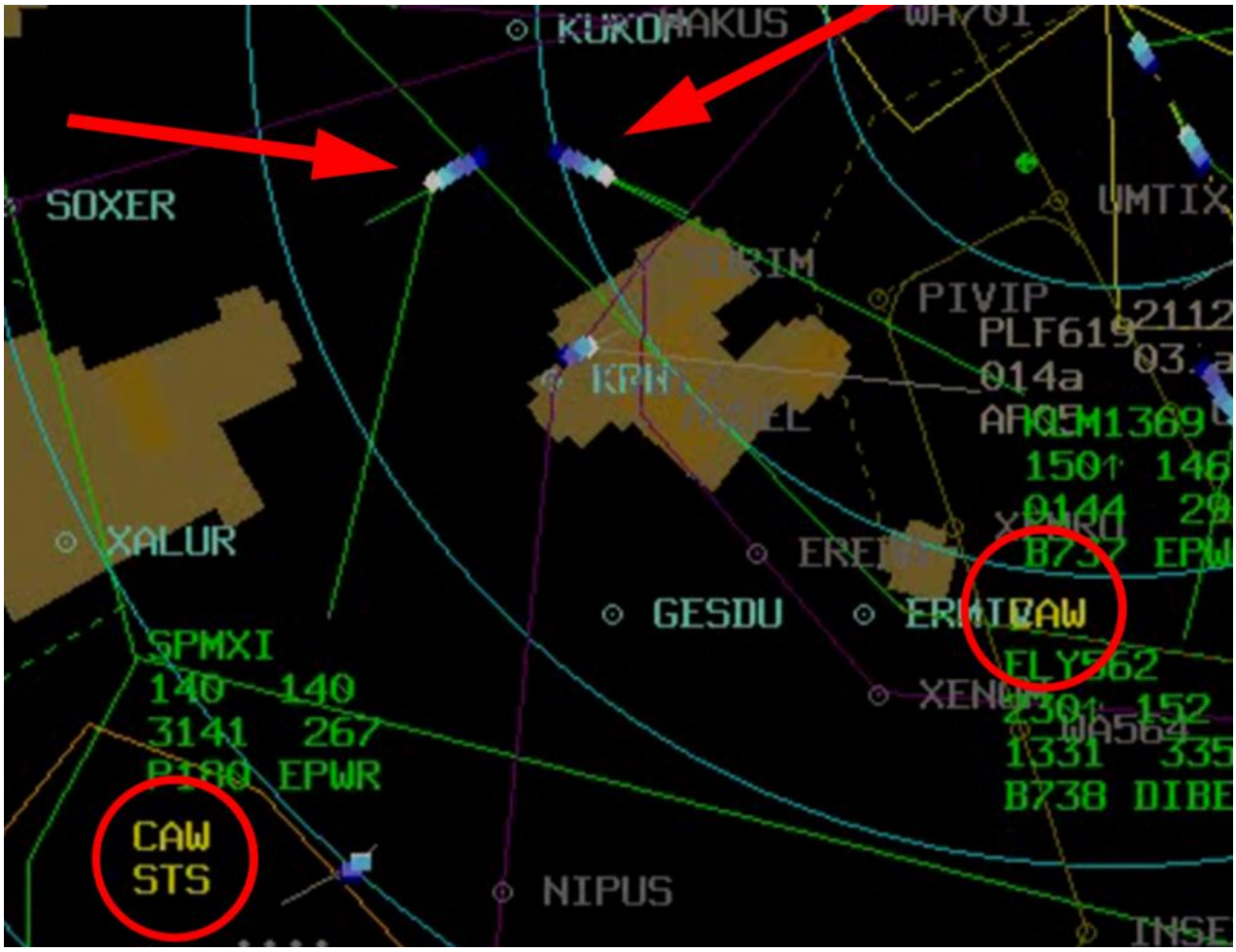
During the analyzed occurrence STCA system generated "CAW" flashing yellow, but it did not cause immediate reaction of the Controller due to other similar visual warnings appearing on his screen.

At the time of appearance of the STCA between SRN701 and TAY016G the difference in their altitudes was still 3300 ft (and SRN701 was at FL110, still in accordance with the clearance which was in the Controller's mind). The Controller's reaction occurred 51 seconds later and was based on methodical scanning of the radar screen and detection of a derogation from the expected picture of the situation.

According to the theory of signal detection, setting of parameters of activation of a warning system determines the ratio of occurrences which are not detected to false alarms. In the case of AMS2000+ STCA parameters were set in such a way that the level of detected conflicts was high, but it caused numerous false alarms.

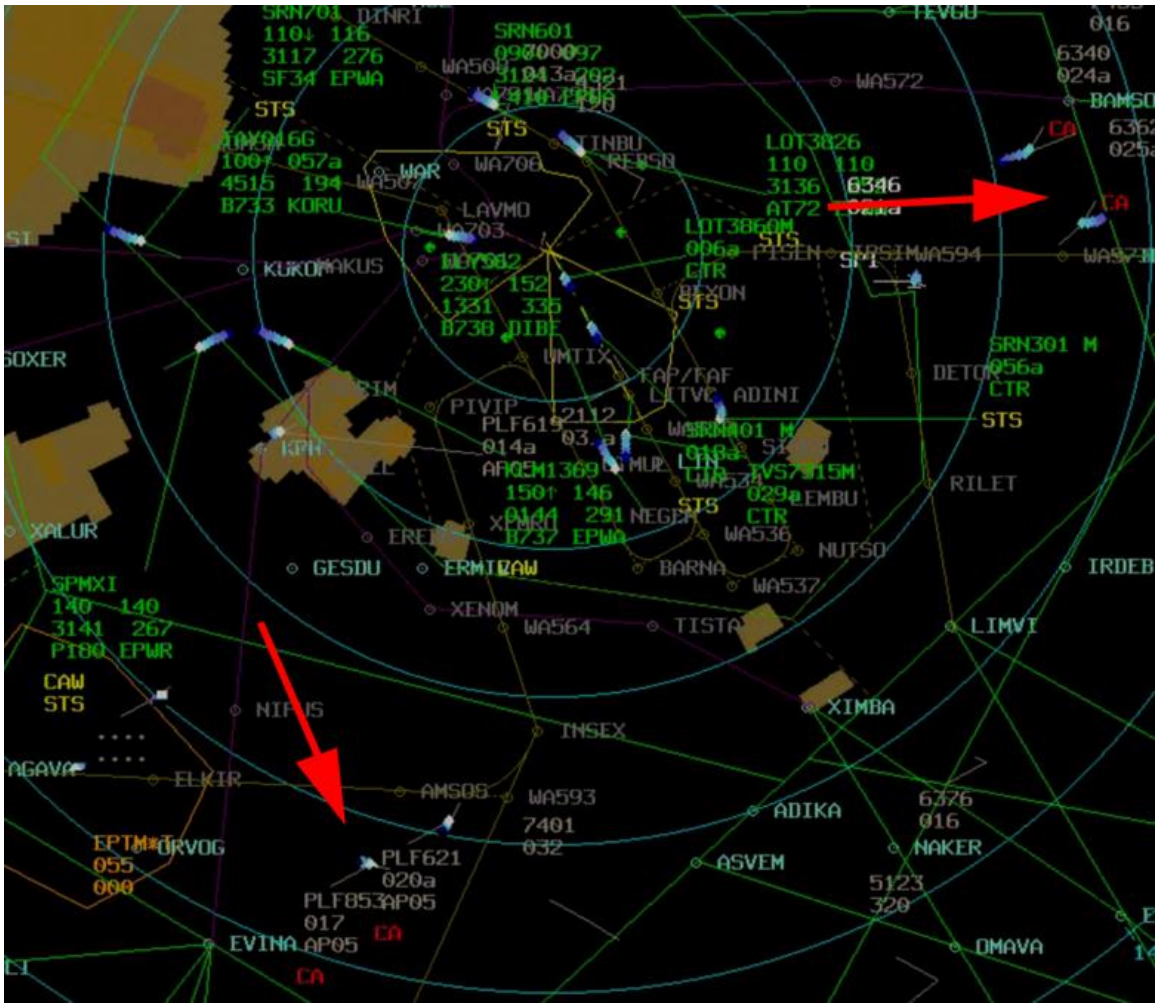
Factors increasing the number of false alarms were as follow:

1. STCA was activated in the situation when aircraft have already passed each other. This meant that a need for urgent action of a Controller did not exist any longer and was not expected. This kind of alarm only distracted Controller's attention.



2. In EPWA APP system the STCA settings were identical to the ACC system where the lateral separation is 7 NM (for APP 3NM/5 NM). This meant that the situation which was absolutely correct repeatedly activated the alarm.

3. Large portion of the STCA alert is generated in a situation where one or more aircraft are changing flight level, and only if they had not ceased the climb/descent in accordance with a received clearance, a dangerous proximity would have happened. However, there was no warning about exceeding a cleared flight level.
4. STCA has the same parameters for the airspace in which the separation between aircraft is not applied and security is ensured by visual contact. This airspace is located under the EPWA TMA, so it is shown on the entire Controller's screen. This is also a cause of numerous false alarms.
5. Similar concerns as in item 3 in relation to STCA are applicable to APW (Area Proximity Warning) system, which generates alarms in relation to aircraft in uncontrolled traffic and/or authorized to enter a particular zone. There are no procedures that require the authority controlling the traffic to/from a zone to deactivate the alarm related to a particular aircraft (APW Suppress function available in the AMS2000+ system).



A similar mechanism of adaptation of sensitivity level worked in the Controller's mind. Knowing that almost all STCA alarms had been false, he did not give them priority over other activities. In addition, the graphical representation of essential alarms (STCA, APW), which for

functional reasons should definitely distinguish them from all other information, was similar to many other pieces of information presented on the Controller's screen.

These were:

1. Flashing yellow description: "HAND OFF" - transfer of aircraft control between sectors;
2. Flashing white description: "SPi" - squaw ident - prior to the occurrence activated several times by uncontrolled aircraft (in the EPMM aerodrome area);
3. Yellow "STS" marking near to a track label, which only indicated one of many possible pieces of information contained in the flight plan (e.g. flight status HEAD, STATE, HOSP, lack of 8.33 equipment, RVSM, PRNAV, etc.). In the analyzed situation half of aircraft on the Controller's screen had such markings;

The above factors caused that the alerts in practice delayed detection of a conflict (they "desensitized" Controller).

In the analyzed case the conflict was detected 51 seconds after activation of STCA, what illustrates its "visibility" in the mass of other similar information (and similar cognitive value, taking into account the conclusions from the observation that the majority of alarms is false).

In addition, in the AMS2000+ system information about exceeding of a cleared level is depicted in the form of a small arrow added in a plot description (after a flight level information) and showing the direction of the maneuver (climb/descent) aimed at reaching the cleared level. The arrow is in the same color as the plot description (green), and does not have a warning character. The only information displayed is the change of its direction if the cleared level is exceeded more than the tolerance, i.e. +/- 300ft. Therefore, the system does not provide any form of warning about exceeding the cleared level - Level Bust.

At the moment of recognition of a conflict situation requiring immediate action, the Controller decided to order the SRN701 crew to climb immediately. The proximity of the two aircraft at this moment resulted in generation of ACAS RA for both some time later. EUROCONTROL recommendations for Controllers working with aircraft equipped with ACAS indicate maneuvers in the horizontal plane (turns) as a correct method of conflict resolution, due to a possible conflict of climb/descent instruction issued by a Controller and ACAS. In the analyzed occurrence the above mentioned conflict did not occur, but the Controller was not aware of such recommendations.

During the investigation it was found that a few years ago a panel devoted to work of Controllers "in ACAS environment" and a part of presentation of occurrences (TCAS RITA Program) were removed from Controllers' periodic refresher training. "Collision avoidance" training is not carried out during refresher training except for the normal provision of separation. Lack of such courses and simulator trainings may contribute to making late or erroneous decisions. This leads

to the situation that in the case when a cleared flight level would be exceeded a Controller who has had only minimal work experience in environment demanding an immediate, individual instruction, would be resolving a conflict situation for the first time - already as a participant of an air occurrence.

While issuing subsequent clearances the Controller used two opposite patterns of allocation of flight levels – the first, practiced for many years, and the second, rehearsed intensively on the simulator a few days earlier.

Unintentional transition between the two patterns occurred due to:

- reduction in cognitive abilities of the Controller due to work in a very intense air traffic in the preceding 2 hours;
- in the Commission opinion – (likely) fatigue caused by a number of working days with single days off and circadian rhythm disorder (irregular hours of commencing shifts and too short time of regeneration after the night shift;
- more intensive than previously practiced simulator training in the week preceding the occurrence (intensity exceeding the normal operational work intensity);
- time pressure and multitude of tasks associated with bypassing storm clouds, causing additional conflicts in the TMA, as well as the necessity of a number of repetitions due to crews errors;
- cognitive overload caused by accumulation of distracting information and false alarms: STCAs, APWs, HANDOFFs, SPis and STSs with graphical representation and colors characteristic for alarms.

Detection of the conflict by the Controller was significantly delayed by the following factors:

- large number of false STCA alarms (before and during the occurrence, as well as in everyday work) causing that the Controller could not give priority to the alerts (reduced sensory sensitivity to filter out false alarms);
- large amount of other information with the graphical representation similar to alerts, deepening the above phenomenon;
- lack of a clear Level Bust Warning system.

Lack of training in the work "in ACAS environment" and the lack of collision avoidance elements in the refresher training could have an impact on issuance of the instruction "to climb immediately" in a situation where a collision with the ACAS instruction was possible.

During investigation of this occurrence by PANSA several recommendations for modification of the AMS2000+ radar system were formulated. The Investigator-in-Charge had a conversation

with PANSA representatives on possible implementation of the above mentioned modifications. Due to lack of technical support from manufacturer of the AMS2000+ system and ongoing preparation for implementation of the P_21 Pegasus system, in which these functions were to be implemented, modification of AMS2000+ system was abandoned.

During investigation of this serious incident by SCAAI, on 14 October 2014, a dangerous proximity occurred between an airplane taking off from EPWA and an airplane executing a missed approach at Warsaw-Babice aerodrome (EPBC).

During the occurrence PEGASUS_21 did not generate the STCA due to the fact that the system was disabled to generate STCAs in EPWA TMA in the range of altitude from zero to 4000 ft inside the polygon described by the coordinates:

522154N 0205824E, 521855N 0211035E, 520944N 0211720E, 520019N 0210940E, 515755N 0205730E, 520310N 0204204E 521005N 0203843E, 521736N 0204235E.

The above coordinates define the area that corresponds to a distance of approximately 12 NM from EPWA aerodrome. The alarm was invisible only when both aircraft involved in a conflict were in the defined area at the same time.

Typical defensive barriers in aviation can be divided into three groups: technology, training and regulations. The technological defensive barriers (STCA, ACAS, MSAW and others) are usually the last barrier which most frequently prevent dangerous potential or actual air occurrences resulting from latent conditions and human errors (Human Involvement).

STCA is to help ATS staff to prevent collision of aircraft by generating, in a timely manner, warning about potential or actual breach of separation minima. Most, if not all, of the strategies reducing the impact of potential or actual safety hazards to flight operations are based on strengthening the existing defensive barriers or developing new ones.

The Commission considers that disabling STCA of PEGASUS_21 in the above described portion of airspace degraded the ground-based safety net performance.

Therefore, the Commission formulated the safety recommendation number 10 despite lack of its direct relationship with the course and the circumstances of the investigated occurrence, but affecting the safety of air operations in the area of EPWA aerodrome.

2.2. Evacuation action

Not applicable.

3. CONCLUSIONS.

3.1. Commission findings.

1. The Controller possessed the required qualifications and ratings to perform air duties.
2. In the course of the occurrence the two-way communication with the flight crews was maintained.

3. The radar system generated: "Collision Alert Warning" and later "Collision Alert".
4. The ACASs generated "ACAS RAs" which were executed by the pilots.
5. Lack of a clear Level Bust Warning system.
6. The radar system generated numerous warnings of minor operational significance, which reduced the sensitivity of the Controller to STCA in a conflict situation.
7. Lack of refresher trainings including collision avoidance in situations other than ensuring normal separation.
8. A few years ago the panel devoted to work of Controllers "in ACAS environment" was removed from their periodic refresher training.
9. During the two hours immediately preceding the occurrence the volume of air traffic in the EPWA TMA was high (39 operations in the first hour and 34 operations in the second hour). TMA sector capacity in the determined configuration was specified for 33 operations per hour (based on FMP INOP). CFMU regulations were not applied.

3.2. Cause of the serious incident:

Errors in ATM work, which led to a dangerous aircraft proximity.

Contributing factors:

1. Participation of the Controller in the simulator training much more intensive than the previous ones and containing the issuance of clearances for descent to FL 100 (and no longer to FL 110) and climb to FL 90 (and no longer to FL 100).
2. Limited time for resting and lack of regeneration of the Controller's cognitive abilities in a period longer than one day.
3. Heavy air traffic and simultaneous presence of storm clouds, which required bypassing them by aircraft. It resulted in the situation that none of the aircraft moving to/from the west to/from the EPWA aerodrome flew its planned route.
4. Exceeding sector capacity of EPWA TMA.
5. Frequent alerts in the period immediately preceding the occurrence, irrelevant to the proper operation of the Controller in his area of responsibility (except for the one concerning the analyzed proximity).

4. SAFETY RECOMMENDATIONS.

Air Navigation Services Provider

1. Restore the panel on ACAS in the refresher training for controllers.
2. Disseminate the material from this investigation describing the ACAS maneuver and the conclusions for use in controllers training.

3. Complement refresher training for controllers with a panel on collision avoidance.
4. Develop and enforce clear rules regulating CFMU for Warsaw APP.
5. Verify the provisions concerning principles of the controllers work planning so as to provide the time needed for regeneration of the Controller's cognitive abilities between the blocks of working days and allow for better matching of the duty roster to the requirements for regeneration in case of circadian rhythm disorder (increased regularity and adequate rest time after a night shift).
6. Plan for training related to operational changes in a way that do not require excessive intensity and do not affect significantly the regularity of controllers work/rest time.
7. Consider introduction of the principle that the working time during simulator training is treated in the same way and subjected to the same restrictions as during operational work.
8. Take into account Human Factors in the planning and implementation of operational changes and ATM systems with particular regard to restrictions on perception (alerts presentation and priorities, elimination of false alarms) and changes in decision-making strategies (change of flight level allocation pattern) and the impact of circadian rhythm disorder.
9. Verify whether the functions of the new Pegasus_21 system, which replaced the existing system AMS2000+ does not cause hazards similar to those described in this report as contributing factors.
10. Activate STCA of PEGASUS_21 system in the range of altitude from zero to 4000 ft at a distance of 12 NM from the EPWA aerodrome taking into account:
    - airspace classification;
    - different users of airspace;
    - Flexible Use of Airspace (FUA);
    - the applicable procedures of air navigation services, with setting the parameters of STCA which minimize false alarms.

THE END

SCAAI Investigator-in-Charge:

….....*signature on the original Report*.....