**INTERSTATE AVIATION COMMITTEE**

**AIR ACCIDENT INVESTIGATION COMMISSION**

# FINAL REPORT
# ON RESULTS OF INVESTIGATION OF ACCIDENT

| | |
|---|---|
| Type of accident | Fatal accident |
| Type of aircraft | ATR72-201 aeroplane |
| Registration | VP-BYZ, Bermudas |
| Owner | BLF Limited |
| Operator | UTAir Aviation, JSC |
| Place of accident | 1500 m from RWY 21 threshold; cross-track deviation about 400 m, Roschino aerodrome, Tyumen.<br>Coordinates: N 57°09.440′ E 065°16.000′ |
| Date and time of accident | 02.04.2012, 01:35 UTC (07:35 local time), day time |

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| μ | Friction coefficient (Ксц) |
| A/C | aircraft (ВС) |
| A/P | Autopilot |
| AAI STSC | Air Accident Investigation Scientific and Technical Support Commission |
| AAIB UK | Air Accidents Investigation Branch, United Kingdom |
| AAS | Anti-Icing Advisory System |
| AAIC | Air Accident Investigation Commission |
| ACC | Area Control Center (РДЦ) |
| AD | Aerodrome |
| ADTS | Automated Data Transfer System (АСПД) |
| AFM | Aircraft Flight Manual (РЛЭ) |
| AEA | Association of European Airlines |
| AIDS | Automated Information Data System (АИС) |
| ALT | Radio Altimeter (РВ) |
| AMC | Aviation Meteorological Center (АМЦ) |
| AMM | Aircraft Maintenance Manual (РТЭ) |
| AOA | Angle of Attack |
| AP | Airport |
| APCH | Approach |
| APU | Auxiliary Power Unit (ВСУ) |
| ARP | Aerodrome Reference Point (КТА) |
| ASL | above sea level |
| ATC | Air Traffic Control (УВД) |
| ATM | Air Traffic Management (ОрВД) |
| ATPL | Airline Transport Pilot License |
| ATT | Breaking Action Measuring Vehicle |
| ATR | Avions de Transport Régional, Joint venture, France-Italy |
| ATS | Air Traffic Service (ОВД) |
| BEA | Bureau d'Enquêtes et d'Analyses (Accident Investigation Authority of France) |
| B-RNAV | Basic Area Navigation |

| | |
|---|---|
| CA | Civil Aviation (ГА) |
| CAA | Civil Aviation Authority |
| COSPAS-SARSAT | International Satellite System for Search and Rescue |
| CG | Center of Gravity |
| CHMC | Hydrometeorology And Environmental Monitoring Center (ЦГМС) |
| CJSC | Closed Joint Stock Company (ЗАО) |
| CPL | Commercial Pilot License |
| CVR | Cockpit Voice Recorder (МС) |
| DAF | De-icing / Anti-icing Fluid |
| DFDR | Digital Flight Data Recorder |
| DH/A | Decision Height/Altitude (ВПР) |
| E | Eastern longitude |
| EIS | Entry into service |
| EMERCOM RF | Ministry of the Russian Federation for Civil Defense, Emergency Management and Natural Disasters Response (МЧС РФ) |
| ES | Engineering Staff |
| F/O | First Officer (2П) |
| FAA | Federal Aviation Administration, USA |
| FAP | Federal Aviation Rules of RF (ФАП) |
| FAP Med CA | FAP “Medical examination of flight personnel, ATC officers, flight attendants, CA schools and colleges trainees and applicants” approved by the Order No.50 of Ministry of transport of RF on 22.04.2002 (ФАП МО ГА) |
| FAP-128 | FAP-128 “Flight procedures and operations for the RF CA” approved by the Order No.128 of Ministry of transport of RF on 31.07.2009 (ФАП-128) |
| FAS | Federal Aviation Service |
| FATA | Federal Air Transport Agency (RF CAA) |
| FCOM | Flight Crew Operating Manual |
| FCTM | Flight Crew Training Manual |
| FD | Flight Director |
| FDAU | Flight Data Acquisition Unit |
| FFS | Full Flight Simulator (КТС) |
| FH | Flight Hours |
| FIR | Flight Information Region (РПИ) |
| FLTA | Forward Looking Terrain Avoidance |

| | |
|---|---|
| FME | Flight Medical Expertise (ВЛЭК) |
| FMS | Flight Management System |
| FOM | Flight Operations Manual (РПП) |
| fr. | frame (шп.) |
| FRMS | Fatigue Risk Management System |
| FSFEI | Federal State-Funded Educational Institution (ФГОУ) |
| FSFI | Federal State-Funded Institution (ФГБУ) |
| FSI | Federal State Institution (ФГУ) |
| FSUAE | Federal State Unitary Aviation Enterprise |
| FSUE | Federal State Unitary Enterprise (ФГУП) |
| FSUE “CAI” | Federal State Unitary Enterprise Centre of Aeronautical Information (FSUE “CAI”) (ЦАИ) |
| ft | feet |
| FTC | Flight Test Center (ЛИС) |
| FTLB | Flight Technical Log-Book |
| GAMC | Main Aviation Meteorological Center of ROSHYDROMET (ГАМЦ) |
| GOSNII GA | State Scientific-Research Institute of Civil Aviation (ГосНИИ ГА) |
| GPS | Global Positioning System |
| GRD | ground |
| H | height |
| HP | High Pressure (КВД) |
| hPa | hectopascals (гПа) |
| HQC | Higher Qualification Commission (ВКК) |
| $H_R$ | Radio height (Нрв) |
| HST | High Speed Taxiway (МРД) |
| $H_{ter}$ | Terrain height (Нр) |
| IAC | Interstate Aviation Committee (МАК) |
| IATA | International Air Transport Association |
| IFALPA | International Federation of Air Line Pilots Association |
| ICAO | International Civil Aviation Organization |
| illeg. | illegible |
| ILS | Instrumental Landing System |
| IMC | Instrument Meteorological Conditions (СМУ) |
| ISO | International Organization for Standardization |
| ITO AT | Interregional Territorial Office of Air Transport (МТУ ВТ) |

| | |
|---|---|
| JSC | Joint Stock Company (ОАО) |
| km/h | kilometers per hour |
| KRAMS-4 | Integrated Aerodrome Radiotechnical Weather Station (КРАМС-4) |
| kt | knots |
| LH | Left Half |
| LLC | Liability Limited Company |
| LMM | Locator middle marker (БПРМ) |
| LOM | Locator outer marker (ДПРМ) |
| LP | Low Pressure |
| Ltd | Limited Company (ООО) |
| m | meter |
| m/s | meters per second |
| MAC | Mean Aerodynamic Chord |
| mbar | millibar |
| METAR | Aerodrome Routine Meteorological Report |
| MFC | Multi Function Computer |
| MH | Magnetic Heading (МК) |
| $MH_{land}$ | MH to land ($МК_{пос}$) |
| MLS | Microwave Landing System (МВС) |
| mmhg | millimeters of mercury |
| MOE | Maintenance Organization Exposition |
| MSN | Manufacturer Serial Number |
| MSTU CA | Moscow State Technical University of Civil Aviation (МИИ ГА) |
| N | Northern Latitude (СШ) |
| N/A | Not Applicable |
| NAV | Navigation (FMS mode) |
| NM | Nautical Mile |
| NOTAM | Notice to Airmen |
| NPO | Scientific Production Association (НПО) |
| NPP | Non-profit Partnership |
| NSC | No Significant Clouds |
| NSW | No Significant Weather |
| NTERAT – 93 | Regulations on Technical Operation and Repair of Aircraft Equipment in Civil Aviation, issued 1993 (НТЭРАТ – 93) |
| NTSB | National Transportation Safety Board, USA |

| | |
|---|---|
| $N_y$ | Vertical Load Factor |
| OKVED | Russian National Classification of Economic Activities (ОКВЕД) |
| OAT | Outside Air Temperature |
| PANS-OPS | Procedures for Air Navigation Services. Aircraft Flight Operations. DOC 8168 – OPS/611 |
| PIC | Pilot-in-Command |
| PPCD | Production Planning and Control Department |
| PRAPI | Rules of Investigation of Air Accidents and Incidents for Civil Aviation, RF, 1998 |
| QAR | Quick-Access Recorder |
| QFE | Atmospheric pressure at runway threshold |
| QFI | Qualified Flight Instructor |
| QMS | Quality Management System (СМК) |
| QNH | Mean See Level Pressure |
| R/C | Rotorcraft |
| RF | Russian Federation |
| RH | Right Half |
| ROSHYDROMET | Russian Federal Service for Hydrometeorology and Environmental Monitoring (Росгидромет). |
| ROSTRANSNADZOR | Russian Federation Federal Authority for Transport Oversight (Transport Security Department) (ФСНСТ) |
| RTC and NAV | Radiotechnical Communications and Navigational Equipment Department (ЭРТОС) |
| RTOP | Radiotechnical and Navigation Operational Support (РТОП) |
| RVR | Runway Visual Range |
| RVSM | Reduced Vertical Separation Minimum |
| RWY | Runway |
| SAT | Static Air Temperature |
| SID | Standard Instrument Departure |
| SLL | Service Life Limit |
| SMM | Safety Management System |
| SMS | Safety Management System |
| SOP | Standard Operating Procedures |
| SR | Surveillance Radar (ОРЛ) |
| STAR | Standard Instrument Arrival |

| | |
|---|---|
| SW | Significant Weather (ОЯП) |
| TAF | Terminal Aerodrome Forecast |
| TAWS | Terrain Awareness and Warning System |
| TCAS | Traffic Alert Collision Avoidance System |
| TIN | Tax Identification Number |
| TL | Transition Level |
| TOW | Takeoff Weight |
| TQ | Engine Torque |
| TSB | TSB Canada |
| TWR | Aerodrome Control Tower (combined DEPARTURE and ARRIVAL) (СДП) |
| TWY | Taxiway (РД) |
| UASC | Universal Avionics Systems Corporation |
| UTC | Coordinated Universal Time |
| VHF | Very High Frequency (УКВ) |
| VMC | Visual Meteorological Conditions |
| VNAV | Vertical Navigation |
| $V_1$ | Critical engine failure recognition speed |
| $V_2$ | Takeoff safety speed |
| $V_r$ | Rotation speed |
| $V_y$ | Rate-of-Descent |
| ZAMC | Zonal Aviation Meteorological Center (ЗАМЦ) |

## Synopsis

On 02.04.2012, at 01:35 UTC[1] (07:35 local time), at day time, under VMC after the takeoff from the Roschino (Tyumen) airport RWY 21, the ATR72-201 VP-BYZ aircraft, operated by JSC "UTAir Aviation" (further referred to as "UTAir") crashed while performing the scheduled passenger flight UTA120 from Tyumen to Surgut.

According to the load sheet the A/C TOW and center of gravity were 18730 kg and 30.72 % MAC correspondingly and that was within the aircraft operation limits. Onboard there were 4 crew members (PIC, F/O and two flight attendants) and 39 passengers, all RF citizens.

After the landing gear and the flaps retraction the aircraft started descending with a significant left bank and then collided with terrain. The ground collision first led to the structural damage of left wing followed by the fuel spillage and fire, and further to the complete destruction of aircraft with the right wing, cockpit and rear section with empennage separation.

Out of the 43 persons onboard, 4 crew members and 29 passengers were killed. Others received serious injuries.

The information of the accident was received by the Interstate Aviation Committee (IAC) on 02.04.2012 at 01:57, and the initial notification was received at 05:55.

The Investigation Team was assigned by Order No.4/569-P of 02.04.2012 by the IAC Vice-Chairman – Chairman of AAIC.

In accordance with Annex 13 to the ICAO Chicago Convention (further Annex 13) Notifications were sent to BEA France (as a State of Design and Manufacturer), TSB Canada (as a State of Engine Design and Manufacturer), and to AAIB UK (as a State of Registry) as the A/C was registered in the Bermuda Islands. In accordance with Annex 13 items 4.5 and 4.6 these States assigned their Accredited Representatives and Advisors for the investigation.

Experts from the Federal Transport Agency (FATA) also took part in the investigation.

The investigation was started on 02.04.2012.

The investigation was completed on 12.07.2013.

A preliminary criminal investigation is being conducted by the Urals Investigation Directorate of the Investigative Committee of RF.

[1] Here and further unless otherwise is stated UTC time is given.

# 1. Factual Information

## 1.1. Flight history

On 01.04.2012 the the UTAir Air Division 1 crew (based at Surgut AP) was conducting a scheduled passenger flight UTA-119 on the ATR 72-201 VP-BYZ A/C from Surgut to Tyumen. The landing at Tyumen (Roschino) AP was performed at 17:41 (23:41 local time).

Descending for landing at Roschino (Tyumen) AD was conducted in extended cloudiness with icing conditions. According to the FDR records the flight crew used the aircraft ice protection system.

At the time of flight UTA-119 landing at Roschino (Tyumen) AD the weather was as follows: surface wind 090°-7 m/s, visibility 1600 m, showers of moderate snow with rain, significant cumulonimbus (5-7 oct.) clouds, fractonimbus, cloud base at 140 m, temperature + 0.2°C, dew point + 0.2°C, QFE 735 mmhg (980 hPa), friction coefficient 0.6; moderate icing at cloud layer from 140 m to 4800 m. Forecast for landing: tempo visibility 500 m, showers of heavy snow with rain, vertical visibility 90 m.

Weather at Roschino (Tyumen) AD at day time on 01.04.2012 and at night from 01.04.2012 to 02.04.2012 was formed by the cyclone trough forward part with the widespread precipitation area associated with warm front. A passage of the warm front through Roschino (Tyumen) AD was expected in the period from 20:00 to 21:00, with a temperature of 0°C and relative humidity 100% precipitations were fallen from the cumulonimbus and fractonimbus clouds in form of showers of snow with rain. Visibility in precipitations was 1200–1600 m with individual charges of heavy wet snow with visibility 600–700 m and vertical visibility 100 m. Precipitation was followed by east wind 9–10 m/s, direction 90–110°, with individual gusts up to 13–14 m/s. This direction of wind remained till 21:00. After the passage of front through the region of Roschino (Tyumen) AD, at 21:05 the surface wind changed its direction to the west 250° – 260° with gradual increase of wind speed from 2–4 m/s to 7–10 m/s.

Precipitation in the form of showers of moderate snow with rain at Roschino (Tyumen) AD went on till 22:00, 01.04.2012. From 22:00, 01.04.2012 to 01:00, 02.04.2012 precipitation turned into showers of slight snow with rain with a temperature of 0°C and relative humidity 100%.

According to the observations of weather stations situated at a distance of about 200–250 km from Roschino (Tyumen) AD and affected by the cyclone on 01.04.2012 as well as on 02.04.2012 storm detecting information was sent to the Roschino (Tyumen) AD AMC about glaze-ice accretion of wet snow.

After the landing the A/C was placed at stand 3 heading to the air terminal (MH 30°). According to the flight shift work schedule the crew left for rest to the Liner Hotel at Roschino AP and had a rest till 23:30 (05:30 local time).

After having their rest the crew members arrived to the AP and started the preflight preparation for the UTA120 scheduled passenger flight from Tyumen to Surgut with visiting AMC where at 00:15 they got weather briefing and documentation. The Nizhnevartovsk AD had been appointed as the alternate AP. At the end of the weather briefing the PIC received Form AB-11 No.1 and put his signature at the sheet of the "Log of flight crews' weather briefings at Tyumen-Roschino AMC" indicating the flight number and the A/C number.

The weather forecast and actual weather at the departure AD, destination AD and alternate AD as well as their technical conditions did not imply any hazard for the flight operation.

At 00:20 the crew passed a medical examination at the AP pre-start medical station and was cleared for the flight.

According to the intra-airport radio conversation, around the same time the PIC made his decision to fly. After the medical examination the F/O visited the aeronautical information office and received a navigator's briefcase and flight plan; which is recorded in pertinent logbooks. Further the crew continued the preflight preparation in the briefing room.

According to the load documents there were 39 passengers, 133 kg of cargo, 143 kg of passengers' luggage, and 1 kg of mail registered for the UTA120 flight. The fuel on board was 2000 kg, the A/C TOW was 18730 kg, the A/C weight balance was 30.72% mean aerodynamic chord. The TOW and weight balance were inside the AFM (FCOM) limitations.

According to an avionics technician's statements the crew arrived to the A/C around 00:30.

By the external observation video camera records it can be seen that the PIC performed the preflight inspection very briefly. He lingered for a few minutes by the right engine then moved along the fuselage sides, then stopped by the left main gear, and finally went into the cockpit.

The after-inspection FTLB entry made by the PIC was: "LC PERFORMED BY CDR", the PIC also put the time of inspection which was 00:40 and quantity of fuel 2000 kg. There were no remarks made against the A/C condition in the FTLB.

By the external observation video camera records it can be seen that at 01:13 the boarding had been completed and the entrance door was closed.

So the A/C had been remaining at the AD under the influence of precipitations in the form of rain and wet snow with ambient temperature around zero degrees Celsius and wind velocity more than 10 m/s for more than 7 hours.

There was no de/anti-icing treatment performed for the A/C before the flight.

At 01:20 the flight crew performed the engine start, after that the crew passed through the Before Taxi checklist.

At 01:24:46 the flight crew obtained clearance for holding position.

At 01:32:08 after clearance for lineup position the flight crew reported: "*Lining up".*

At 01:32:58 the A/C started taking off. The takeoff was performed with flaps extended at 15°.

The A/C lift-off occurred at 01:33:28 with a speed of around ≈127 kt.

At 01:33:56 at height 600 ft[2] and speed of 135 kt the A/P was engaged.

At 01:34:00 at height 640 ft and speed of 139 kt the flaps retraction was started.

At 01:34:08 after the retraction had been completed, at 690 ft and at a speed of 150 kt uncommanded development of right bank started. At 01:34:10 the A/P was disengaged. The bank angle reached around 40° to the right within 3 s and after that was counteracted by ailerons and rudder deflection.

Further the A/C banked to the left, which the flight crew was not able to compensate with full deflection of ailerons to the right.

The A/C collision into terrain occurred at 01:34:35 with a pitch down angle ≈11°, left bank angle ≈55° and vertical rate of descent over 20 m/s.

The ASL elevation of the accident area is about ≈110 m.

The accident resulted in the A/C full destruction and partial damage by the ground fire. From the 43 persons onboard 4 crew members and 29 passengers were killed. Others sustained serious injuries.

## 1.2. Injuries to Persons

| Injuries | Crew | Passengers | Others |
|---|---|---|---|
| Fatal | 4 | 29 | - |
| Serious | - | 10 | - |
| Minor/None | -/- | -/- | -/- |

[2] Here and further the the height measured by radio altimeter is given. Terrain elevation difference in the accident site area is not more than 10 m.

## 1.3. Damage to Aircraft

As a result of the ground collision the A/C was fully destroyed. Some of the A/C fragments have been further destroyed by the ground fire following the accident.

**Airframe**

The A/C fuselage broke into three parts:

- fuselage nose section up to fr. 21 along the right side and up to fr. 25 along the left side;

- fuselage center section from fr. 23 up to fr. 29 (fr. 22 was destroyed) along the right side and from fr. 26 up to fr. 29 (fr. 30 and 31 were destroyed and partly burned) along the left side;

- fuselage rear section from fr. 31 (right side) and fr. 32 (left side) till fr. 48.

Fuselage damage was obtained as a result of the A/C ground collision. The fuselage left side had more significant damages. Some wing attachment fittings remaining at the fuselage show that the wing separation from the fuselage occurred as a result of off-design loads' effect. At the vertical stabilizer attachment fittings there was no damage observed. The state of doors and access doors locking mechanisms shows that A/C doors were closed at the time of the accident.

The wing broke into several fragments. The largest fragment is a wing section between LH rib 13 and RH rib 13. The nature of the left and right wing tip fracture shows the effect of significant loads that resulted from the ground collision. All wing fragments were found at the accident site that there was no in-flight destruction of the wing.

The wing section between LH rib 13 and RH rib 13 shows evidence of high-temperature damage mostly at the points of the right engine mount attachment. At this point the wing top skin was totally burnt. The high-temperature damage character shows that those damage were caused by the surface fire.

No traces of ground ice-formation were observed on the outer wing sections separated on impact. There was some contamination at the fuselage nose section however it was not possible to recognize unambiguously the nature of that contamination.

No traces of ice contamination were observed at the fuselage rear section and at the vertical stabilizer at the time of their inspection. However the examination of photographs taken during the first hours after the accident revealed some snow and ice contamination residues on the horizontal stabilizer right side. The residual snow and ice contaminants are located along the front spar of the stabilizer that was the "cold accumulator" within the period of the aircraft parking that is on this area the contamination must be more abundant. (see Figure 1).


**Figure 1. Horizontal stabilizer right side with traces of snow and ice deposits**

**A/C Flight Control System**

Both pilots' control columns were torn off and sustained significant damage caused by the fuselage deformation (flattening) in the cockpit area. F/O control pedals' package with cranks, links and fittings sustained damage as well. Control pedals' kinematic linkage at PIC's side is separated into several fragments. The A/C control system linkage being routed through underfloor and ceiling portions of the cockpit is torn. The points of linkage tears are consistent with the areas of fuselage destruction.

At the central pedestal the flap control lever is set at "0", control columns lock lever is jammed in the position that is consistent with the control columns unlocked state.

Elevators were at their normal locations, elevators hinge fittings did not show any damage, kinematic linkage with trimmers was not broken. Elevator control system linkage starting from the aft pressure bulkhead up to control surfaces remained intact and did not obtain any disconnections.

LH and RH elevator uncoupling mechanism (that is needed in case of asymmetric load on the elevator parts and is located on the stabilizer) was uncoupled. The control linkage uncoupling occurred as a result of stabilizer attachment fittings' destruction. There was no evidence of either fatigue failure or corrosion observed on destroyed fittings; so the destruction was caused by the application of a single off-design load.

Elevator trim tab rods' way-outs were measured:

- LH – 42 mm;
- RH – 40 mm.

The above values meet the elevator trim tab trailing edge up deflection (nose down).

The stick pusher is at its normal location, there are no linkage uncoupling. The stick pusher rod way-out is 80 mm that corresponds to its inactivated mode.

Aileron and spoiler control system was destroyed as a result of the A/C wing and fuselage destruction. The control system elements that remained intact at the A/C wing and fuselage sections did not show any uncoupling; their breaks correspond to the structural damage obtained as a result of the A/C ground collision. The aileron trim tab actuator rod way-out is around 20 mm that meets the trim tab "0" position.

The RH spoiler was found partly destroyed but at its normal location on the wing. The LH spoiler was separated into small fragments. The spoiler system control mechanisms that survived did not show any uncoupling.

The rudder control system cable linkage being routed through the ceiling portion of the fuselage was destroyed. The rudder kinematic link at the aft part did not show any uncoupling. The rudder and the balance tab were at their normal locations, hinge fittings were not damaged. The rudder horn was not damaged. The trim tab kinematic link remained intact. The trim tab

actuator rod way-out was measured being 20 mm that corresponds to the rudder trim tab "0" position.

The LH outboard flap broke down into three fragments. A part of inboard LH flap section (near engine) survived but the rest was burned due to the ground fire. Cylinders of inboard and outboard flaps actuators cannot indicate the A/C flight configuration at the moment of the accident as they could be moved freely.

An outboard section of RH outboard flap was found. Kinematic link with associated hinge fittings together with a flap actuating mechanism as well as a part of a flap actuator fairing survived. Observation of flap actuator fairing state suggests that the RH outboard flap was retracted. The RH inboard flap was burned in the ground fire (only hinge fittings and flap actuation kinematic links survived).

Observation of the flap actuating mechanism suggests that there was no in-flight destruction of either flap actuating mechanism or the flaps. All destructions were obtained due to the A/C ground collision.

**Fuel System**

The A/C fuel tanks were fully destroyed due to the wing destruction and sequential ground fire. The fuel flowed out and burnt in sequential ground fire, so it was impossible to collect fuel samples from the fuel tanks. The remaining fuel system elements were found at their normal locations.

**Hydraulic System**

Resulting from the LH fuselage center section ground impact the hydraulic tank and pumps of both hydraulic systems installed at the fuselage LH behind fr. 27 were torn out of their mounting seats together with hinge fittings. There was no hydraulic fluid left in the hydraulic tank as a result of the hydraulic pipes destruction. The system components and pipes obtained damage as a result of the fuselage structural destruction.

Hydraulic system filter clogging indicators were in down position that indicated their normal in-flight operation. External examinations of return line hydraulic tank filter elements and of GREEN and BLUE hydraulic systems' filter stack with pressure probes testified the absence of unacceptable contamination that indicated normal operation of the hydraulic system components.

**Landing Gear**

The A/C nose landing gear is found in retracted position and locked up. On ground impact with the fuselage nose section, the nose landing gear wheels together with a shock strut piston made a 90º right turn relating to the landing gear actuating cylinder axis. All nose landing gear assemblies were secured and splint-pinned. The nose landing gear wheels' tires did not show evidence of damage or destructions sustained during takeoff.

The RH main landing gear is found in retracted position and locked up. Main landing gear kinematics does not show significant damage; actuating and shock struts are secured. There are no scuff marks that could indicate wheels' jamming or partial braking at wheels' tires during takeoff.

The LH main landing gear is found separated from the fuselage on its attachment fittings at the landing gear compartment; the attachment fittings show significant deformation as a result of strong LH frames 25 and 27 destruction. There were no scuff marks that could indicate any wheels' jamming or partial braking at wheels' tires during takeoff.

The cockpit examination determined that the landing gear control lever on the central instrument panel was in retracted position. The manual extension hand crank was not activated.

**Wing and empennage ice protection system**

Along the empennage (vertical and horizontal stabilizers) the leading edges' rubber pneumatic boot de-icers remained intact. The RH wing leading edge pneumatic boot de-icer situated between fuselage and engine is found separated from the wing. Damage of the rubber parts corresponded to the areas of structure deformations. Local thermal damage resulted from the fuel ignition as the RH engine housing was destroyed.

The LH wing leading edge pneumatic boot de-icer situated between the fuselage and engine was in the bed of the ground fire; resulting in its complete destruction.

Boot de-icers that remained on other wing sections not exposed to ground fire obtained some damage caused by the wing destruction.

Boots' pneumatic pipes are damaged at the same places where wings were damaged. The adapter tee for air supply to the RH engine anti-icing system, with its pressure indicators, was torn out of the attachment seat due to the engine destruction. The adapter tee for air supply to the LH engine anti-icing system, with its pressure indicators, was found in its normal location.

**Power plant**

**LH engine**

The on-site examination revealed that the LH engine was placed on the left side together with the engine mount; in inverted position; the inlet fairing was destroyed in three different locations. All cowl panels were absent. The cowl panel fragments were found on ground along the direction of the A/C movement. There was no evidence of the engine fire or burning.

Resulting from the ground impact the LH engine obtained the following significant damage:

- the spinner was fully crumpled; propeller blades were absent; the propeller pitch control mechanism was destroyed;

- the crankcase was cracked;

- the engine mount beam together with engine mounting attachments was destroyed as a result of off-design loads application;

- the engine exhaust system was crumpled; some attachment screws were torn off.

Turbine blades showed neither evidence of overheating or melting nor evidence of any failure. There were no punctures found on the compressor stator and turbine cases as well as on the combustor casing that would indicate uncontained engine failure.

All LP compressor rotor blades obtained damage such as nicks and slight tears in counter-rotation direction. LP compressor rotor rotated with difficulty, squeaking, as a result of compressor casing deformation obtained on impact. In the compressor inlet some earth and dirt was found. The HP rotor could not rotate because of accessory drives' jamming. The free turbine rotor rotated with difficulties as a result of its deformation on impact. The rotor blades' damage indicates that at the moment of the A/C ground collision the rotor was rotating.

It was not possible to determine the engine's operation mode by the configuration of fuel system rods because the rods had been displaced by the ground impact.

The air bleed system pipes and connections were found destroyed. The HP port air bleed valve and the LP port air bleed valve were found at their normal locations and secured. The shutters were found damaged in "closed" position.

Engine main components were found damaged with evidence of mechanical destruction.

After the field investigation the following engine components were dismounted and sent for additional examinations:

a) oil filters of: reduction gear and engine;

b) fuel filters: inlet fuel filter and fuel pump fine filter.

The visual inspection of filtering elements revealed no off-design deviations from the specifications (no significant contamination, no evidence of fuel and oil system components internal failures).

Simultaneously with filter elements removal fuel samples were collected from the fuel inlet filter bowl, as well as oil samples from the engine oil filter bowl, from the engine case, and from the oil temperature sensing unit housing.

Main results of the examination are presented in item 1.16.5.

**RH engine**

The RH engine was found separated along the reduction gear box into two fragments: the engine core and the reduction gear together with the airscrew hub. The engine core was lying on its right side and showed significant damage. There was no engine fire evidence found.

At the compressor stator and turbine cases as well as at the combustor casing there was no reach-through damage found that would indicate any uncontained engine failure.

All LP compressor rotor blades obtained damage such as nicks and slight tears in counter-rotation direction. LP compressor rotor could not rotate. In the compressor inlet some earth and dirt was found. The HP and free turbine rotor could not rotate. The LP compressor rotor blades' damage indicated that at the moment of the ground collision the rotor was rotating. Turbine blades did not show any evidence of overheating or melting or any evidence of failure. The HP port air bleed valve and the LP port air bleed valve were found at their normal locations and in closed position.

The reduction gear together with airscrew hub and two blades showed significant mechanical damage but no evidence of fire or failure. All the engine right mounting trunnion attachments were in their normal locations and secured. The engine left mounting trunnion was torn off, it was not found. The engine crankcase was broken as a result of off-design loads influence. The oil pressure sensor and oil pressure switch brackets were destroyed and separated from the engine case. The intake fuel filter casing was destroyed, the filter element was crumpled.

The engine on-site examination revealed destruction of fuel supply pipes resulting from the engine ground impact.

It was not possible to determine the engine's operation mode by the configuration of fuel system rods because the rods had been displaced by the ground impact.

The air bleed system pipelines and connections are found destroyed. The HP port air bleed valve and the LP port air bleed valve were found at their normal locations and secured. The shutters were found damaged in "closed" position.

After the field investigation the following engine components were dismounted and sent for additional examinations:

а) oil filters of: reduction gear and engine;

б) fuel filters: inlet fuel filter and fuel pump fine filter.

The visual inspection of filtering elements revealed no off-design deviations from the specifications (no significant contamination, no evidence of fuel and oil system components internal failures).

At the same time as the filter elements removal oil samples were collected from the engine oil filter bowl, from the engine case, and from oil temperature sensing unit housing.

However the engine fuel samples were not collected as the fuel had flown completely out of the destroyed components from which appropriate samples might have been collected.

Main results of the examination are presented in item 1.16.5.

**Propeller blades**

Six propeller blades were separated from the propeller heads and contained evidence of bending and destruction. Two RH propeller blades were bent and damaged as well.

The nature of blades damage (bending in counter-rotation direction) as well as the fact of their separation from the propeller heads and their location at a significant distance from the engines implied that the propellers were rotating at the moment of the ground impact.

So the nature of the fuselage and wing destruction implies that the A/C hit the ground with a left bank and a nose-down pitch.

The A/C ground impact with a left bank is confirmed by the fact that the LH wing as well as the LH fuselage section sustained more significant damage as compared to the RH, and that the LH landing gear compartment was completely destroyed. The nose-down pitch is confirmed by the complete destruction of the underfloor cockpit section and the cockpit flattening in bottom up direction as well as by specific destruction of the radome.

There were no A/C fragments found outside of the accident site. There was no A/C in-flight failure.

## 1.4. Other damage

There was no other object damage.

## 1.5. Personnel Information

### 1.5.1. Flight Crew Information

**Pilot-in-Command (PIC)**

| | |
|---|---|
| ATR 42/72 PIC | male |
| Date of birth | 03.04.1984 |
| Education | Special education – Ulyanovsk Higher Aviation School for CA, 2008, Diploma No. ВСГ 2196817, qualification – engineer-pilot, specialization “A/C operation and Air Traffic Management” |
| Pilot license | ATPL, license II П No.000734 |
| Date of issue | Issued by HQC, FAS RF on 02.11.2011 |
| Validity | Valid till 03.02.2013г. |

| | |
|---|---|
| Pilot Medical Certificate | Certificate PA No.0400183 of 03.02.2012, issued by UTAir medical flight-expert commission (Tyumen), valid till 03.02.2013 |
| Type transition training to ATR 42/72 | 06.10.2008 – 15.01.2009; Personnel Training Center, NPP (Tyumen). Certificate No. 4641 issued 15.01.2009 |
| PIC commissioning training | 30.05.2011 – 03.06.2011. Certificate No. 24222 issued 03.06.2011 by Personnel Training Center, NPP (Tyumen) |
| Authorization as PIC | Order No. 2641-л/13.00; issued 14.11.2011 |
| Weather minimum | Authorized for weather minima on ATR 42/72 A/C: DH – 60 m, RVR – 550 m, takeoff – 200 m. Verified on FFS on 10.02.2012. Examiner – UTAir QFI |
| Total flying experience | 2602 FH |
| Type experience on ATR 42/72 | 2522 FH |
| Experience as a PIC on ATR42/72 | 288 FH (ATR 42 – 53 FH; ATR 72 – 235 FH) |
| FHs within the last 3 months | 183 h 05 min |
| FHs within the last calendar month | 89 h 20 min |
| FHs within the last 3 days | 30.03.2012 – 4 h 05 min, 31.03.2012 – day off, 01.04.2012 – flight Surgut–Tyumen (Roschino) 02 h 05 min |
| FHs on the day of accident | ≈ 2 min |
| Total duty time on the day of accident | 1 h 15 min |
| Inaction period | There were no breaks in flight work.<br>Annual leave 2011: from 09.11.2011 till 16.11.2011 – 8 days.<br>Annual leave 2012: from 15.01.2012 till 03.02.2012 – 20 days.<br>Unused vacation days:<br>- from 21.07.2009 till 20.07.2010: 26 unused days;<br>- from 21.07.2010 till 20.07.2011: 51 unused day;<br>- from 21.07.2011 till 01.04.2012: 34 unused days.<br>Total: 111 unused vacation days |
| Last check of piloting and navigation skill | 18.12.2011; mark “5”. Supervisory pilot – Deputy Director of UTAir Air Division No. 1 |

| | |
|---|---|
| Simulator Training | 10-11.02.2012; FFS ATR 72 Finnair Flight Academy (Helsinki, Finland), mark "5". Summary: authorized for CAT I flights, takeoff 200 m |
| Simulator stall training | 16.12.2008 and 17.12.2008: FFT ATR 42 (Toulouse, France)<br>06.06.2009: FFS-2(72) F-137 (Toulouse, France)<br>19.12.2009: FFS-1(72) F1-002B (Helsinki, Finland)<br>12.02.2010: FFS-1(72) F1-002A (Helsinki, Finland)<br>16.08.2010: FFS-1(72) F1-002B (Helsinki, Finland)<br>14.08.2011: FFS-1(72) F1-002B (Helsinki, Finland) |
| Authorization for radio communication in English | None |
| Advanced ground training for ATR 42/72 | Certificate No. 18040 of 20.01.2011; issued by Personnel Training Center, NPP (Tyumen) |
| Dry emergency-rescue training<br>Wet emergency-rescue training | 27.10.2011; Personnel Training Center, NPP (Tyumen)<br>22.10.2010; Personnel Training Center, NPP (Tyumen) |
| Dangerous goods training | 22.09.2010; Personnel Training Center, NPP (Tyumen) |
| 2011-2012 autumn/winter period preparation | 13.09.2011; responsible person: Deputy Director of UTAir Air Division; Order No. 2641-л/13.00 of 14.11.2011 |
| 2012 spring/summer period preparation | 21.03.2012; by Deputy Director of UTAir Air Division |
| Pre-flight rest, | 01.04.2012 from 19:00 till 23:30 – 4 h 30 min; hotel "Liner", Roschino (Tyumen) AP |
| Pre-flight medical examination | on 02.04.2012 at 00 h 20 min. UTAir pre-shift medical unit at Roschino (Tyumen) AP |
| Pre-flight preparation | Before Flight UTA120 on 02.04.2012 at Roschino (Tyumen) AP led by the PIC himself |
| Accidents and incidents in the past | None |
| Insurance | ЮС No. 20/12-000186-05/10 issued 28.07.2010 |

**PIC's proficiency information**

The PIC graduated from Ulyanovsk Higher Aviation School for CA in 2008, and received a qualification as engineer-pilot with the following specialization "A/C Operations and Air Traffic Management". Number of his diploma is No.2102 series ВСГ 2196817 issued on

11.07.2008. During the study he had flown 80 FH including 48 FH on Yak-18 and 32 FH on An-26.

From 10.03.2008 till 18.07.2008 he completed training at the Aircrew Training Center of independent non-profit enterprise «Siberian Center of Resources» with specialization "Flight crew members' initial training course for international flight operations". License No. 076 of 18.07.2008.

The PIC was employed as a F/O to UTAir by General Director Deputy Order No. 2459-л/13.4.00 of 21.07.2008.

From 01.09.2008 till 13.09.2008 he completed training for ATR 42 pilots at the Personnel Training Center, NPP (Tyumen). Certificate No. 4059 issued 13.09.2008 (studying general issues: the Airline's FOM, piloting, meteorology, guidance documents).

From 06.10.2008 till 15.01.2009 he completed transition training to ATR 42 at the Personnel Training Center, NPP (Tyumen). Certificate No. 4641 issued 15.01.2009.

On 19.01.2009 by the Director of UTAir Air Division No. 1 Order No. 72-л/134a he was classified for flight training in accordance with ATR 42 Flight Personnel Training Program (UTAir FOM Part D, Attachment D-2.3).

From 19.01.2009 till 16.05.2009 as per his training task No. 136/ЛО1-09 he completed training in accordance with Flight Personnel Training Program 1 Chapter 1 (UTAir FOM Part D-2) on ATR 42 A/C with mark "Excellent" after performing 42 flights (total flight hours 105 h 35 min). Trainer: Deputy Director of UTAir Air Squadron.

***Note:*** *UTAir ATR 42 Flight Personnel Training Program 1 Chapter 1 (approved by RF Ministry of Transport ROSTRANSNADZOR Flight Oversight Department Director on 14.12.2006) stated that the minimum number of flights to accomplish Task 4 shall be 20 flights regardless of actual flight hours.*

In the time period from 21.01.2009 till 23.03.2009 he performed 4 flights as observer pilot with mark "4". Following the results of the task accomplishment it was concluded: "May be authorized for Task-4 training".

On 05.03.2009 he completed the transition training to ATR 72. Conclusion: "Task-4 flight training completed with mark "Good" . May be authorized for flight operations on ATR 72 A/C modification".

On 20.05.2009 by the Director of UTAir Air Division No. 1 Order No. 1210-л/13.4.00 the PIC was authorized for solo flights as a F/O on ATR 42/72 A/C with authorization to ICAO CAT I takeoffs and landings within a crew.

On 29.07.2009 by the UTAir General Director Deputy – Director of Flight Operations Order No. 1931-л/13.4.00 he was authorized for the ATR 42/72 A/C preflight ground inspection.

On 13.02.2010 he passed his rating check at ATR 42 FFS for ICAO CAT II landing and takeoff minima 200 m with mark “Good” ; “May be authorized for ICAO CAT II flights as an ATR 42/72 A/C F/O”.

In period from 06.09.2010 till 10.09.2010 he completed a 34-hours initial training for flight crew members for international flights in Personnel Training Center, NPP (Tyumen). Certificate No. 13697 issued 10.09.2010.

On 19.10.2010 by the Director Deputy of Air Division No. 1, UTAir Order No. 2417л/13.00 he was authorized for flights with application of the open crew composing method considering individual experience.

From 20.10.2010 till 20.01.2011 he completed recurrent ground training for ATR 42/72 A/C pilots at the Personnel Training Center, NPP (Tyumen). Certificate No. 18040 issued 20.01.2011.

On 21.01.2011 by the Director of UTAir Air Division No. 1 Order No. 93-л/13.00 and after completion of all training as per ATR 42/72 Flying Personnel Training (UTAir FOM Part D, Attachment D-2.3) according to the training task records, he was authorized for ATR 42/72 ICAO CAT II flights within a crew.

In the period from 30.05.2011 till 03.06.2011 he completed PIC commissioning training at the Personnel Training Center, NPP. Certificate No. 24222 issued 03.06.2011.

On 27.06.2011 by the Director Deputy of Air Division No. 1, UTAir Order No. 1442-л/13.00 and after completion of ATR 42/72 Pilots Training Program (the name of program since 2009, before that it was called Flight Personnel Training Program) for advanced training he was authorized for flights on ATR 72-212A A/C.

Total flight experience by task 1.2.1 of ATR 42/72 Pilots Training Program by the 10.08.2011 was: 1567 hours at day, 507 hours at night. On 11.08.2011 he performed a qualification flight before authorization for commissioning flights as PIC with mark “Excellent” . Trainer – Director Deputy of Air Division.

***Note:*** *ATR 42/72 Pilot Training Program (approved by RF Ministry of Transport FATA Department of Flight Standards Director on 22.12.2009) Chapter 2. Task 1 stated the minimum flight experience of 1500 hours for pilots that receive training in accordance with Program 1 Variant VI.*

On 10.08.2011 as per his training task No. 2297/ЛО1-11 he completed his recurrent training for ICAO CAT II operations authorization with conclusion: “May be authorized for simulator training for ICAO CAT II operations”.

On 13.08.2011 and on 14.08.2011 as per his training tasks No. 2297-2298/ЛО1-11 he completed the left seat simulator training as PIC at FFS-1 in Finnair Flight Academy (Helsinki,

Finland) per exercises 3.1.1; 3.1.2; 3.1.3; 3.1.4; 3.1.5. During the ground training he learned and was checked for awareness of autumn and winter period preparation issues. Following the results of the training the following conclusions were made:

1. "The full-scale training in accordance with Program 3 "Recurrent training and qualification" was completed with mark "Excellent" . The authorization for ICAO CAT II operations by, takeoffs RVR 200 m, and visual approaches for landing has been verified" (with pilot-trainer).
2. "Task 1.3.2 simulator training was completed with mark "Excellent" . May be classified for line training with pilot-trainer as per exercise 1.3.3".
3. "The full-scale annual recurrent training and qualification was completed with mark "Excellent" ".

On 24.08.2011 by the Director Deputy of UTAir Air Division No. 1 Order No. 1898-л/13.00 he was classified for training to be authorized for solo flights in accordance with the ATR 42/72 Flight Personnel Training Program as PIC-trainee.

In the period from 27.08.2011 till 28.10.2011 as per his training task No. 2296/ЛО1-11 he completed line training in accordance with ATR 42/72 Flight Personnel Training Program 1 Chapter 3 Task 3. When performing Task 3 his total flight experience was 75 flights, 166 flight hours. After his completion of Task 3 the following conclusion was made: "The line training with pilot-trainer as per Task 1.3.3 was completed with mark "Excellent" . May be classified for qualification flights to be authorized for solo flights as PIC".

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 (approved by RF Ministry of Transport FATA Department of Flight Standard Director on 22.12.2009) Chapter 3 Task 3 stated the minimum flight experience of at least 50 flights but not less than 150 hours for pilots that receive training in accordance with Program 1 Variant VI.*

On 26.10.2011 he completed the qualification flights before authorization for solo flights as PIC on route Surgut-Ufa-Kazan. 2 flights, 3 h 35 min. Following the results of qualification flights the following conclusion was made: "The qualification flights as per Task 1.3.4 have been completed with mark "Excellent" . Complies with the ATR 42/72 PIC qualification minima: for landing: DH/A (MLS) 80 m, RVR 1000 m; for takeoff: visibility 400 m".

On 08.11.2011 by the UTAir General Director Deputy Order No. 258/3-л/13.00 he was assigned as PIC.

On 14.11.2011 by the Director of UTAir Air Division No. 1 Order No. 2641-л/13.00 according to the training task records and personal flight records, and to Protocol of FATA ITO AT Tyumen Regional Qualification Commission No. 32 of 31.10.2011 he was authorized for

solo flights as ATR 42/72 PIC with the following minima: landing 80x1000 m, takeoff RVR 400 m.

On 18.12.2011 the qualification check flight for PIC minima downgrading was performed on route Barnaul-Tomsk-Surgut with mark "Excellent" . Following the results of the qualification check flight the following conclusion was made: "Complies with an ATR 42/72 PIC qualification as per FOM for ICAO CAT I minima: landing 60x550 m, takeoff 200 m".

***Note:*** *The actual weather conditions at departure and arrival APs during the PIC qualification check flights were above the CAT I minima. According to UTAir command staff statements the check's objective was to assess the flight crew SOP with consideration of the earlier performed FFS landing approaches with ICAO CAT I minima.*

On 19.12.2011 by the Director Deputy of Air Division No. 1, UTAir Order No. 2927-л/13.00 according to the training task records and personal flight records (32 solo flights with the following minima: landing 80x1000 m; takeoff 400 m) he was authorized to perform solo flights as ATR 42/72 PIC with the following minima: landing 60x550 m, takeoff – RVR 200 m.

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 Chapter 3 Task 1 (approved by RF Ministry of Transport FATA Department of Flight Standards Director on 22.12.2009) establishes the minimum flight experience of at least 15 flights for ICAO CAT I minima authorization for the pilots who do not have flight experience as PIC on their previous A/C type with CAT I minima and lower.*

***Note:*** *It was not possible to determine the quantity of flights performed with the following weather minima: 80x1000 m, takeoff 400 m by his personal flight records data and task training records.*

On 10.02.2012 according to his training task No. 107/ЛО-12 he completed training in accordance with ATR 42/72 Flight Personnel Training Program 3 Chapter 1. Following the results of the training the conclusion was made: "The training in accordance with ATR 42/72 Flight Personnel Training Program 3 "Recurrent Training and Qualification" has been accomplished in full with mark "Excellent" . Authorization for CAT I flights: takeoff 200 m and visual approach has been verified". During the FFS training piloting and emergency procedures were checked with mark "Excellent" . Following the results of the check the conclusion was made: "PIC ATR 42/72 qualification is verified".

On 11.02.2012 according to his training task No. 105-106/ЛО-12 he completed training in accordance with ATR 42/72 Flight Personnel Training Program 2 Chapter 1. Following the results of the training the following conclusion was made: "The qualification check flights per

Exercise 2.1.1.4 have been accomplished with mark “Excellent” . Can be authorized for ICAO CAT II approach and landing operation. Has completed simulator check flights to be authorized for flights with RVR 200 m”.

On 11.02.2012 the PIC had a check flight for minima downgrading at FFS with mark “Excellent” ). Following the results of the check the following conclusion was made: “PIC qualification for ICAO CAT II minima: takeoff 200 m, landing 30 x 350 is verified”.

On 14.03.2012 by the Director of UTAir Air Division No. 1 Order No. 583-л/13.00 he was authorized for flights on ATR 42/72 as PIC with open crew composition.

According to the training task record No. 2647/ЛО1-11 he performed 107 flights per exercise 1.3.6.1 (self-training) of 207 h 15 min.

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 Chapter 3 Task 6 (approved by RF Ministry of Transport FATA Department of Flight Standards Director on 22.12.2009) established the minimum flight experience for flight operations with open crew composition of at least 20 flights and not less than 200 h as a PIC for pilots who are trained under the Program I Variant VI.*

**PIC’s training for operations under icing conditions and for stall recovery**

***Note:*** *In accordance with FAP-128 Item 5.84 the Operator shall authorize the flight crew members for operations only provided they have completed the Operator’s Training Program appropriative training for their flight duties execution and:*

*e) provides the follows:*

*- classroom training as well as upset, pre-stall and stall recovery training – **at least once per three years**; …*

In the period from 06.10.2008 till 15.01.2009 when completing ATR 42 Flight Personnel Advanced Training Program he studied peculiarities of operations under icing conditions.

***Note:*** *discipline 1.4. Operation procedures*
*item 1.4.1. A/C performance*
*topic No.4 Operations under icing conditions:*
*frozen deposits influence on A/C performance;*
*procedures under significant icing conditions;*
*procedures under icing conditions at different flight stages.*
*Item 1.4.3. Normal operation procedures:*
*topic 1, Preparation to Flight, provides pre-flight A/C inspection procedures and de/anti-icing A/C treatment procedures.*

On 16.12.2008 and 17.12.2008 he performed a simulator flight at near-critical AOA on the t ATR 42 FFT (Toulouse, France) in the F/O seat with mark " Good" :

deceleration in normal conditions up to shaker triggering with the following A/C configurations:

flaps and landing gear retracted, flaps 15/landing gear extended, flaps 30/landing gear extended;

one approach to stall was performed with A/P ON;

one stall is performed in icing conditions with anti-icing system OFF and Icing AOA annunciation OFF;

one stall is performed with Icing AOA ON.

From 13.12.2008 till 24.12.2008 when performing six simulator sessions in accordance with ATR 42 Flight Personnel Recurrent Training the training was performed with simulated icing conditions.

On 06.06.2009 he completed simulator training at FFS-2(72)F-137 (Toulouse, France) in the F/O seat with mark " Excellent" concerning high AOA warning triggering.

On 21.07.2009 as per his training task No. 444/ЛI01-09 he completed the ground and simulator training with mark "Good" as to A/C upset recovery.

On 19.12.2009 and 20.12.2009 he completed training at FFS-1(72)F1-002B (Helsinki, Finland) in the F/O seat with mark "Good" concerning high AOA warning annunciation.

On 12.02.2010 he completed training at FFS-1-002A (Helsinki, Finland) in the F/O seat with mark "Excellent" concerning high AOA warning annunciation.

On 16.08.2010 he completed training at FFS-1(72)F1-002B (Helsinki, Finland) from F/O seat with mark "Excellent" as to upset, pre-stall and stall recovery procedures.On 18.10.2010 within 2010-2011 autumn-winter period preparation he underwent the training under the flight personnel initial training program 'Aircraft ground de-icing/anti-icing protection' with a mark "Good"

On 14.08.2011 he completed training at FFS-1(72)F1-002B (Helsinki, Finland) in the PIC seat as to upset, pre-stall and stall recovery procedures with mark "5" (Excellent) under supervision of a pilot instructor.

On 08.09.2011 within 2011-2012 autumn-winter period preparation he underwent the training under the flight personnel annual training program 'Aircraft ground de-icing/anti-icing protection' with a mark "Good"

***Note:*** *Most of pre-stall and stall recovery training was performed during the phases*

*of approach and cruise flight at altitudes of 3000 ft. and higher.*

*ATR 42/72 Training Program 3 "Recurrent training and qualification" does not stipulate training for stall recovery during climb-out (see. Chapter 1 General provisions, items 10 and 13).*

Conclusion: Based on the documents showing the PIC's qualification proficiency in accordance with UTAir regulatory documents the PIC was allowed to perform the flight task on the ATR 72-201 A/C.

**First Officer (F/O)**

| | |
|---|---|
| F/O | male |
| Date of birth | 12.08.1988 |
| Education | Krasny Kut Flight College for CA; 2008. Diploma No. 6409 series 90 БА 0104995, issued 16.07.2008 |
| Pilot License | Class 3 CPL, license III П No. 005962 |
| Date of issue | Issued by MQC, Krasny Kut Flight College for CA on 16.07.2008 |
| Validity | Valid till 26.04.2012 |
| Pilot Medical Certificate | Certificate No. 0213202 issued by UTAir medical flight-expert commission, Surgut on 26.04.2011, valid till 26.04.2012 |
| Type transition rating to ATR 42/72 | 20.03.2009 – 03.04.2009; ATR 42 classroom transition training classes at Sabenavita Training Center (Lithuania), license No. 3113 of 06.04.2009. The classes took place in Tyumen; approval of ROSTRANSNADZOR No. 6.1.16-68 of 22.01.2008. 06.04.2009 – 21.06.2009; ATR 42 (supplementary) transition training classes; Personnel Training Center, NPP (Tyumen); certificate No. 1914 issued 21.06.2009 |
| Total flying experience | 1825 h |
| Type experience on ATR 42/72 | 1765 h (ATR 42 – 1131 h; ATR 72 – 634 h) |
| FHs within the last calendar month | 80 h |
| FHs within the last 3 days | 30.03.2012 – 4 h 05 min, 31.03.2012 – day off, 01.04.2012 – flight Surgut – Roschino; flight hours: 02 h 05 min |
| FHs on the day of accident | ≈ 2 min |

| | |
|---|---|
| Total working time on the day of accident | 1 h 15 min |
| Breaks in flights | Had no breaks in flight work.<br>Annual leaves:<br>2010: from 27.03.2010 till 14.04.2010;<br>2011: none;<br>2012: from 04.01.2012 till 11.01.2012<br>Unused vacation days:<br>- from 08.10.2009 till 07.10.2010: 46 unused days;<br>- from 08.10.2010 till 07.10.2011: 51 unused day;<br>- from 08.10.2011 till 01.04.2012: 26 unused days.<br>Total: 123 unused vacation days |
| Last check of piloting and navigation skill | 14.09.2011, mark "5". Supervisory pilot – Deputy Director of UTAir Air Division |
| Simulator Training | 13.01.2012; FFS ATR 72 Finnair Flight Academy (Helsinki, Finland), mark "5". Authorization for CAT II operations, takeoff 200 m was verified. Instructor: Deputy Director of UTAir Air Squadron |
| Authorization for radio communication in English | None |
| Advanced training | Certificate No. 153-028554 of 26.10.2011; issued by Personnel Training Center, NPP (Tyumen) |
| Dry emergency-rescue training<br>Wet emergency-rescue training | 05.12.2011; Personnel Training Center, NPP (Tyumen)<br>12.04.2011; Personnel Training Center, NPP (Tyumen) |
| Dangerous goods training | 13.04.2011; Personnel Training Center, NPP (Tyumen) |
| 2011-2012 autumn and winter period preparation | No. 2164/1-л/13.00 of 28.09.2011; UTAir |
| 2012 spring and summer period preparation | 21.03.2012 by Deputy Director of UTAir Air Division |
| Preliminary training | 21.03.2012 by Deputy Director of UTAir Air Division |
| Pre-flight rest | 01.04.2012 from 19:00 till 23:30 – 4 h 30 min; hotel "Liner", Roschino (Tyumen) AP |
| Pre-flight medical examination | on 02.04.2012 at 00 h 20 min. UTAir pre-shift medical unit at Roschino (Tyumen) AP. |
| Pre-flight briefing | Before the flight UTA120 on 02.04.2012 at Roschino (Tyumen) AP conducted by the PIC |

| | |
|---|---|
| Accidents and incidents in the past | None |
| Insurance | ЮС No.20/12-001513-05/10 issued 17.11.2010 |

**F/O's proficiency information**

The F/O graduated from Krasny Kut Flight College for CA in 2008 and was qualified as a pilot with specialization "A/C Operations". Number of his diploma was No.6409 series 90 БА 0104995 issued on 16.07.2008. During the study he made 60 FH on An-26.

On 08.10.2008 by the UTAir General Director Deputy – Director of Flight Operations Oder No. 3532-л/13.4.01 he was employed as the F/O to UTAir Air Division No.3 ATR Air Squadron 17.

From 29.10.2008 till 06.02.2009 he completed initial flight crew training course for international flight operations at Tyumen Aircrew Training Center. License No.5800 of 06.02.2009.

From 18.02.2009 till 20.03.2009 he completed flight crew English courses at Tyumen Aircrew Training Center with mark "Satisfactory" . License No.624 issued on 20.03.2009.

From 20.03.2009 till 03.04.2009 he completed classroom transition training course for ATR 42 at Sabenavita Training Center (Lithuania); license No.3113 issued on 06.04.2009. The classes were completed at Tyumen, training classes' approval is No.6.1.16-68 of 22.01.2008.

From 06.04.2009 till 21.06.2009 he completed ATR 42 (supplementary) transition training classes at Personnel Training Center, NPP (Tyumen); certificate No. 1914 of 21.06.2009. Following the results of the training the following conclusion was made: "ATR 42 transition training has been completed with mark "Good" . Manual flight operation skills need to be improved. May be authorized for operations as the ATR 42 F/O in accordance with ATR 42 Flight Personnel Training Program".

On 11.06.2009 he completed ATR 72 supplementary difference training (ATR 72 and ATR 42 differences) at Sabenavita Training Center (Lithuania); certificate No.3217 of 22.06.2009.

On 25.06.2009 by the Director of UTAir Air Division No. 3 Order he was classified for training per ATR 42/72 Flight Personnel Training Program 1.

On 18.12.2009 according to his training task No.506/ЛО1-09Т he completed simulator training in the F/O seat at FFS-1(42)F1-002A (Helsinki, Finland). Following the results of training the following conclusion was made: "Has passed the simulator training with mark "Good".

On 08.06.2010 and on 09.06.2010 according to his training tasks No.965-966/ЛО1-10 he passed simulator checks in the F/O seat at FFS with mark "Good".

On 21.06.2010 he completed exercise 1 task 2 “Line training as observer” with mark “Good” after 7 flights of 23 h 55 min total. Following the results of task accomplishment the following conclusion was made: “May be classified for exercise 2 training”.

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 (approved by RF Ministry of Transport FATA Department of Flight Standard Director on 22.12.2009) Chapter 2 Task 2 Exercise 1 establish the minimum flight experience of not less than 6 flights as an observer when trained for solo flights as a F/O (for pilots who is trained per Program 1 Variant VI).*

In the period from 22.06.2010 till 21.10.2010 he completed line training with a pilot-trainer with mark “Good” after 79 flights completion with total flight experience 151 h 15 min.

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 (approved by RF Ministry of Transport FATA Department of Flight Standard Director on 22.12.2009) Chapter 1 Task 2 Exercise 2 establishes the minimum flight experience over 50 flights with 150 h with a pilot-trainer when trained for solo flights as a F/O (for pilots who is training per Program 1 Variant VI).*

On 27.09.2010 as per his training task No.1375/ЛО1-10 he completed his ground training for international flights with mark “Excellent” . The conclusion made by the senior navigation officer was as follows: “May be classified to accomplish task 2, Line Training for International Flights”.

On 26.10.2010 he performed a qualification check flight with mark “Good” . Following the results of the qualification check flight the following conclusion was made: “Program 1 Task 5 completed. Classified for ICAO CAT I takeoff and landing operations with fixed crew composition”.

On 27.10.2010 by the Director of UTAir Air Division No. 1 Order No.2468-л/13.00 he was authorized for solo flights as an ATR 42/72 F/O with authorization for takeoff and landing operations.

From 28.07.2010 till 28.10.2010 he completed ATR 42/72 recurrent ground training at Personnel Training Center, NPP (Tyumen). Certificate No.15274 of 28.10.2010.

From 14.12.2010 till 17.12.2010 as per his training task No.1546-1547/ЛО1-10 he completed takeoff and landing training under ICAO CAT II minima: takeoff by RVR 200 m. Following the results of training the following conclusions were made: “Simulator check flights to be authorized for takeoffs under RVR 200 m as per exercise 2.1.2.4 completed with mark “Excellent” : 1) May be authorized for ICAO CAT II takeoff and landing operations (in a crew); 2) Authorized for flight operations.

On 16.12.2010 he passed checks in the F/O seat at FFS-1(72)F1-002B. Following the checks the following conclusion was made: "Full-scale training in accordance with Program 3 "Recurrent training and qualification" was completed with mark "Good" . The authorization for ICAO CAT I operations : takeoff RVR 200 m, and visual approaches has been verified".

From 17.12.2010 till 22.12.2010 he completed refresher training for flight crew members for international flights at the Personnel Training Center, NPP (Tyumen). Certificate No. 16636 issued 22.12.2010.

In the period from 24.12.2010 till 19.01.2011 in accordance with ATR 42/72 Flight Personnel Training Program 2 Chapter 1 Task 1 he performed 5 flights under ICAO CAT II conditions with a pilot-trainer with mark "Good" .

On 24.01.2011 by the Director of UTAir Air Division No. 1 Order No. 110-л/13.00 he was authorized for flights on ATR 42/72 A/C under ICAO CAT II minima as a flight crew member.

From 04.11.2010 till 27.04.2011 as per his training task No.1456/ЛО1-10 he completed training to be authorized for non-fixed crew composition. Total flight hours 310 h 15 min. Based on the training the following conclusion was made: "Has passed refresher training before being authorized for flights within non-fixed crew composition with mark "Good" . May be authorized for flights within non-fixed crew composition".

***Note:*** *ATR 42/72 Flight Personnel Training Program 1 Chapter 1 Task 4 establishes the minimum solo flight experience as a F/O of 300 hours to be authorized for flights with open crew composition (for pilots that receive training in accordance with Program 1 Variant VI).*

On 11.05.2011 by the Director of UTAir Air Division No. 1 Order No. 997-л/13.00 he was authorized for flights on ATR 42/72 with open crew composition.

From 20.05.2011 till 28.05.2011 he completed UTAir supplementary training for ATR 72-212A flights. The following conclusion was made: "Has completed training according to Task 2 with mark "Excellent" . May be authorized for ATR 72-212A flight operations".

On 31.05.2011 by the Director of UTAir Air Division No. 1 Order No.1178-л/13.00 he was authorized for flights on ATR 72-212A A/C.

On 27.06.2011 he completed training for authorization for ICAO CAT II operations.

On 27.06.2011 he passed simulator training in the F/O seat at FFS. During the training he studied the peculiarities of autumn/winter period operations. The following conclusion was made: "Has completed training in accordance with Program 3 "Recurrent training and qualification" with mark "Good" ". The authorization for ICAO CAT II operations , takeoff

RVR200 m, and visual approaches has been verified. The annual recurrent training and qualification was completed with mark “Good” ”.

From 26.07.2011 till 26.10.2011 he completed recurrent ground training (refresher training) for ATR 42/72 pilots at Personnel Training Center, NPP (Tyumen). Certificate No. 153-028554 of 26.10.2011.

On 13.01.2012 he passed FFS training. The conclusion was made: “Full-scale training in accordance with Program 3 “Recurrent training and qualification” was completed with mark “Excellent” . Authorization for ICAO CAT II minima: takeoff 200 m has been verified”.

**F/O’s training for operations under icing conditions and for stall recovery**

On 31.05.2009 under refresher training at ATR 42 FFS the F/O completed training for A/C operation when approaching stall.

On 30.05.2009 and on 04.06.2009 under the ATR 42 transition training at FFS he was trained on in-flight anti-icing system application procedures and operating procedures under in-flight icing conditions.

On 03.06.2009 during the ATR 42 transition training at FFS (Helsinki, Finland) he completed training for A/C operation when approaching stall with engines operable in all configurations; as well as flight at minimum speed up till the stick shaker actuation.

On 06.06.2009 he completed training for taxiing on contaminated TWYs.

On 07.06.2009 and 08.06.2009 during the transition training at ATR 42 FFS he completed training for A/C operation when approaching stall and recovery at high AOA.

In the period from 06.04.2009 till 25.04.2009 during the training as per the ATR 42 Flight Personnel Recurrent Training Program he studied the peculiarities of flight operations in icing conditions.

***Note:*** *Discipline 1.4. Operational Procedures,*
*Item 1.4.1. A/C performance,*
*subject No.4 Flight in icing conditions:*
*influence of ice accretion on A/C performance;*
*operating procedures under severe icing conditions;*
*procedures when flying in icing conditions at different flight stages.*
*Item 1.4.3. Normal Procedures.*
*Topic 1 Preparation for Flight provides for pre-flight inspection and A/C de-icing/anti-icing treatment training.*

On 18.12.2009 according to training task No. 506/JIO1-09T he completed training at FFS-1(42)F1-002A (Helsinki, Finland) for A/C upset, pre-stall and stall recovery.

On 04.10.2010 within 2010-2011 autumn-winter period preparation he underwent the training under the flight personnel initial training program ‘Aircraft ground de-icing/anti-icing protection’ with a mark “Good”.On 27.06.2011 according to training task No. 2181/ЛО1-11 he completed when in the F/O seat the following tasks at FFS:

A/C recovery from near-critical AOA with different wing configurations;

A/C stall recovery;

A/C upset recovery.

On 08.09.2011 within 2011-2012 autumn-winter period preparation he underwent the training under the flight personnel annual training program ‘Aircraft ground de-icing/anti-icing protection’ with a mark “Good”.Conclusion: Based on the available documents the F/O's proficiency level allowed him to perform the flight task on the ATR 72-201 A/C.

There were no deviations from the established requirements during the flight crew training and checkrides found out based on the analysis of the available flight, administrative and medical documentation. The PIC and the flight crew members’ proficiency level generally was sufficient to perform the flight in question.

### 1.5.2. Technical Personnel Information

**Head of the of the Shift No. 4 UTAir-Technic Ltd**

| | |
|---|---|
| Shift Supervisor | male |
| Date of birth | 24.02.1956 |
| Education | Irkutsk Aeronautical Technical School; 1977; Diploma ЮО No. 058184 issued 07.07.1977; specialization – aircraft maintenance technician;<br>MSTU CA; 1992; Diploma ФВ No. 034812 issued 19.02.1992; specialization – A/C and engine operation engineer |
| CA personnel license | License of Maintenance and Repair Specialist R-1 No.0038118, issued 29.11.2004 by Ob FATA ITO AT |
| Employment | Employed to UTAir-Technic Ltd; Order No. 41-л/13.4.11 of 06.05.2005. Cat. I engineer (according to Region Qualification Commission record No. 2 of 21.03.2006) |

| | |
|---|---|
| Authorization for maintenance | Authorized for line maintenance of:<br>Tu-154M, license No. 0086947, valid till 28.04.2012;<br>Tu-154B, license No. 0086947, valid till 28.04.2012;<br>Tu -134, license No. 0086404, valid till 28.04.2012;<br>An-24, license No. 0084082, valid till 28.04.2012;<br>Yak-40, license No. 0012521, valid till 28.04.2012 |
| Authorization to ATR ground handling | Authorized for ATR 42-200/300, ATR 72-100/200 A/C ground handling (corresponding notes added into the specialist license). Training and on-the-job training in the period from 12.07.2010 till 12.08.2010 at UTAir-Technic Ltd Maintenance and Overhaul Center, foreign manufactured a/c workshop, line maintenance department. UTAir-Technic Ltd Order No. 29.09.2010 of 29.09.2010 in accordance with "Instruction for ATR 42-200/300, ATR 72-100/200 A/C ground handling" (QMS company standard 328-09), which was put into effect from 11.06.2010 by the UTAir-Technic Ltd General Director Order No.ПТ-586/10 of 10.06.2010. |
| Additional Information | Since 1986 he o performed flights as an An-24 A/C flight mechanic, since 1990 – as Tu-154 A/C flight engineer. Retired from flight operations in 2003. |
| 2011-2012 autumn and winter period preparation | Done, UTAir-Technic Ltd Order to authorization No. ПТ-104 of 11.10.2011 |
| Training for A/C anti-icing operations | At UTAir-Technic Ltd Maintenance and Overhaul Center and Roschino AP Special vehicle service facilities, UTAir Ltd Order No. ПТ-1217/11 of 17.11.2011 |

**Avionics Technician of the Shift No. 4 UTAir-Technic Ltd**

| | |
|---|---|
| Avionics Technician | male |
| Date of birth | 18.03.1953 |
| Education | Arzamas Sovkhoz technical school; 1972; (Diploma No. I-953020 issued 06.03.1972; specialization – electrical technician) |

| | |
|---|---|
| CA personnel license | License of Maintenance and Repair Specialists R-1 No. 0009879; issued 19.02.1999 by ROSTRANSNADZOR Ob Department of Aviation Transport Oversight |
| Employment | Employed as a Cat. 6 Avionics Technician to UTAir-Technic Ltd; Order No. 82-л/13.4.11 of 01.06.2005 |
| Authorization for maintenance | Authorized for providing maintenance to Russian-manufactured A/C |
| Authorization for ground handling | Authorized for ATR 42-200/300, ATR 72-100/200 A/C ground handling. The authorization was issued on the basis of certificate of training and on-the-job training at UTAir-Technic Ltd Maintenance and Overhaul Center, foreign manufactured a/c workshop, line maintenance department in the period from 25.07.2011-29.07.2011. Authorized for ATR 42-200/300; ATR 72-100/200 A/C ground handling by Order No. ПТ-838/9 of 21.08.2009. According to the above order he was authorized for A/C ground handling in accordance with "Instruction for ATR 42-200/300, ATR 72-100/200 A/C ground handling" (СТП СМК 328-09), which was put into effect from 11.06.2010 by the UTAir-Technic Ltd General Director Order No.ПТ-586/10 of 10.06.2010. |
| 2011-2012 autumn and winter period preparation | Done, UTAir-Technic Ltd Order to authorization No. ПТ-104 of 11.10.2011 |
| Training for A/C anti-icing treatment | No authorization |

**Airframe and power plant technician of the Shift No. 4 UTAir-Technic Ltd**

| | |
|---|---|
| Airframe and power plant technician | male |
| Date of birth | 23.07.1965 |
| Education | Troitzk Aeronautical Technical School; 1985; Diploma ЗТ No. 075471, specialization – airframe and power plant technician |
| CA personnel license | License of Maintenance and Repair Specialist R-1 No. 0052055, issued 10.08.2004 by Ob FATA ITO AT |

| | |
|---|---|
| Employment | Employed as a Cat. 5 maintenance technician to UTAir-Technic Ltd; Order No. 804-л/38.02 of 08.09.2011 |
| Authorization for maintenance | Authorized for providing maintenance to Tu-134, Tu-154M A/C |
| Authorization for ground handling | Authorized for providing ground handling to ATR 42-200/300; ATR 72-100/200. The authorization was issued on the basis of certificate of training and on-the-job training at UTAir-Technic Ltd Maintenance and Overhaul Center, foreign manufactured a/c workshop, line maintenance department in period 06.10.2011-09.10.2011. Authorized to ATR 42-200/300; ATR 72-100/200 A/C ground handling by Order No. ПТ-1088/11 of 20.10.2011. According to the above order he was authorized to A/C ground handling in accordance with "Instruction for ATR 42-200/300, ATR 72-100/200 A/C ground handling" (СТП СМК 328-09) that had been implemented by the UTAir-Technic General Director Order No.ПТ-586/10 issued 10.06.2010. |
| 2011-2012 autumn and winter period preparation | Done, UTAir-Technic Ltd Order for authorization No. ПТ-104 of 11.10.2011 |
| Training for A/C anti-icing treatment | No authorization |
| Additional Information | In the personal record there is a license of authorization No. 0816337 for A/C anti-icing treatment and operation under the ground icing conditions issued on 30.09.2008 by FSFEI Komi Republic Regional Aviation Personnel Training Center, valid for two years. |

**Airframe and power plant mechanic of the Shift No. 4 UTAir-Technic Ltd**

| | |
|---|---|
| Airframe and power plant mechanic | male |
| Date of birth | 28.08.1975 |
| Education | Tyumen polytechnic school; 1995; specialization – building-technician, buildings' and constructions' building and operation; Diploma No. 954497 of 23.12.1994 |

| | |
|---|---|
| CA specialist qualification | None |
| Employment | Employed as an airframe and power plant mechanic to UTAir-Technic Ltd maintenance shop for foreign-manufactured A/C maintenance; Order No. 972-л/38.02 of 12.07.2010 |
| Authorization for maintenance | None |
| Authorization for ground handling | Authorized for providing ground handling to ATR 42-200/300; ATR 72-100/200 (a certificate issued by the UTAir-Technic Ltd Maintenance Supervision Center Director was supplemented to the Order of authorization). Training and on-the-job training was undergone at UTAir-Technic Ltd Maintenance and Overhaul Center, Shop of foreign manufactured a/c, line maintenance department in the period 06.09-23.09.2010. Authorized for ATR 42-200/300; ATR 72-100/200 A/C ground handling by UTAir-Technic Ltd Order No. ПТ-1243/10 of 23.11.2010 in accordance with "Instruction for ATR 42-200/300, ATR 72-100/200 A/C ground handling" (СТП СМК 328-09), which was put into effect from 11.06.2010 by the UTAir-Technic Ltd General Director Order No.ПТ-586/10 of 10.06.2010. According to the job description he was authorized to work under a supervision of an engineer |
| 2011-2012 autumn and winter period preparation | Done, UTAir-Technic Ltd Order on authorization No. ПТ-104 of 11.10.2011 |
| Training for A/C anti-icing treatment | At UTAir-Technic Ltd Maintenance and Overhaul Center and Roschino AP Special vehicle service facilities, UTAir Ltd Order No. ПТ-1217/11 of 17.11.2011 |
| Additional Information | Never worked for CA organizations before being employment by UTAir-Technic Ltd |

## 1.6. Aircraft Information

ATR72-201 VP-BYZ A/C, MSN 332, manufactured by ATR GIE Avions de Transport Regional, France on 14.12.1992; flight hours since entry into service – 35523 h 12 min, landings – 49663 , overhauls – none.

Registered in Bermuda CAA Register; Certificate of A/C Registration No. 1331, issued 20.06.2008 by Bermuda Department of Civil Aviation. The registration entry shows «BLF Limited» company as the A/C owner. The A/C was operated by «UTAir Aviation» in accordance with the lease agreement with «WestSib – Lease Limited» company (Lease Agreement of 22.10.2007). The document of renaming of the above company into "PL PANORAMA LEASING LIMITED" is available (Certificate of renaming of 22.11.2008).

The A/C exterior appearance before the accident is shown in Figure 2.


**Figure 2. ATR72-201 VP-BYZ A/C general view before the accident**

## A/C data

| | |
|---|---|
| Тип ВС | ATR 72-201 |
| MSN | 332 |
| Manufacturer, date of manufacturing | ATR GIE Avions de Transport Regional, France; 14.12.1992 |
| Registration | VP-BYZ |
| Certificate of A/C Registration | No. 1331, of 20.06.2008 issued by Bermuda Department of CA |
| Airworthiness Certificate | No. 1225 of 21.09.2011 issued by Bermuda Department of CA; valid till 20.09.2012 |
| Owner | «BLF Limited» company |
| Operator | UTAir Aviation, JSC |
| Engine operation time since EIS | 35523 h 12 min, 49663 landings |

| | |
|---|---|
| Overhaul information | Safe life operation practice |
| Last base maintenance check | 1A Check, 22.01.2012, UTAir-Technic Ltd |
| Last line check | Oil & Evi Check, 01.04.2012<br>Pre-flight preparation was done the day before departure at Tyumen (Roschino) AP by UTAir-Technic Ltd; ground handling job card No. T-3193.<br>No A/C de/anti-icing treatment was done before departure |
| A/C Insurance | None |

**Engines' data**

| | | |
|---|---|---|
| Type of Engine | PW124B | PW124B |
| Power plant Number | 1 | 2 |
| Engine MSN | 124629 | 124579 |
| Manufacturer | Pratt&Whitney, Canada | Pratt&Whitney, Canada |
| Date of manufacturing | 01.1993г. | 06.1992г. |
| Power plant time since EIS | 29231 h, 42427 cycles | 29121 h, 45567 cycles |
| Power plant overhauls | 11.01.2012 by Dallas Airmotive, USA | 27.08.2010 by Finnair, Finland |

**Propellers**

| | **Left** | **Right** |
|---|---|---|
| Type of Propeller | 14SF-11 | 14SF-11 |
| Propeller MSN | MFG880619 | MFG901003 |
| Manufacturer | Hamilton Sundstrand | Hamilton Sundstrand |
| Date of manufacturing | 14.07.1988 | 23.10.1990 |
| SLL | N/A | N/A |
| Hub 802308-1 | 139A | 2010070192 |
| Operation time since last overhaul as of 02.04.2012 | 328 h | 489 h |
| Time left to the next overhaul as of 02.04.2012 | 10172 h | 10011 h |
| Blade 1 | SFA13S1P0A 200008028-11 | SFA13N1R0A 863694-11 |
| Operation time since last overhaul as | 4520 h | 489 h |

| | | |
|---|---|---|
| of 02.04.2012 | | |
| Time left to the next overhaul as of 02.04.2012 | 5980 h | 10011 h |
| Blade 2 | SFA13N1R0A 869240-11 | SFA13N1R0A 858062 |
| Operation time since last overhaul as of 02.04.2012 | 7864 h | 8031 h |
| Time left to the next overhaul as of 02.04.2012 | 2636 h | 2469 h |
| Blade 3 | SFA13S1P0A 200008013-11 | SFA13S1P0A 862452-11 |
| Operation time since last overhaul as of 02.04.2012 | 4173 h | 8031 h |
| Time left to the next overhaul as for 02.04.2012 | 6327 h | 2469 h |
| Blade 4 | SFA13N1R0A 860492-11 | SFA13S1P0A 867129-11 |
| Operation time since last overhaul as of 02.04.2012 | 5593 h | 3303 h |
| Time left to the next overhaul as of 02.04.2012 | 4907 h | 7197 h |

### 1.6.1. ATR72-201 ice protection system

The A/C ice protection system ensures safe flight operations under in-flight icing conditions in compliance with the A/C certification basis. The A/C is also equipped with the Anti-Icing Advisory System (AAS). ***However the abovementioned systems had not been designed for alerting the flight crew on ground icing, as well as for ground icing prevention and/or removal***.

The ice protection system consists of electrical anti-icing and pneumatic de-icing elements (see Figure 3).

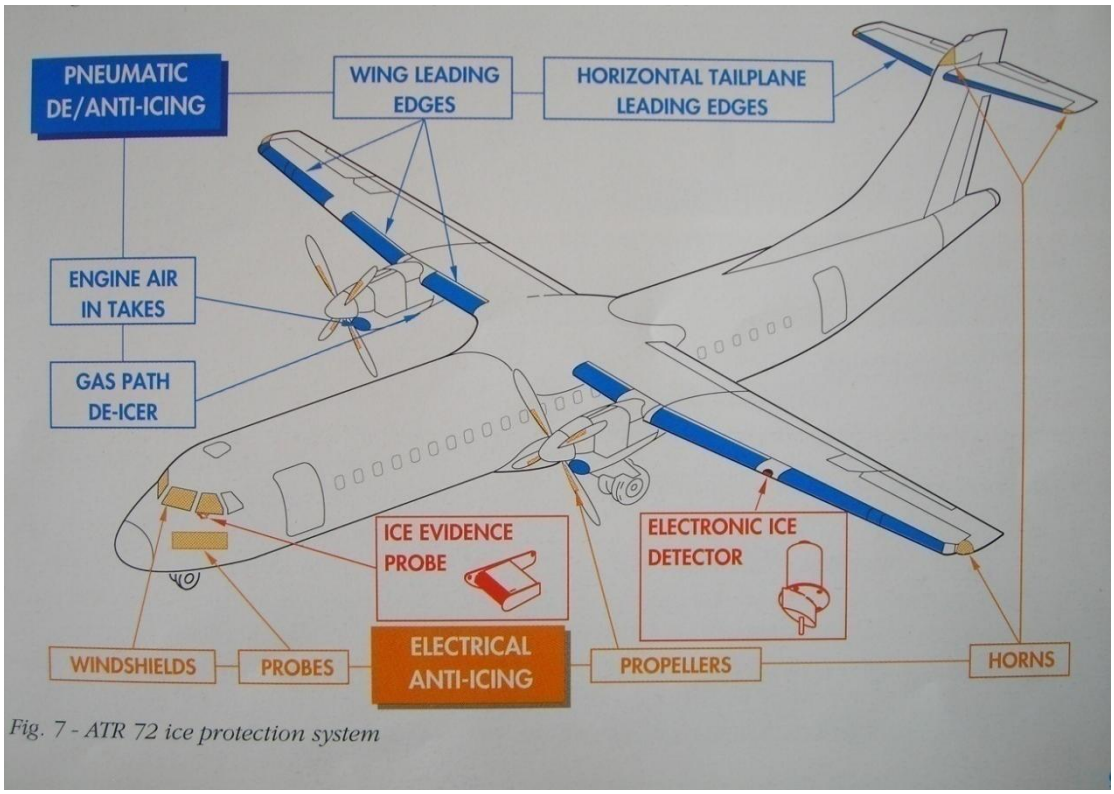



**Figure 3. A/C Anti-Icing System schematic diagram**

The anti-icing system includes electrical heating of propeller blades, cockpit windshields, various sensors (pitot probes, angle-of-attack sensors etc.) and aerodynamic horns of ailerons, elevators and ruder. The system has two levels (modes) of operation. The first one shall be mandatory switched on before a flight which activates the electrical heating of sensors and windshields. The second one is activated while flying in the atmospheric icing conditions, which activates the electrical heating of propeller blades, aerodynamic horns of ailerons, elevators and rudder, and side windows, and also the Icing AOA indication is on.

When the second level of anti-icing system is switched on the stall warning thresholds are reset to be triggered earlier. The stall warning thresholds as a function of AOA value for aural warning (cricket), stick shaker (the shaker is triggered along with the cricket) and the stick pusher are provided in the table below .

**For local angle of attack**

| | Clean A/C | | Icing conditions | | | |
|---|---|---|---|---|---|---|
| | | | Takeoff | | En route | |
| | Shaker | Pusher | Shaker | Pusher | Shaker | Pusher |
| Flaps 0° | 17.0 | 20.0 | N/A | N/A | 11.2 | 15.3 |
| Flaps 15° | 17.0 | 20.0 | 14.5 | 16.4 | 12.5 | 16.4 |
| Flaps 30° | 16.5 | 19.5 | N/A | N/A | 12.0 | 17.0 |

**For a/c angle of attack**

| | Clean A/C | | Icing conditions | | | |
|---|---|---|---|---|---|---|
| | | | Takeoff | | En route | |
| | Shaker | Pusher | Shaker | Pusher | Shaker | Pusher |
| Flaps 0° | 11.6 | 13.5 | N/A | N/A | 8.0 | 10.6 |
| Flaps 15° | 11.3 | 13.3 | 9.7 | 10.9 | 8.4 | 10.9 |
| Flaps 30° | 10.5 | 12.4 | N/A | N/A | 7.7 | 10.8 |

When ice accretion is detected in-flight then de-icing pneumatic system is to be used. The pneumatic de-icing system provides de-icing for the wing inboard, central, and outboard leading edges, horizontal stabilizer leading edges, vertical stabilizer leading edge, and engine intakes.

De-icing is done by the pneumatic boot inflation in the predefined order (engines, wings, horizontal stabilizer and vertical stabilizer). The sequence and cycle duration of the pneumatic boot inflation is controlled by computer.

The AAS includes an Ice Detector, Ice Evidence Probe and corresponding lights in the cockpit (for more information see FCOM chapter 1.13).

## 1.7. Meteorological Information

The meteorological group, which included main specialists of IAC and ROSHYDROMET, analyzed the following documentation :

- constant pressure maps for 850 hPa, 700 hPa, 500 hPa, 400 hPa, 300 hPa for 00:00 and 12:00 on 01.04.2012 and for 00:00 on 02.04.2012;

- area surface weather maps for 15:00, 18:00, 21:00 on 01.04.2012 and for 00:00 at 02.04.12;

- GAMC of ROSHYDROMET prognostic charts of significant weather at levers between 700 and 150 hPa (FL100-450) valid for 00:00 on 02.04.2012;

- Novosibirsk ZAMC prognostic charts of significant weather below 700 hPa valid for 00:00 on 02.04.2012;

- GAMC of ROSHYDROMET (Vnukovo Branch) forecast weather and wind charts for FL300 valid for 00:00 on 02.04.2012;

- cloudiness photographs made by METEOSAT-7 for 00:00 and 01:00 on 02.04.2012

- copies of radio-sonde data for 00:00 and 12:00 on 01.04.2012 made by Tobolsk and Omsk;

- Roschino (Tyumen) AD flight information service meteorological instruction;

- meteorological documentation that was obtained by the flight crew at the weather briefing during the flight preparation to the flight Tyumen-Surgut;

- actual weather at Roschino (Tyumen) AD from 00:00 on 01.04.2012 till 03:00 on 02.04.2012;

- actual weather at Surgut and Nizhnevartovsk ADs for 00:00 and 01:00 on 02.04.2012;

- weather forecasts for Roschino (Tyumen), Surgut and Nizhnevartovsk ADs;

- extracts from the Weather Log AB-6 of Roschino (Tyumen) AD from 00:00 on 01.04.2012 till 06:00 on 02.04.2012;

- KRAMS-4 copies of archive data of direction sensors and surface wind speed sensors;

- OAT data in graphical layout and digital view for 01-02.04.2012;

- copy of the extract of the "flight crew – ATC controller" radio communications;

- copy of the extract of the loudspeaker communications between technician – meteorologist – ATC controller;

- copies of Roschino (Tyumen) AD information No. 9, 10 and 11 of 01.04.2012;

- copies of FIR information No. 1 of 02.04.2012;

- copy of Roschino (Tyumen) AD In-flight-weather Log of 01-02.04.2012;

- weather observation data marked as "storm" obtained from hydrometeorological stations for 01-02.04.2012;

- Roschino (Tyumen) AD ATIS information for 17:30 on 01.04.2012; 01:00, 01:30, and 01:50 on 02.04.2012;

- CHMC agricultural meteorological center "Tyumen" information;

- Tyumen (Roschino) AMC forecast area chart;

- Tyumen (Roschino) AMC synoptic and technician-meteorologist explanatory reports.

The meteorological group has studied the ROSHYDROMET license issued for FSFI "Omsk CHMC-R", a division of Tyumen (Roschino) AMC, for "Hydrometeorology and adjoining area activity", reg. P/2012/1952/100/Л of 10.02.2012 without limitation of the period of validity; the Certificate of Compliance for aviation meteorological service providing of Tyumen (Roschino) AMC valid from 16.05.2008 till 15.05.2013; the license for "Hydrometeorology and adjoining area activity", reg. P/1915/100/Л issued by ROSHYDROMET for Surgut Civil AMC Division of FSFI "AviaMetTelecom ROSHYDROMET" of 23.09.2011 valid till 10.12.2015.

Meteorological group has studied the Certificate of Operability of KRAMS-4 station ИТАВ.416311.005 valid till 31.12.2013, and Verification Certificate of meteorological data sensors as part KRAMS-4.

As a result of the abovementioned documentation analysis it was determined that the meteorological service for the ATR 72-201 VP-BYZ A/C operated by UTAir that departed from Roschino (Tyumen) AP on 02.04.2012 at 01:33, flight number UTA120 on route Tyumen-Surgut

had been provided by a duty shift of FSFI "Omsk CHMC-R", Tyumen (Roschino) AMC division.

The Roschino (Tyumen) AMC works round the clock and supplies meteorological data for Tyumen Unified ATM System ACC, Roschino (Tyumen) AD ATM control centers, A/C flight crews and Tyumen (Roschino) AP ATS ground offices.

There are two RWYs for A/Cs' takeoff and landing at Roschino (Tyumen) AD: paved RWY 03/21 and paved RWY 12/30. The main weather station is situated at TWR-214, secondary weather stations – at TWR-34, TWR-301, and TWR-121, and supplementary weather stations are situated at LMM MH-214, LMM MH-34, LMM MH-121, and LMM MH-301. Weather observations at secondary and supplementary weather stations are performed remotely from the main weather station by the KRAMS-4 station. At secondary weather stations the following data are collected: speed and direction of wind and visibility. In addition at supplementary weather stations cloud base is measured if the cloud base goes down to 200 m and lower at the main weather station.

Routine weather observations are performed round the clock; routine weather reports are developed by a technician-meteorologist every hour and every half-hour; special observations are performed as supplements to routine weather reports in case of AD weather conditions deterioration or improvement in accordance with ATC approved criteria and AD minima.

Weather observations are performed by a technician-meteorologist with the use of KRAMS-4 station. Actual weather data is entered by a technician-meteorologist into the computer for broadcasting ATIS information, into AIDS "Meteodisplay" (TWR-214, TWR-34, TWR-301/121, supplementary weather station), and are transferred in METAR format through ADTS CA channels of communication.

On 01.04.2012 at 17:41 UTC (23:41 local time) the ATR72 VP-BYZ A/C performed landing at Roschino (Tyumen) AD after the UTA-119 flight on route Surgut-Tyumen completion. The above flight meteorological support on route Surgut-Tyumen was provided by the duty shift of Surgut aviation civil meteorological station.

When approaching to Roschino (Tyumen) AD the ATR72 VP-BYZ A/C entered extended cloudiness with icing area. According to the FDR data the flight crew used the A/C anti-icing system.

By the UTA-119 flight landing there were the following weather conditions at Roschino (Tyumen) AD: *surface wind 090°-7 m/s, visibility 1600 m, moderate snow shower with rain, heavy cloudiness (5-7 oct) cumulonimbus, fractonimbus base at 140 m, OAT plus 0.2°C, dew-point plus 0.2°C, QFE 735 mmhg / 980 hPa, breaking coefficient 0.6, in-clouds moderate icing*

*at layers from 140 m up to 4800 m, forecast for landing: tempo 0500 m, heavy show shower with rain, vertical visibility 090 m.*

Weather conditions at the Roschino (Tyumen) AD on 01.04.2012 at day and at night from 01.04.2012 to 02.04.2012 were determined by the cyclone trough forward part with its central part around Chelyabinsk and minimum pressure at the cyclone central part being 991.5 hPa.

The cyclone was moving to the North-East at a speed of 50 km/h. At altitudes of 5-7 km weather was determined by high level trough with a trough line passing through Chelyabinsk-Kockchetav. A warm front associated with the cyclone was running through Chelyabinsk-Shadrinsk-Ishim, drifting to the North-East at a speed of 40 km/h. The front line was expected to pass over Roschino (Tyumen) AD about 20:00 or 21:00. During the whole day on 01.04.2012 the wide precipitation zone associated with the warm front was determining the AD weather. Precipitations occurred from cumulonimbus and fractonimbus clouds by the OAT 0 ° and relative humidity 100% as snow shower with rain. Visibility in precipitation was 1200-1600 m, individual charges of heavy wet snow with visibility 600–700 m and vertical visibility 100 m. Precipitation was accompanied by east wind 90-110° 9-10 m/s, individual gusts up to 13-14 m/s. The above wind direction was kept till 21:00. After the front line passing Roschino (Tyumen) AD area at 21:05 the surface wind changed to the West 250-260° with gradual speed increase from 2-4 up to 7-10 m/s.

Precipitation such as moderate snow shower with rain at Roschino (Tyumen) AD was occurring till 22:00 on 01.04.2012. From 22:00 on 01.04.2012 till 01:00 on 02.04.2012 precipitation was occurring as slight snow shower with rain at OAT 0°C and relative humidity 100%.

According to observations of different hydrometeorological stations at 200-250 km around Roschino (Tyumen) AD that were situated under cyclone influence during 1-2.04.2012 there was the following “storm” information reported about freezing slush deposits build-up:

- storm Shatrovo 011435 glaze, minus 0°C;
- storm Irbit 011440 sleet (wet snow) deposits are building up, minus 0°C;
- storm Верхотурье 011545 sleet deposits are building up, minus 0°C;
- storm Dalmatovo 011610 sleet deposits are building up, minus 0°C, Northern 2;
- storm Doubrovo 011645 sleet deposits are building up, minus 1°C;
- storm Ivdel 011648 sleet deposits are building up;
- storm Dalmatovo 011710 end of sleet deposits building up, minus 1°C;
- storm Syssert 011732 end of sleet deposits building up, diameter of deposits 0.8 mm, minus 1°C;

- storm Irbit 011840 end of sleet deposits building up, minus 1°C;

- storm Artyemovsky 012045 glaze, end of sleet deposits building up, diameter of deposits 7 mm, minus 1°C;

- storm Verkhoturye 012055 end of sleet deposits building up, diameter of deposits 22 mm, minus 1°C;

- storm Demyanskoye 020105 sleet deposits are building up, diameter of deposits 1 mm, plus 0°C;

- storm Demyanskoye 020235 end of sleet deposits building up, plus 1°C;

Sleet deposits stopped building up at Tyumen ACC area at 02:35 on 02.04.2012.

***Note:*** *Frozen (iced) wet snow means an ice layer that is generated at an A/C surface as a result of stuck wet show or snow with rain freezing. Precipitations of such type occur at temperatures from -3°C to +3°C. The iced wet snow density varies from 0.2 to 0.6 g/cm$^3$ in relation to temperature, type of precipitation and speed of wind. In contrast to in-flight A/C icing when ice covers A/C leading edges the ground ice contaminations cover wing, fuselage and horizontal stabilizers' upper surfaces. For contaminants generated under wind influence is typical that first of all wind-facing surfaces are accreted. A/C takeoff with the presence of on-ground ice contaminations is dangerous. (See Manual of weather conditions for aviation forecasting, Leningrad, Hydrometizdat, 1983, para 5.3. On-ground A/Cs ice contamination).*

Upon the Meteorological group request about sleet precipitation presence, type, diameter and depth the FSFI "Tyumen CHMC" answered as follows:

| Date | Time | Phenomena type | OAT, °C |
|---|---|---|---|
| 01.04.2012 | 07:50 - 12:40 | Snow with rain | from +0.1 to -0.1 |
| | 08:30 - 11:40 | Sleet deposits build-up, diameter 1 mm | 0.1 |
| | 12:40 - 16:10 | Dry snow | from -0.8 to -0.9 |
| | 16:10 - 18:40 | Rain, snow with rain | from -0.5 to +0.2 |
| | 18:40 - 22:50 | Snow with rain | from -0.5 to +0.2 |

***Note:*** *The sleet deposits are measured on the wires of an ice accretion indicator, the ice accretion indicator is placed at a height of 2 m, the wires' diameter is 5 mm.*

Amount of precipitation on 01.04.2012 in the period from 07:50 to 15:00 was 3.4 mm; in the period from 15:00 to 03:00 on 02.04.2012 it was 2.8 mm.

The full precipitation depth on 01-02.04.2012 was 6.2 mm and considering the norm of 7 mm for Tyumen for ten-day period this means 88.6% of ten-day period normal value.

According to in-flight weather reports on 01.04.2012 from flight crews that performed landings at Roschino (Tyumen) AD there was moderate icing at layers below 4800 m and moderate turbulence at layers below 1500 m. These significant weather data were included into the actual weather report and into ATIS information.

The ATIS information at the time of the ATR 72 VP-BYZ A/C approach was as follows:

Information NOVEMBER for 17:30:

*RWY 034.*

*Wet.*

*Braking coefficient 0.55.*

*Surface wind 100°-7 m/s gusts up to 10 m/s.*

*Altitude 100 m. Wind 100°-18 m/s.*

*Radar. Wind 110°-28 m/s.*

*Visibility 1600 m.*

*Moderate snow and rain showers.*

*Heavy cumulonimbus 140 m.*

*Heavy altostratus 2100 m.*

*Temperature plus 0°C.*

*Dew-point plus 0°C.*

*Pressure 735 mmhg, 980 hPa.*

*In clouds moderate icing from 140 m till 4800 m.*

*Tempo:*

*Visibility 500 m.*

*Heavy snow and rain showers.*

*Vertical visibility 90 m.*

Roschino (Tyumen) AMC weather observers' duty shift had composed AD warnings for Roschino (Tyumen) AD.

AD warning No. 8 valid from 0117:30 till 0120:00: expected temperature transition at Roschino AD from positive to negative values (composed at 17:10; delivered at 17:12);

AD warning No. 9 valid from 0117:30 till 0123:00: freezing rain expected at Roschino AD (composed at 17:13; delivered at 17:15);

AD warning No. 10 valid from 0121:00 till 0124:00: expected temperature transition at Roschino AD from positive to negative values (composed at 20:20; delivered at 20:22);

AD warning No. 11 valid from 0123:00 till 0205:00: expected wind 15 m/s at Roschino AD (composed at 22:31; delivered at 22:32);

AD warning No. 1 valid from 0200:00 till 0206:00: moderate in-clouds icing and freezing precipitation expected at Tyumen FIR /1-4/ at layer 3000/0 the phenomena is stationary, intensity without alteration (composed at 22:32; delivered at 22:33).

In accordance with the procedure of weather information distribution at Roschino AD stated in the Roschino AD Flight Information Service Meteorological Instruction, Attachment 8 the AD warnings were delivered to the Airport Deputy Director (for information) and to AD ATS controller and to PPCD dispatcher (with written acknowledgement of receipt). The PPCD dispatcher delivers the AD warnings further to PPCD supervisory services, to transportation departments (passenger and cargo), to international department, to "UTAir-Technic" PPCD, Tyumen Emergency vehicle service, to Information, to RTC and NAV Office, to Flight electrical and lighting service, to the Airport Deputy Director, and to UTAir office.

During the flight crew preparation for UTA-120 flight Tyumen-Surgut on 02.04.2012 at 00:15 the ATR 72 VP-BYZ PIC got a weather briefing at Tyumen (Roschino) AMC. Under this weather briefing the PIC learned the following documentation:

- GAMC (Vnukovo, Moscow) prognostic chart of significant weather at FL100-450 (between 700 and 150 kPa) valid for 00:00 02.04.2012;
- GAMC (Vnukovo, Moscow) weather and temperature forecast chart FL300 valid for 00:00 02.04.2012;
- Form AB-11 No.1 with TAF weather forecast and METAR actual weather for the Roschino (Tyumen) departure AD, Nizhnevartovsk alternate AD and Surgut destination AD.

The PIC received Form AB-11 No.1 which he confirmed with his signature putting the flight number and A/C number at 00:15 in the sheet of "Book of records of flight crews' weather briefings at AMC Tyumen-Roschino".

AD of departure – Roschino (Tyumen) AD weather forecast from 23:00 on 01.04.2012 till 24:00 on 02.04.2012:

TAF USTR 012235Z 0123/0224 26008G13MPS 1500 SHSN BLSN BKN005 BKN020CB 650050 530004 TEMPO 0123/0206 26015MPS 0400 +SHSN FZRA VV002 BECMG 0206/0208 4000 -SHSN BKN007 BKN020CB TEMPO 0208/0212 0500 +SHSN VV002=

*Surface wind 260°-8 gusts up to 13 m/s, visibility 1500 m, rain showers, blowing snow, broken clouds (5-7 oct), cloud base 150 m, heavy cumulonimbus with base at 600 m, in clouds moderate icing, out of clouds frequent turbulence at layer from surface till 1200 m, tempo from 23:00 on 01.04.12 till 06:00 on 02.04.2012 surface wind 260°-15 m/s, visibility 400 m, heavy*

*snow shower, freezing rain, vertical visibility 4000 m, slight snow shower, broken clouds (5-7 oct), base 210 m, heavy cumulonimbus with base at 600 m, tempo from 08:00 on 02.04.12 till 12:00 on 02.04.2012, visibility 500 m, heavy snow shower, vertical visibility 60 m.*

AD of departure – Roschino (Tyumen) AD actual weather for 01:00 02.04.2012.

METAR USTR 020100Z 25007MPS 9999 BKN013CB M00/M01 Q1001 TEMPO 26015MPS 1500 SHSN BKN005 RMK QFE741/0988 21290060 30750029=

*01:00: surface wind 250°-7 m/s, visibility 10 km, broken clouds (5-7 oct) cumulonimbus, base at 390 m, OAT minus 0°C, dew-point temperature minus -1°C, QNH-1001 hPa, tempo wind 260°-15 m/s, visibility 1500 m, moderate snow shower, broken clouds (5-7 oct), base at 150 m, remark – QFE 741 mmhg / 988 hPa, at RWY 21 braking coefficient 0.6, at RWY 30 braking coefficient 0.29.*

AD of landing (Surgut AD) weather forecast for 00:00 on 02.04.2012 till 24:00 02.04.2012:

TAF USRR 012237Z 0200/0224 12009G15MPS 7000 BKN020 OVC066 620200 530004 TEMPO 0200/0209 2000 SNRA SCT007 BECMG 0208/0210 19009G15MPS=

*Surface wind 120°-9 gusts up to 15 m/s, visibility 7000 m, broken clouds (5-7 oct), base at 600 m, overcast (8 oct) base at 1980 m in-clouds slight icing, out of clouds moderate frequent turbulence from surface till 1200 m, tempo from 00:00 till 09:00 02.04.2012 visibility 2000 m, snow and rain, scattered clouds (3-4 oct), base at 210 m, gradually from 08:00 till 10:00 02.04.2012 wind 190°-9 gusts up to 15 m/s.*

AD of landing, Surgut AD actual weather for 02.04.2012 at 00:00:

METAR USRR 020000Z 11007G10MPS 7000 SCT050 BKN070 04/M05 Q1003 TEMPO 12010G15MPS RMK QFE748 07////60=

*00:00 surface wind 110°-7 gusts up to 10 m/s, visibility 7000 m, scattered clouds (3-4 oct), base at 1500 m, broken clouds (5-7 oct), base at 2100 m, OAT 4°C, dew-point temperature -5°C, QNH-1003 hPa, tempo wind 120°-10 gut up to 15 m/s, remark - QFE 748 mmhg, braking coefficient 0.6.*

Alternate AD, Nizhnevartovsk AD weather forecast for 02.04.2012 from 00:00 till 24:00:

TAF USNN 012300Z 0200/0224 12008G13MPS 9999 SCT030 BKN100 510003=

*Surface wind 120°-8 gusts up to 13 m/s, visibility 10 km, scattered clouds (3-4 oct), base at 900 m, broken clouds (5-7 oct), base at 3000 m, slight turbulence from surface till 900 m.*

Alternate AD, Nizhnevartovsk AD actual weather for 02.04.2012 at 00:00:

METAR USNN 020000Z 11008G11MPS CAVOK 02/M05 Q1008 NOSIG RMK QFE752 0300//65=

*00:00 surface wind 110°-8 gusts up to 11 m/s, visibility 10 km, NSC, OAT 2°C, dew-pointminus 5°C, QNH-1008 hPa, NSW, remark - QFE 752 mmhg, at RWY 03 braking coefficient 0.65.*

By the time of ATR 72 VP-BYZ A/C takeoff from the Roschino (Tyumen) AD at 01:33 the weather was as follows:

METAR USTR 020130Z 24006G09MPS 9999 BKN013CB M01/M01 Q1002 TEMPO 26015MPS 1500 SHSN BLSN BKN005 RMK QFE742/0989 21290060 30750029=

*01:30 surface wind 240°-06 gusts up to 9 m/s, visibility 10 km, broken clouds (5-7 oct), cumulonimbus with base at 390 m, OAT -1°, dew-point temperature -1°, QNH 1002 hPa, tempo surface wind 260°-15 m/s, visibility 1500 m snow shower, blowing snow, broken clouds (5-7 oct), base at 150 m, remark QFE 742 mmhg / 0989 hPa, at RWY 21 braking coefficient 0.6, at RWY 30 braking coefficient 0.29.*

Before the A/C takeoff the ATC controller provided the flight crew with information about wind, OAT and pressure from ATIS information Echo.

*Information ECHO for 01:30:*

*APCH: ILS*

*RWY 21.*

*Wet.*

*Braking coefficient 0.6.*

*TL 050.*

*Reporting altitude 1302 m.*

*Operational frequency at circle 126.1.*

*There are AD service vehicles operating at TWY.*

*Ramp and TWY slippery.*

*Surface wind 230°C-6 gusts up to 9 m/s.*

*Altitude 100 m. Wind 270°C-18 m/s.*

*Radar. Wind 280°C-25 m/s.*

*Visibility over 10 km.*

*Heavy cumulonimbus 400 m.*

*Pressure 742 mmhg, 989 hPa.*

At 01:50, after the accident with the ATR72 VP-BYZ A/C had occurred a technician-meteorologist on-duty received a request from Radar controller to perform an out-of-schedule actual weather observation in the format of the one-hour weather report.

The Roschino (Tyumen) AD actual weather when receiving ALARM signal at 01:50:

*Surface wind 230°-5 gusts up to 8 m/s, wind at altitude 100 m - 240°-15 m/s (forecasting), wind at traffic circuit altitude 250°-21 m/s (forecasting), visibility 10 km, broken clouds (5-7 oct), cumulonimbus, base at 320 m, OAT -0.6°C, dew-point temperature minus 1.1°C, QNH-1002.7 hPa, forecast for landing – tempo wind 260°-15 m/s, visibility 1500 m, moderate snow shower, snow blowing, broken clouds (5-7 oct), base 150 m, remark – QFE 742.6 mmhg / 990.2 hPa, braking coefficient 0.6.*

## 1.8. Aids to Navigation

No details of Navigation Aids, Landing Aids and ATC are included into this Final Report because their operation didn't affect the emergency situation development.

All available means to be certified do have their operational certificates in-force, and are within their life time limitations. All means to be tested by flight tests have been tested in time.

When the emergency situation was developing all the navigation and landing aids were in normal state and operating properly.

## 1.9. Communications

No details of communication aids are included into this Final Report because their operation didn't affect the emergency situation development

During the pre-takeoff preparation and takeoff a stable two-way radio communication between the flight crew and ATC was provided. There were no remarks as to the quality of the radio communication.

The crew to ATC controller conversations as well as the conversations between different services officers' were recorded by corresponding recorders, and later transcribed and used in the course of investigation.

## 1.10. Aerodrome information

The JSC Roschino Airport has the Certificate of Compliance of its aerodrome equipment No.ФАВТ А.01.01854 issued 09.06.2010 (valid till 09.06.2013).

The Roschino (Tyumen) AD maintenance and operation is provided by the airfield service.

The Roschino (Tyumen) AD is approved for operation of the following A/C: all modifications of B-767-200, A-319/320, all modifications of B-737, B-757, IL-86, IL-76TD, IL-76, Tu-154, Tu-134, Yak-42, IL-18, An-12, An-148, CRJ-100/200, SSJ-100, ATR 72, ATR 42, An-26, An-24, Yak-40, and other III and IV class A/C, as well as all types of R/C.

AD is of Class B.

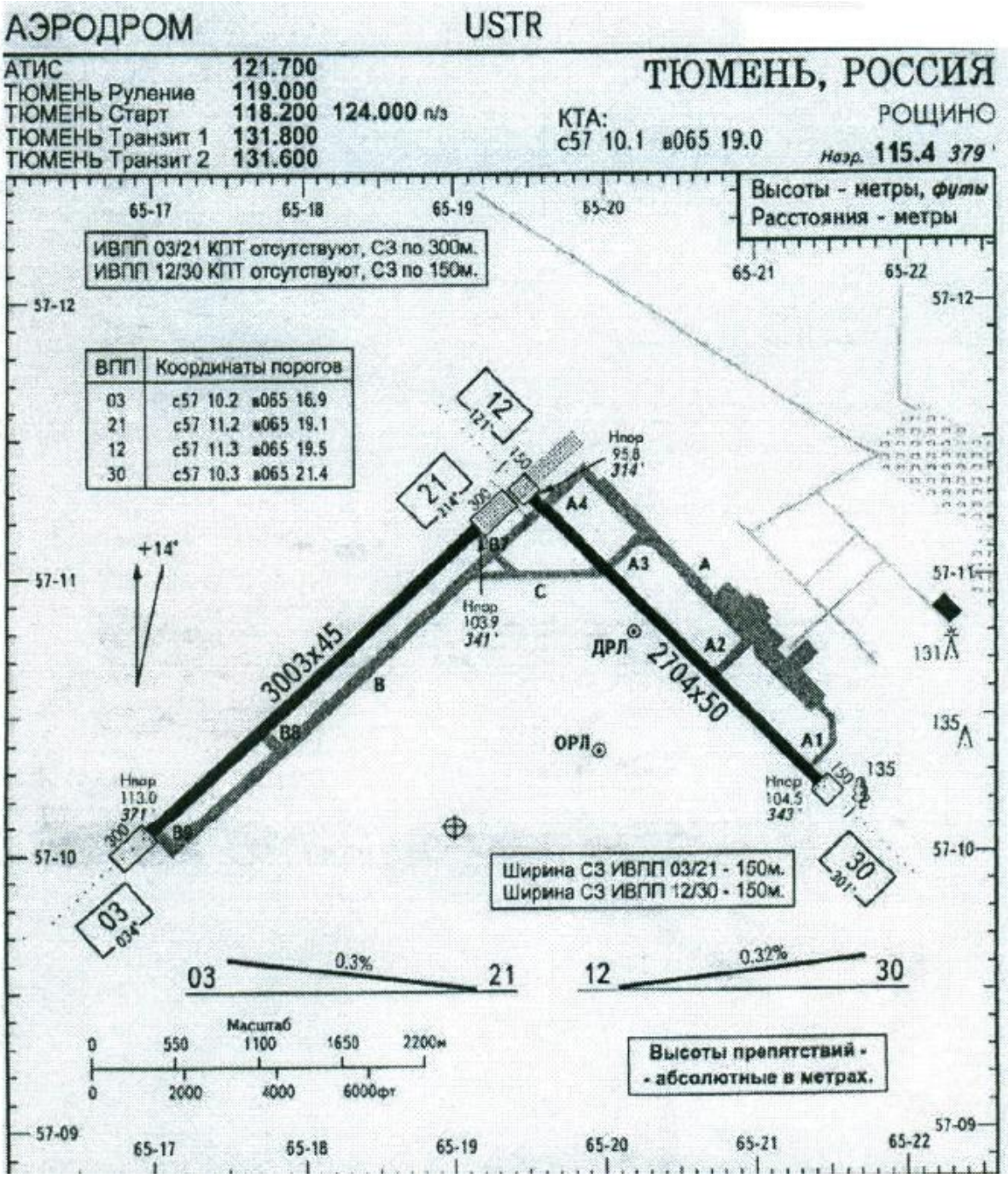



**Figure 4. Roschino (Tyumen) AD layout**

There are two paved RWYs at the AD. The ATR 72-201 VP-BYZ A/C takeoff was performed from RWY 21.

RWY 21/03; $MH_{land}$ 214º-34º, dimension 3003x45, including 2703x45 cement concrete pavement h = 28 cm, reinforced by asphaltic concrete h = 17 cm; thresholds 150 m, fibercrete pavement h = 28 cm, reinforced by asphaltic concrete h = 17 cm; PCN 63R/C/X/T

The airfield preparation to flights on 01.04.2012 - 02.04.2012

On 01.04.2012 in the period from 14:30 till 15:30 an airfield inspection was performed for the airfield status estimation followed by the associated entry into the Tyumen (Roschino) AP Log of airfield status.

The airfield status at 15:00 on 01.04.2012:

- paved RWY-21/03 – wet, covered with slush h = 3 mm, braking coefficient 0.50/0.50/0.50/ATT-2;

- paved RWY-12/30 – patches of ice, braking coefficient 0.29/0.29/0.29/ATT-2;

- TWYs, Stands – wet, ice patchy, wet show patchy.

With consideration of the airfield actual status and the weather forecast for the duty period (sleet precipitation, wind up to 15 m/s, temperature transition from positive to negative values) the decision was made to clean the AD paved surface. The paved RWY-21/03 cleaning was performed by patrol method (between flights) in the period from 16:00 till 17:15 on 01.04.2012.

The airfield status from 17:15: wet, patches of slush h = 2 mm, braking coefficient 0.55/0.55/0.55/ATT-2.

On 01.04.2012 at 22:00 (snow, OAT 0ºC with downward tendency) the decision was made to treat the paved RWY-21/03 with anti-icing agent to prevent the surface icing. On 01.04.2012 in the period from 22:00 till 23:00 the paved RWY-21/03 anti-icing treatment was performed with Nordway-Super agent (4 tones). The RWY-21/03 status at 23:00 on 01.04.2012: wet, braking coefficient 0.60/0.60/0.60/ATT-2.

At the time of the shift handover at 02:00 on 02.04.2012 the airfield elements' condition was:

- paved RWY-21/03 – wet, braking coefficient 0,60/0,60/0,60/ATT-2;

- paved RWY-12/30 – patches of, braking coefficient 0.29/0.29/0.29/ATT-2;

- TWYs, Stands – wet, patches of ice, patches of slush.

On 02.04.2012 from 02:30 till 03:00 (after the accident) an inspection of the airfield elements' condition was conducted by a commission composed of AP Deputy Director – Head of Joint Work Shift, Chief of Flight Safety Inspection, Chief of airfield service and the aerodrome operation engineer. The commission concluded the following:

- paved RWY-21/03 –wet, braking coefficient 0.60/0.60/0.60/ATT-2;

- TWYs, Stands – wet, patches of ice, patches of slush, patches of wet snow;

- there were no foreign objects found along the A/C taxiway.

Following the results of the inspection a statement of fact was drawn up (at 03:00 on 02.04.2012).

## 1.11. Flight and ground recorders

### 1.11.1. On-board recorders

The recorders' data readout was performed at the IAC Air Accident Investigation Scientific and Technical Support Commission (AAI STSC) facilities on 02.04.2012.

**Cockpit Voice Recorder (CVR), model FA2100**

The CVR visual inspection determined that the case was not damaged. There was an identification label at the CVR case: **PNR 2100-1020-02, SER 000274566, MFR 06141, DMF 042004.**

The hydroacoustic beacon was installed into the protected memory storage device with the serial number **SC84235**.

The CVR FA2100 external view can be seen on Figures 5 and 6.

**Figure 5. Cockpit Voice Recorder (CVR) FA2100 SN000274566**


**Figure 6. CVR identification label**

The CVR records (the last 30 minutes of records in high quality) was read out with the manufacturer (L-3-Com) official software. Four files were obtained:

- three audio-files of the first three input channels with quality 128 kb/s;

- Cockpit Area Microphone input with quality 256 kb/s.

The overall audio records' length was 31 min 3.6 s in each file. The quality of record was good. The ATR 72-201 VP-BYZ A/C crew communications during the approach to Roschino (Tyumen) AD on 01.04.2012 as well as during their preparation for takeoff and takeoff from the abovementioned AD starting from the moment of the engine start on 02.04.2012 were fully recorded.

**Flight Data Recorder (FDR), model FA2100**

The FDR FA2100 external view can be seen on Figures 7 and 8.

**Figure 7. Flight Data Recorder (FDR) FA2100 SN000501604**

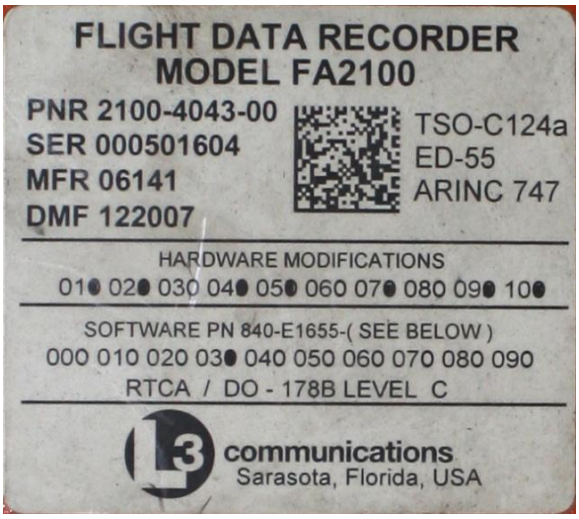



**Figure 8. FDR identification label**

The FDR visual inspection determined that the case was not damaged. There was an identification label on the FDR case: **PNR 2100-4043-00, SER 000501604, MFR 06141, DMF 122007**.

The hydroacoustic beacon was installed into the protected memory storage device with the serial number **SC41049**.

The FDR data was read out with the manufacturer (L-3-Com) official software. The read-out FDR raw data file contained data on 600 h 27 min 34 s of flight (for 238 flights), including data of the accident flight from the moment of engine start. The quality of record was good.

**Quick-Access Recorder (μQAR) – CompactFlash KingMax 2GB**

The ATR 72-201 VP-BYZ A/C was equipped with a supplementary on-board flight data recording system (μQAR). The source of data for the above system as well as for the FDR is FDAU. Data is recorded to the QAR memory card – CompactFlash.

The CompactFlash memory card external view can be seen on Figures 9, 10, and 11.

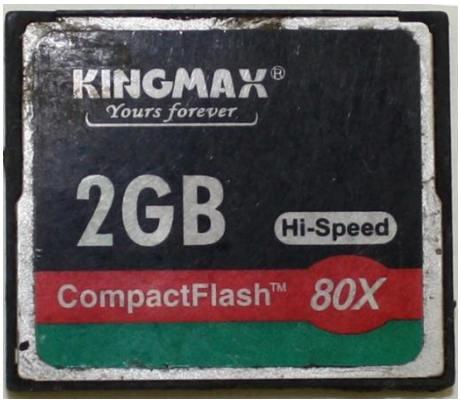



**Figure 9. CompactFlash memory card (plane view)**


**Figure 10. CompactFlash memory card (bottom view)**

**Figure 11. Memory card connector**

The data was read out with the official software, «μQAR Flight Data Processor». The following analysis determined that the CompactFlash memory card contained the ATR 72-201 VP-BYZ A/C data for 02.04.2012 only.

### 1.11.2. Readout and timing of the CVR and ground recorders data

Following the CVR data readout a transcript of the crew communications was composed and used in course of investigation by the Investigation Team. The crew members' voice identification was performed by the UTAir representatives as well as by an independent expert who used to fly together with the crew members.

For the FDR, CVR, and ATC recorder data timing the UTC time of ATC recorder was chosen as the basic one. Following the transcript of the crew to ATC controller communications the time was synchronized with the CVR time.

The following figures present the results of FDR and CVR data readout and processing.

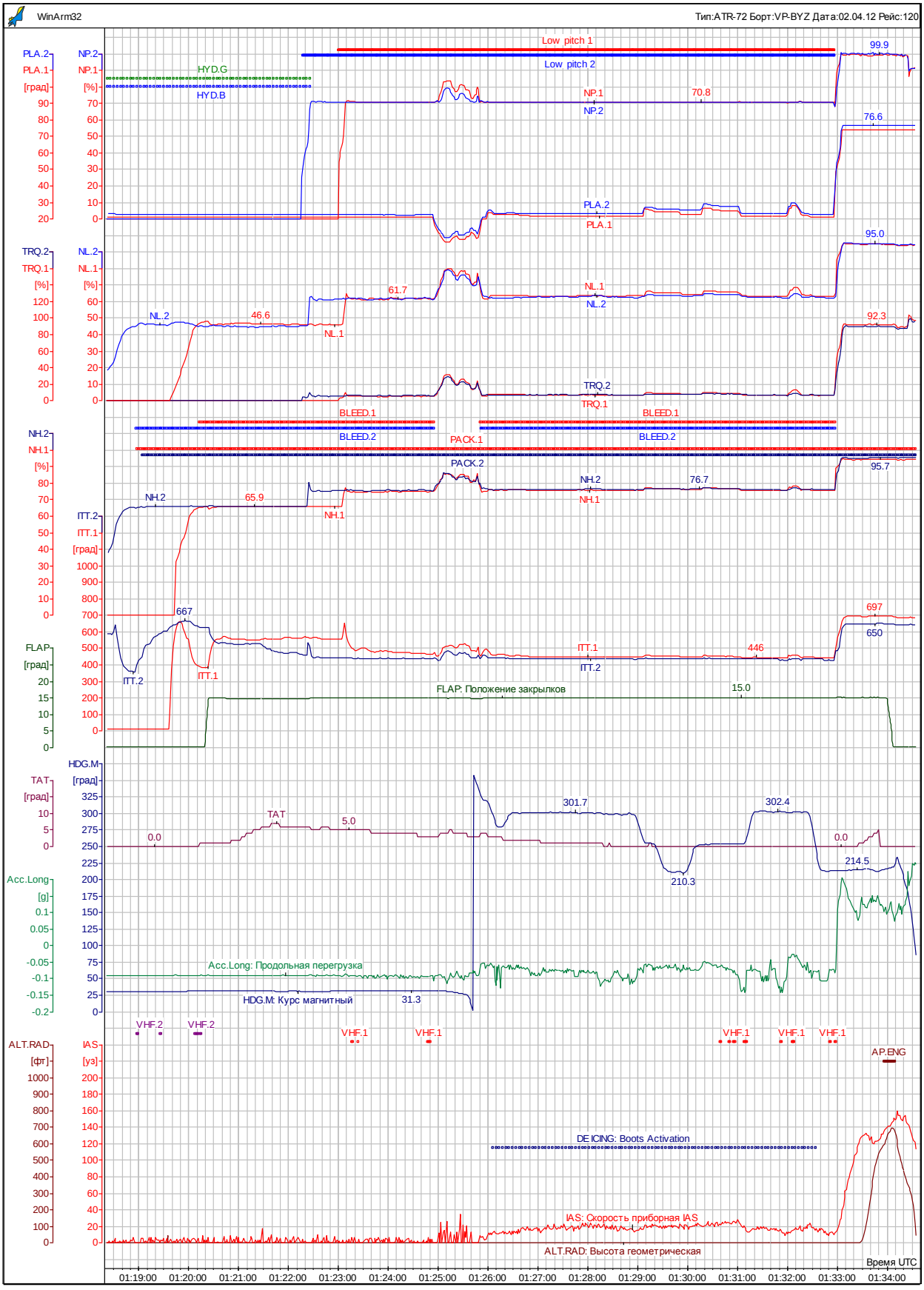



**Figure 12. ATR 72-201 VP-BYZ A/C flight parameters on 02.04.2012**

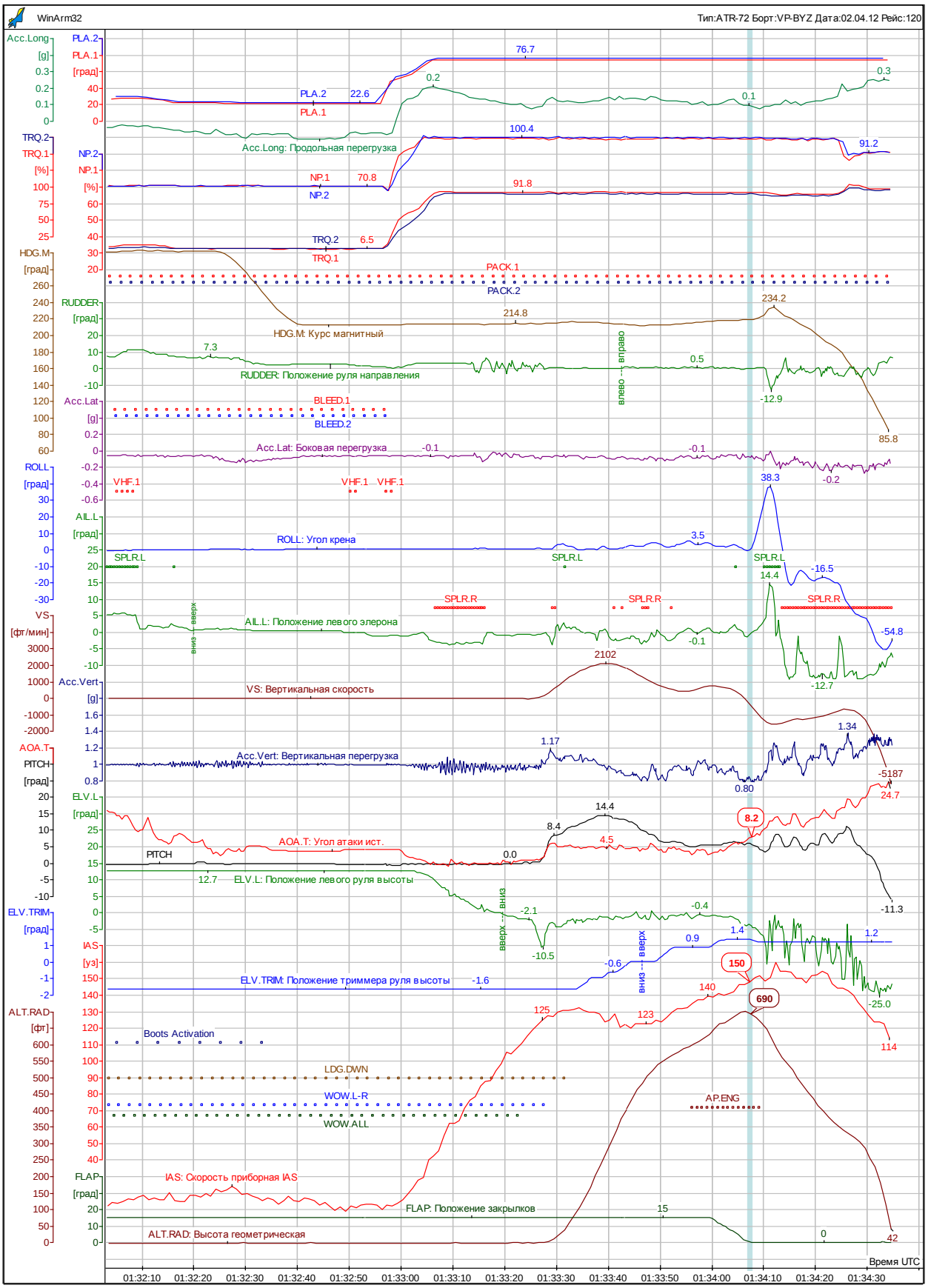



**Figure 13. ATR 72-201 VP-BYZ A/C flight parameters on 02.04.2012**

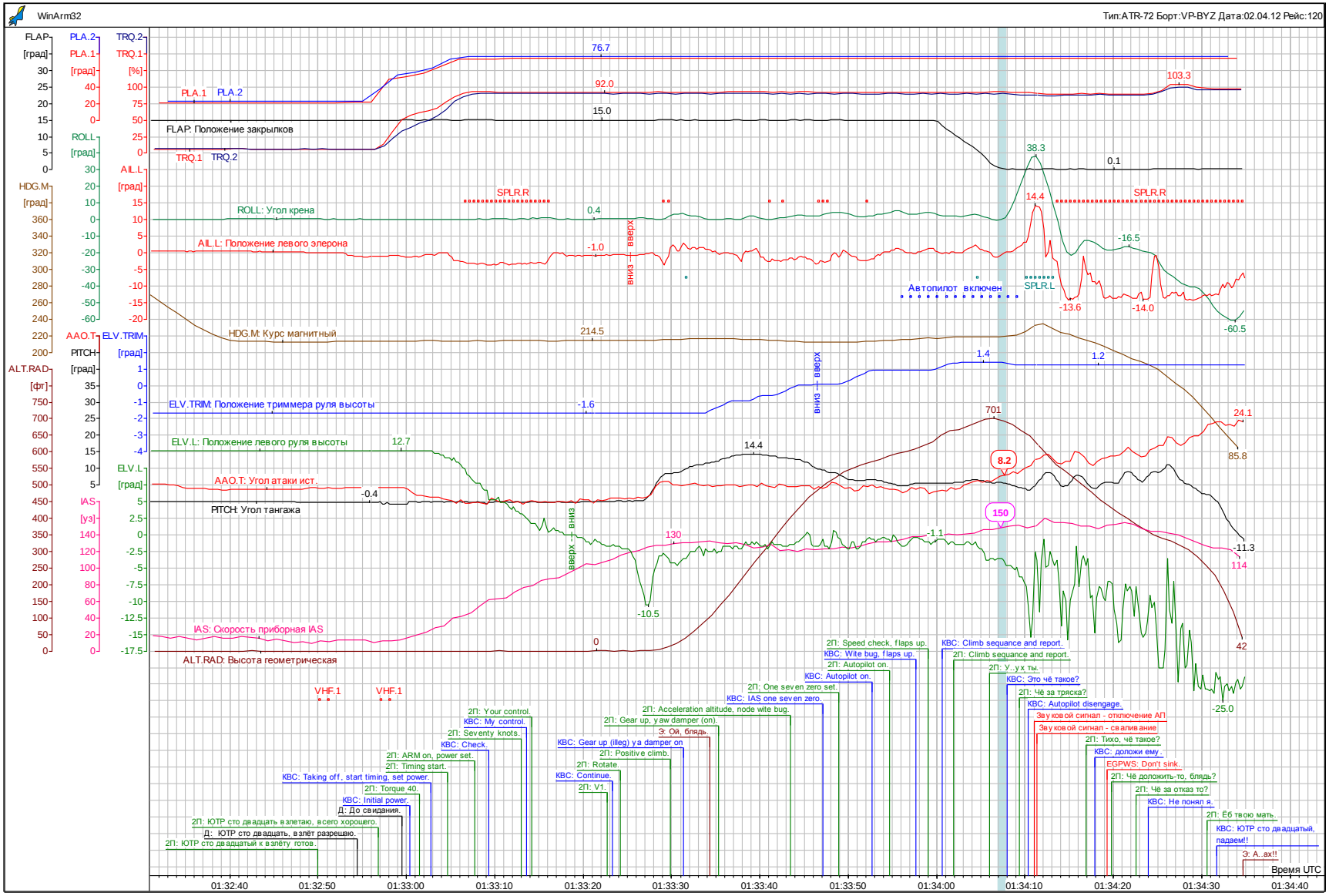



**Figure 14. ATR72-201 VP-BYZ ATR 72-201 VP-BYZ A/C flight parameters on 02.04.2012**

The FDR data revealed no engine or A/C system failures.

The data were used for the accidental flight engineering simulation and to analyze the accident causes.

### 1.11.3. Surveillance cameras' video data analysis

On the basis of the Tyumen (Roschino) AP ramp surveillance cameras' data analysis the following can be seen:


**Figure 15. ATR 72 VP-BYZ A/C arrived to Roschino AD on 01.04.2012 at 17:43 and was put to stand 3**


**Figure 16. At 00:23:50 doors were open and the A/C ground handling was started by round personnel**


**Figure 17. The PIC's arriving at the A/C**


**Figure 18. De-/anti-icing vehicle is leaving**


**Figure 19. De-/anti-icing vehicle has arrived to the ATR 72 VP-BYZ A/C**

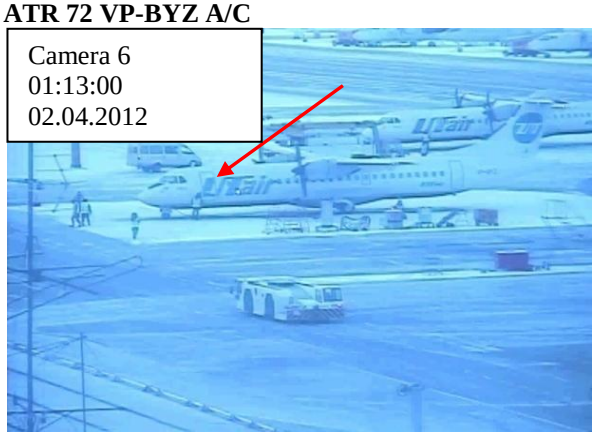



**Figure 20. The doors' closing**


**Figure 21. RH Engine startup**


**Figure 22. LH Engine startup**


**Figure 23. Backward Taxiing out of the stand**


**Figure 24. View of the stand after the A/C taxiing out**


**Figure 25. ATR 72 VQ-BLI anti-icing treatment at stand 2 to the right of the ATR 72 VP-BYZ A/C**


**Figure 26. B-737 (Yamal) anti-icing treatment at stand 4 to the left of the ATR 2 VP-BYZ A/C**


**Figure 27. Taxiing of a/c: ATR 72 VP-BYZ (on the left) and B-737 Yamal (on the right)**

**Figure 28. The trajectory of the A/C after the takeoff with developing left bank and descent**

***Note:*** *The camera was focused to the A/C landing area with* $MH_{land}$ *= 34°.*

## 1.12. Wreckage and impact information

The ATR 72-201 VP-BYZ A/C flight was conducted on 02.04.2012 from Tyumen (Roschino) AP to Surgut AP. Takeoff was performed with heading 214º from RWY 21 beginning. The accident occurred after the takeoff during climb-out.

The Tyumen (Roschino) AP is located in the flat area and its RWY 21 exit threshold elevation is 103.9 m. The area where the accident occurred is a flat ground (at the moment of accident it was covered with snow, H = 30-34 cm) with some adjoining blocks of birch forest with trees' height of 15-20 m (Figure 29). The terrain elevation in the area of the accident is 110 m.

The accident site positioning with reference to the RWY is shown on Figure 30. The A/C center of mass's motion direction on impact was MH ≈ 90º. The A/C debris are located within about ≈190 m along the A/C motion direction and within about ≈50 m edgewise.

The A/C ground collision occurred at distance ≈1500 m from the RWY 03 threshold along the RWY centerline, with lateral deviation to the left ≈400 m of the RWY centerline. The point of initial impact coordinates are: N 57º09.440' E 65º16.000'.

Garmin GPSmap 60CSx was used for the A/C fragments location mapping when making the wreckage plot. An orthogonal axis system was chosen with two reference points with coordinates: N (φ = N 57º09.440' λ = E 65º16.000'), S (φ = N57º09.414' λ = E 65º16.141'). All distances are shown with relation to the reference point N (initial impact point) towards the reference point S.

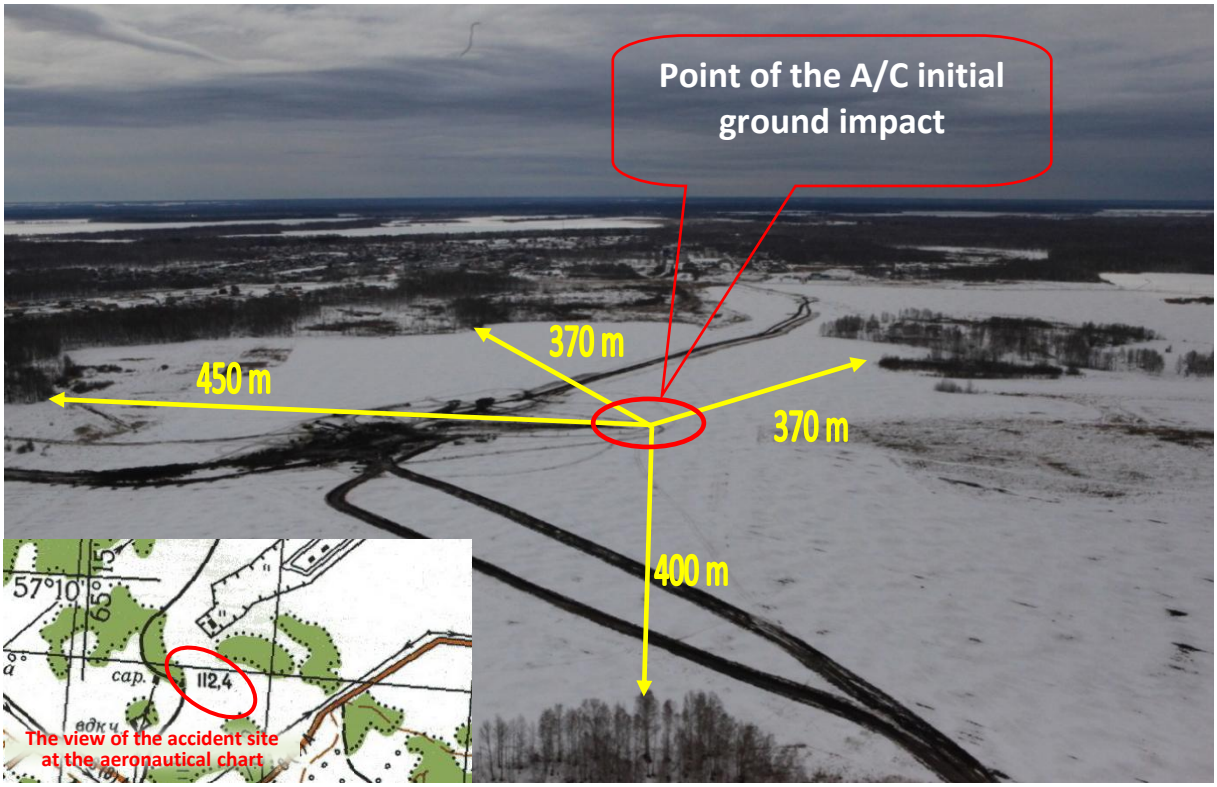



**Figure 29. The accident site positioning with relation to the reference points**

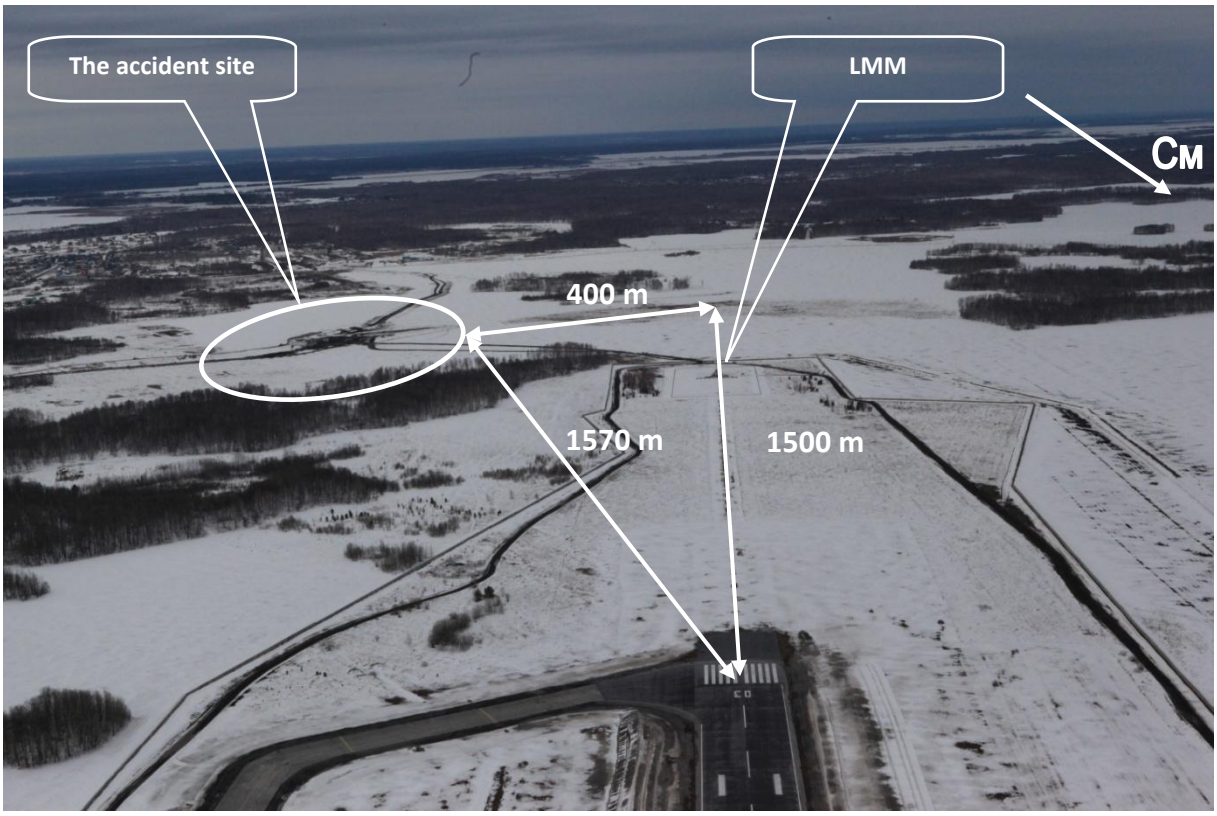



**Figure 30. Airscape view of the accident site with reference to RWY with takeoff heading MH = 214º**

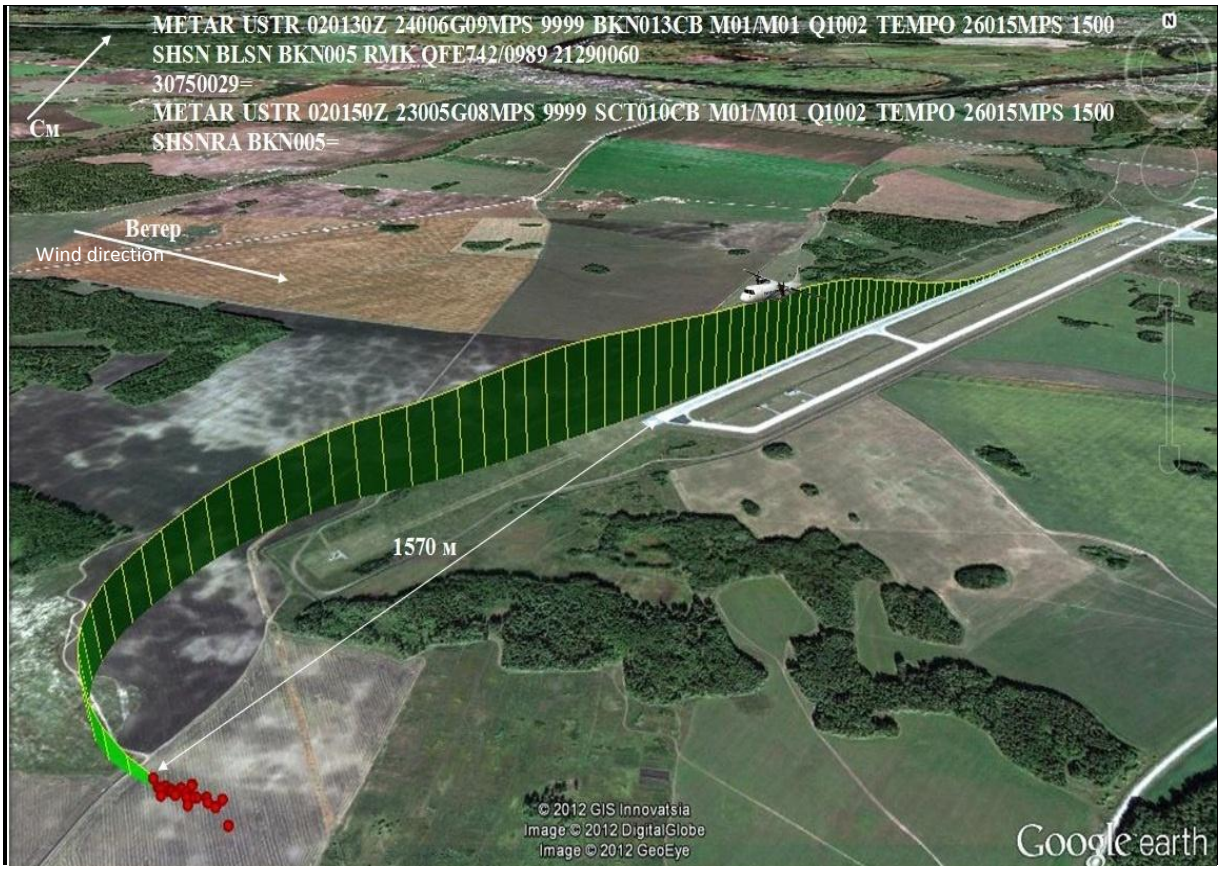



**Figure 31. The A/C after-takeoff pattern of flight**

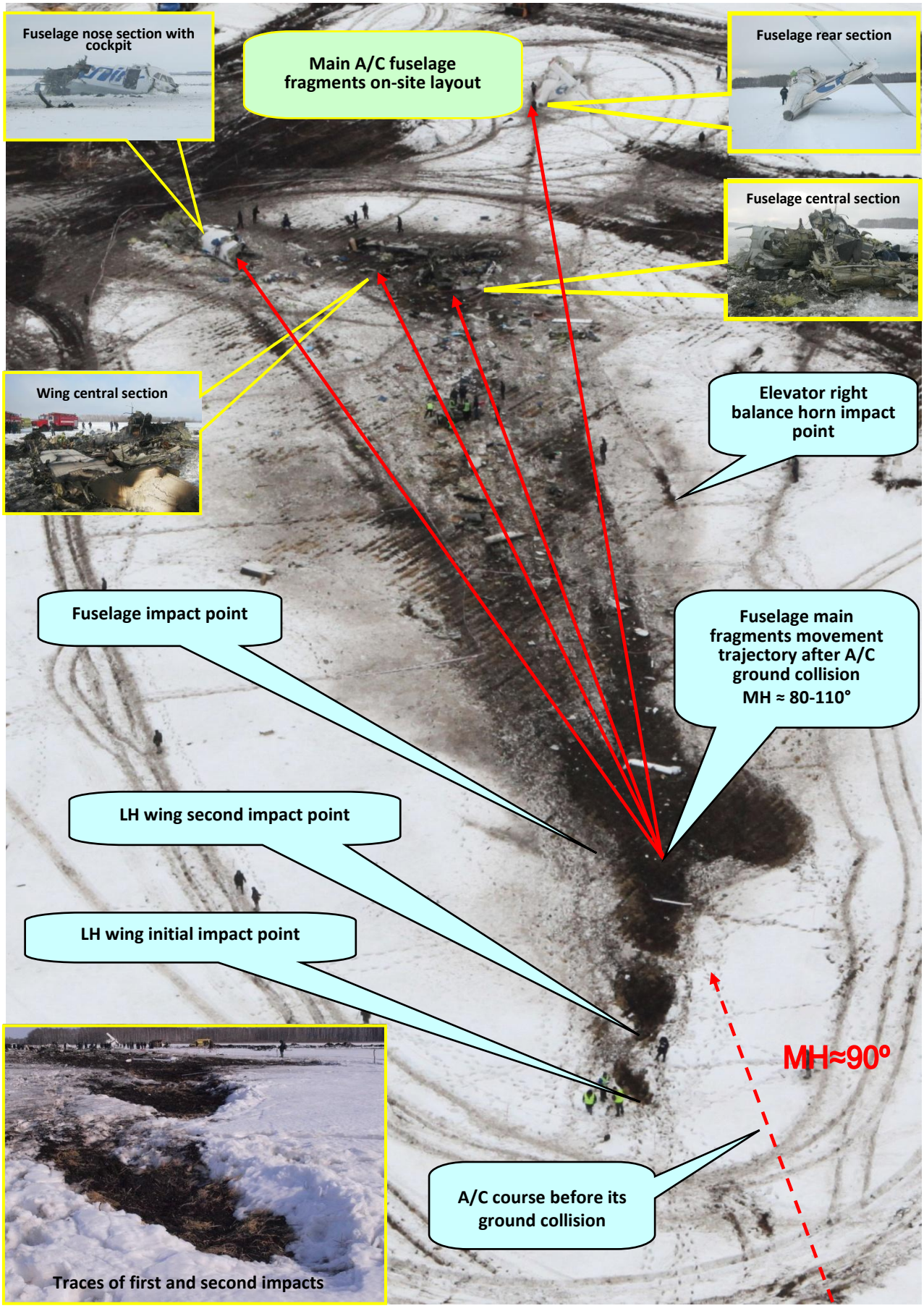



**Figure 32. Airspace view of the accident site**

The initial ground impact was with the LH outer wing and resulted in the outer wing destruction. The initial impact "spot" dimension is 1.6 x 4 m.

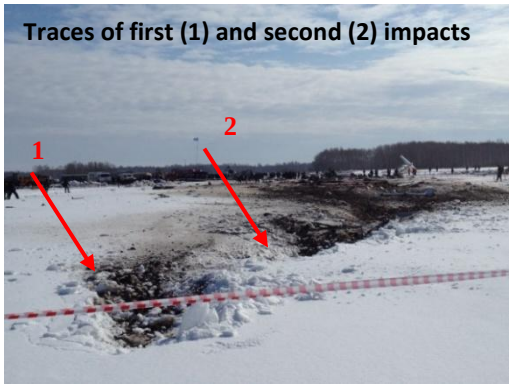



**Figure 33.**

The second impact traces with dimensions 3 x 8.3 m showed further LH wing components destruction and contained some particles of the airplane paint-and-lacquer coating on the ground.

At the point with coordinates N 57º09.428' E 65º16.020' the A/C fuselage hit the ground that resulted in the fuselage breaking into three major parts (cockpit with the fuselage nose section [further FNS], fuselage central section [further FCS] with wing central section, and fuselage rear section [further FRS]) that continued their travelling within the sector from 80º to 110º.


**Figure 34.**


**Figure 35.**

Cockpit with FNS was located at 134 m from the A/C initial impact point. The fuselage major damage, namely deformation, are along the fuselage LH side, and this evidences that the A/C collision first occurred with the fuselage left nose section. This is also evidenced by the absence of the left door that was found about 50 m before the FNS. The FNS did not show any evidence of fire.

The FCS consisted of the structure fragment from fr. 23 up to 29 and included the wheel well of the RH landing gear that was up and locked, and the wing central section that survived from the LH rib 13 up to the RH rib 13. At the RH fuselage section there was a mark of about 50 cm in length caused by the right engine rotor blade impact.

The FCS and the wing central section sustained significant thermal damage caused by the surface fire. There was no fire influence evidence found on the FCS external part. On the inside part there was evidence of significant rapid burning. The LH fuselage skin and LH landing gear compartment were fully burned out.

After the breaking of the A/C structure into fragments the FCS and the wing central section continued their forward movement with heading MH≈90º and further turn to MH≈315º. The FCS was lying on its right side at a distance of 130 m from the initial A/C ground impact point and at distance of 16 m to the right from the centerline of the general direction of the A/C fragments traveling.

The FRS, as a result of significant A/C ground impact, separated from the FCS near the LH fr. 32 and the RH fr. 31 up to fr. 48.


**Figure 36.**


**Figure 37.**

Approximately 25 m after the initial ground impact point a trace of RH elevator horn ground impact existed (coordinates: N 57º09.411' E 65º16.075'); further the FRS continued its in-air traveling heading MH≈110º followed by ground collision. The FRS was located 173 m from the A/C initial ground impact point and 39 m to the right from the general direction of the A/C fragments traveling.


**Figure 38.**


**Figure 39.**

During A/C destruction the engines were torn off their mounting places. The LH engine was located 93 m from the A/C initial ground impact point along the trajectory and 10 m to the right from the general direction of the A/C fragments traveling. The RH engine was located 79 m from the A/C initial ground impact point along the trajectory and 15 m to the right from the general

direction of the A/C fragments traveling. The A/C rotor blades showed the deformation and destruction that is representative for the engines being in operation.

## 1.13. Medical and Pathological Information

The crew passed their pre-flight medical examination at 05:30 – 06:20 local time on 02.04.2012 at Tyumen (Roschino) AP preflight medical examination station and were assessed as fit for flight.

**Flight crew medical examination data**

**Pilot-in-command (PIC)**

Below are the data of medical examinations and line observations in the intervals between the examinations for the last three years:

- Flight medical expertise passed on 22.01.2010 at the UTAir medical station in Surgut. Diagnosis: Healthy. Examination conclusion: Fit for flight operations as pilot. CAT I.

- Semiannual medical expertise passed on 19.07.2010 at the UTAir medical station in Surgut. Diagnosis: Healthy. Fit for flights.

- Flight medical expertise passed on 19.01.2011 at the UTAir medical station in Surgut. Diagnosis: Healthy. Examination conclusion: Fit for flight operations as pilot. CAT I.

- Semiannual medical expertise passed on 19.07.2011 at the UTAir medical station in Surgut. Diagnosis: Healthy. Fit for flights.

- Flight medical expertise passed on 03.02.2012 at the UTAir medical station in Tyumen. Diagnosis: Healthy. Examination conclusion No. 0400183: Fit for flight operations as pilot. CAT I.

On 31.10.2012 the PIC passed psychological examination held by the Flight medical expertise board psychologist at the UTAir medical station in Tyumen. Conclusion: The general level of psychophysiological functions development is high. There are no contraindications to be commissioned as a PIC.

The PIC was physically and mentally fit, with no indication of alcohol abuse, but he smoked. He had no diseases or traumas within the last two years.

Flying time:

- for the last month (March) – 89 h 20 min (with his written consent);

- 30.03.2012 – flight time – 4 h 05 min, time on duty 6 h 20 min;

- 31.03.2012 – day off;

- 01.04.2012 – flight from Surgut to Tyumen, flight time 2 h 05 min.

The PIC had enough rest time within the last two days before the accident.

Regular vacation:

- from 30.12.2008 to 09.01.2009;
- from 04.08.2009 to 12.08.2009;
- from 09.01.2010 to 18.01.2010;
- from 10.05.2010 to 26.05.2010;
- from 09.11.2011 to 16.11.2011;
- from 15.01.2012 to 03.02.2012.

Unused vacation days – 111 days:

- from 21.07.2009 to 20.07.2010: 26 days unused;
- from 21.07.2010 to 20.07.2011: 51 days unused;
- from 21.07.2011 to 01.04.2012: 34 days unused.

**First Officer (F/O)**

Below are the data of medical examinations and line observations in the intervals between the examinations for the last three years:

- Flight medical expertise passed on 29.04.2010 at the UTAir medical station in Surgut. Diagnosis: Healthy. Examination conclusion: Fit for flight operations as pilot. CAT I.

- Semiannual medical expertise passed on 02.11.2010 at the UTAir medical station in Surgut. Diagnosis: Healthy. Fit for flights.

- Flight medical expertise passed on 26.04.2011 at the UTAir medical station in Surgut. Diagnosis: Healthy. Examination conclusion No. 0213202: Fit for flight operations as pilot. CAT I.

- Semiannual medical expertise passed on 27.10.2011 at the UTAir medical station in Surgut. Diagnosis: Healthy. Fit for flights.

Suspension:

- On 06.05.2010 the F/O was suspended by the preflight medical examination conclusion with a diagnosis of acute respiratory disease. He remained on sick leave up to 13.05.2010. Resumed flights on 14.05.2010;

- On 19.08.2010 he was suspended by the preflight medical examination conclusion with a diagnosis of high blood pressure and sinus tachycardia (in accordance with the Flight Schedule, he had not conducted any flights for three days before the examination). He was on sick leave from 19.08.2010 to 25.08.2010 at the medical station in Surgut. On 20.08.2010 he was exposed to 24-hour monitoring of the blood pressure. Medical conclusion: The 24-hour blood pressure profile is within the normal range. Authorized to conduct flights from 26.08.2010 onwards;

- On 27.09.2010 he was suspended by the preflight medical examination conclusion with a diagnosis of high blood pressure (in accordance with the Flight Schedule, his previous flight

was on 25.09.2010). On 27.09.2010 he was examined by the flight squadron doctor and was authorized to fly from 28.09.2010 onwards.

***Note:*** *The cause of the blood pressure increase was not identified during the examination, but the F/O was known to attend a sports center leased by the Airline to practice powerlifting. He mostly attended it in the evenings.*

The F/O was fit both physically and mentally and was never noticed to abuse alcohol or smoking. He had no traumas within the last two years. The F/O lived in a dormitory.

Flying time:

- for the last month (March) – 80 h 00 min;
- 30.03.2012 – flight time 4 h 05 min, time on duty 6 h 20 min;
- 31.03.2012 – day off;
- 01.04.2012 – flight from Surgut to Tyumen, flight time 2 h 05 min.

The F/O had enough rest time within the last two days before the accident.

Regular vacation:

- from 25.09.2009 to 14.10.2009;
- from 27.03.2010 to 14.04.2010;
- from 04.01.2012 to 11.01.2012.

Unused vacation days: 123 days:

- from 08.10.2009 to 07.10.2010: 46 days unused;
- from 08.10.2010 to 07.10.2011: 51 days unused;
- from 08.10.2011 to 01.04.2012: 26 days unused.

**Accident site cockpit observation by medical personnel**

According to a medical officer who was one of the first to access the accident site, the bodies of the PIC and F/O were found at their respective working stations, both fastened with safety belts.

The CVR record analysis revealed that in the course of the pre-crash situation the crew were stressed but were not incapacitated.

**Pathological Expertise Findings**

The PIC died as a result of skull base bones fracture. No evidence of alcohol and/or drug abuse at the time of his death was identified.

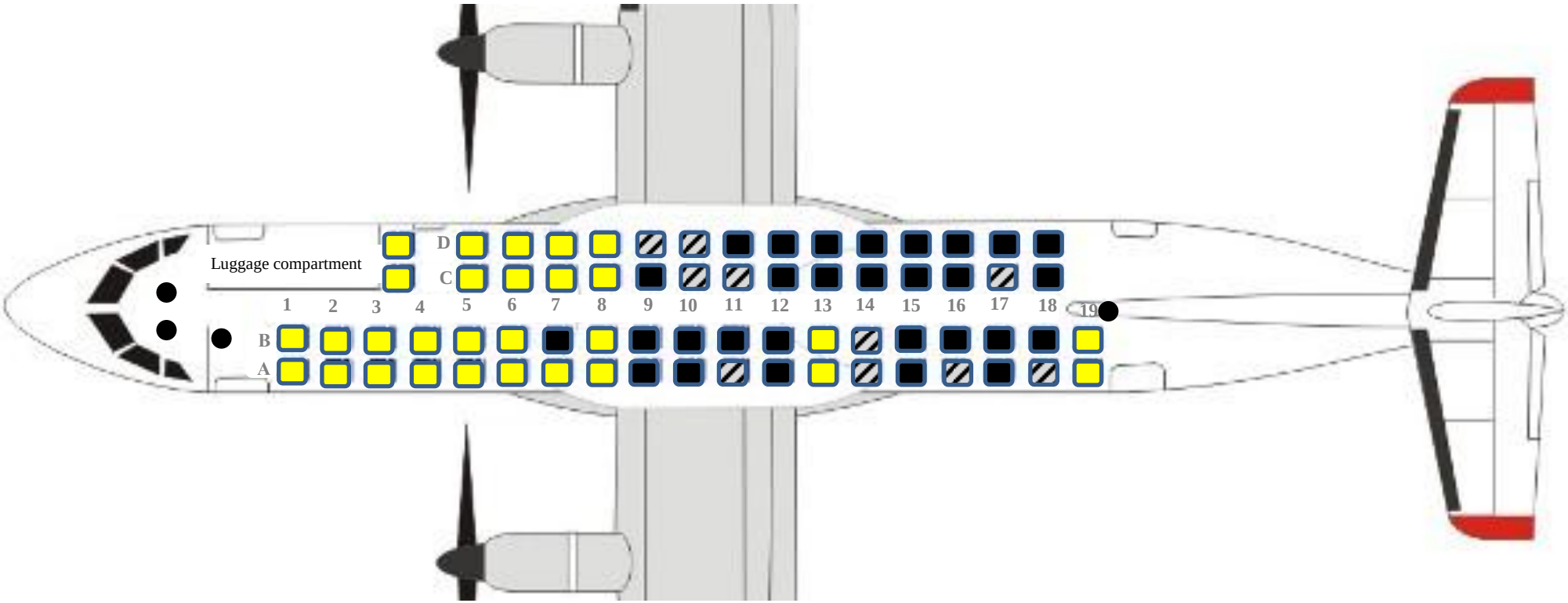
The F/O died as a result of skull cap and base bones fracture. No evidence of alcohol and/or drug abuse at the time of his death was identified.

## 1.14. Survival Aspects

The ATR 72-201 VP-BYZ was operated in a 68-seat layout. The layout modification from 66 to 68 seats had been performed by the previous operator, Finnair airline.

The crew composition of 4 persons for Flight UTA-120 was documented by the data (UTAir list of crew members) entered into the aviation security service logbook where aircraft crew movements within Tyumen airport of Roschino are recorded. The crew names list was compiled after the crew submitted their flight task.

The passenger and luggage registration was conducted at the Astra automated departure management system in accordance with the Procedures for Passenger and Luggage Registration for UTAir Flights, Doc. ДП-Б1.011-01, Revision 1, approved by the joint order No. 1825/627 of 01.12.2008 by the General Director of UTAir and the General Director of the Transportation and Service Provision Center.




- died in the accident (29 passengers);
- injured in the accident (10 passengers);
- vacant seat;
- 4 crew members died.

**Figure 40. Passenger distribution ATR72 VP-BYZ**
**April 02, 2012 at Tyumen (Roschino) AD**

The passengers were distributed in the cabin automatically (by the Astra automated system) in accordance with the cabin layout. According to the registration data, 39 out of the 68 seats were occupied by adult passengers, no children were present (see Figure 40).

In accordance with the explanations made by the AD security service, the preflight inspection of the passenger and luggage was conducted in compliance with the requirements of Roschino Airport regulations as to the procedures of the preflight passenger inspection. No deviations from the established requirements as to the transportation of prohibited items as carry-on or checked luggage (sharp objects, explosive and flammable materials, radioactive items, etc.) were identified. Ammunition was not transported.

Total payload on the flight as per the weight and balance sheet, baggage sheet and passenger sheet was 3343.34 kg, including:

- passengers –2925 kg;
- checked luggage – 14 items, 143 kg (no paid luggage);
- carry-on luggage – 111 kg;
- cargo – 133 kg;
- mail – 1.04 kg;
- service cargo – 30.3 kg,

which was within the maximum possible payload limitations for the flight (6113 kg according to the weight and balance calculations of the Roschino AD weight and balance planning dispatcher).

The cargo was loaded in accordance with the loading pattern issued by the weight and balance dispatcher.

The actual takeoff weight was 18730 kg, while the MTOW was 21500 kg, with the center of gravity being 30.72% MAC (the CG envelope for the actual TOW ranged between 15-37% MAC).

The accident resulted in 33 fatalities (4 crew members and 29 passengers), and 10 passengers were seriously injured.

No aircraft design peculiarities were identified that could have affected the survivability of the passengers or crew members.

According to the forensic medical examination conclusion, the deaths of the passengers were caused by multiple fatal injuries.

## 1.15. Search and Rescue Operations

The search and rescue operations at the accident site were managed by the EMERCOM RF, Search and Rescue Service of the Aerodrome Security Service of Roschino Airport, as well as municipal and federal authorities.

The operations at the accident site were conducted in the following order:

At 01:33 the ATR72-201 VP-BYZ took off.

After the takeoff the crew did not contact the Approach Control.

At 01:34:34 the following phrase was recorded at the Runway Control frequency: "UTAir one hundred tw…!".

After that the aircraft blip was lost from the Approach Control radar.

At 01:36 the ATC shift supervisor of Roschino Aerodrome declared an emergency to the crew of the search and rescue helicopter Mi-8T RA-22633, to the aerodrome services, UTAir and the search and rescue team of the Tyumen Area Search and Rescue Station of Federal Official Institution "Ural Aviation Search and Rescue Center".

At 01:40 the unified emergency center of Tyumen received a message from an eyewitness about an aircraft crash near Roschino Aerodrome.

At 01:43 the aerodrome fire trucks with search and rescue teams of Tyumen Airport (Roschino) arrived at the gathering site (threshold 03 of RWY 03/21) (13 persons, 3 vehicles) and after a briefing they were sent to the accident site.

The crew of an ATR42-500 aircraft registered VQ-BLK that departed at 01:43:14 was asked to examine the takeoff area. The PIC of the ATR42-500 VQ-BLK informed that he saw smoke and destroyed fuselage of the ATR72–201 VP-BYZ on the ground along the takeoff course.

At 01:48 the Search and Rescue Coordination Center (SRCC) of the FOI "Ural Aviation Search and Rescue Center" received a phone call from the ATC shift supervisor of Roschino aerodrome (Tyumen) saying that the ATR72-201 VP-BYZ aircraft did not contact any air traffic control center after it had departed at 01:33.

The Tyumen Area Center of the Unified ATM System sent an alarm message to the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center".

At 01:48 the ground search and rescue team (11 persons, 2 vehicles) of the Roschino Airport (Tyumen) headed by the chief of the Search and Rescue Service of Roschino Airport was given a task by the search and rescue operations supervisor (Deputy Head-in-Charge of the Roschino Airport Dispatch Office) to set off for the accident site and start search and rescue operations.

At 01:49 a fire truck from Gorkovka settlement arrived at the accident site (2 persons, 1 vehicle) and the crash and rescue operations were initiated (the given time indicates the engagement of the first fire-hose barrel).

At 01:54, following a decision of the head of search and rescue operations in order to enhance the search and rescue forces a "Ready for Action" signal was sent via the ATC shift supervisor of Nizhnevartovsk Aerodrome to the crew of a search and rescue aircraft Mi-8T RA-25221.

At 02:03:

- the shift supervisor of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the Main Search and Rescue Coordination Center;

- a dispatch officer of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to a duty officer of the Ural EMERCOM Area Center;

- ambulances (12 persons, 4 vehicles) and accident medical center brigades (6 persons, 2 vehicles) arrived at Roschino AP.

At 02:04:

- fire brigades of Fire Station 123 of the 32nd Division of the Federal Fire Fighting Service for Tyumen Region (7 persons, 2 vehicles) arrived at the accident site;

- Tyumen Regional Emergency Response Team (8 persons, 2 vehicles) arrived at the accident site.

At 02:05:

- a dispatcher of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the EMERCOM headquarters for Tyumen Region;

- an emergency response team of the EMERCOM headquarters for Tyumen Region (5 persons, 1 vehicle) arrived at the accident site.

At 02:06 a dispatcher of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the Tyumen Accident Medicine Territorial Center and Tyumen Areal Hospital.

At 02:08 following the decision of the Head of search and rescue operations in order to enhance the search and rescue forces a "Ready for Action" signal was sent via the ATC shift supervisor of Khanty-Mansiysk AD to the crew of a Mi-8T RA-25307.

At 02:10:

- dispatcher of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the Flight Control Center 2 of the Air Forces and Air Defense Headquarters;

- security officers and security inspector of the Tyumen AP Security Service arrived at the accident site.

At 02:11 fire teams of the 13th fire station, 32nd Office of the Federal Fire Fighting Service for Tyumen Region (7 persons, 2 vehicles) arrived at the accident site.

At 02:12 dispatcher of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the officer on duty of the Office of Interior for Ural Federal Region.

At 02:12 ambulances of the Accident Medicine Center (6 persons, 2 vehicles) arrived at the accident site.

At 02:15:

- a Mi-8T RA-22633 search and rescue helicopter owned by UTAir departed from Roschino (Tyumen) AD with a search and rescue team from Tyumen Area Search and Rescue Station as well as a crash and rescue team on board;

- dispatcher of the Area Search and Rescue Station of FOI "Ural Aviation Search and Rescue Center" reported the accident to the officer on duty of the Central Military District;

- officers of the Department of Motor Vehicles and Traffic Control (4 persons, 2 vehicles) arrived at the accident site.

At 02:17 the PIC of the Mi-8T search and rescue helicopter found the accident site.

At 02:18 the Mi-8T RA-22633 owned by UTAir landed at the accident site. The search and rescue team of the Tyumen Area Search and Rescue Station (3 persons), as well as 5 maintenance technicians of UTAir Technic LLC and 2 medical men started rendering medical aid to the injured and evacuating them. Apart from the dead passengers and crew, 13 heavily injured passengers were evacuated. One passenger died after the evacuation, while being transported, and 2 other passengers died later on in hospital.

The search and rescue helicopter with the search and rescue team on board arrived on time at the accident site.

At 02:19 the accident site was cordoned off by the police.

At 02:20 the major search and rescue group from Roschino AD (9 persons, 1 vehicle) arrived at the accident site.

By the time the aerodrome search and rescue group arrived the fire hotbed had been extinguished and the site was being watered.

At 02:20 Tyumen Region Training Fire Station staff arrived at the accident site (5 persons, 1 vehicle).

At 02:21 staff of the Public Prosecutor's Office for Tyumen Region (6 persons, 2 vehicles) arrived at the accident site.

At 02:21 Specialized Fire Station of the Federal Fire Fighting Service for Tyumen Region (4 persons, 1 vehicle) arrived.

At 02:21 fire fighting teams of the 14th fire station, 32th office of the Federal Fire Fighting Service for Tyumen Region (5 persons, 2 vehicles) arrived at the accident site.

At 02:23 Tyumen Region administrative staff arrived at the accident site.

At 02:25 Head of the Main Office of the EMERCOM for Tyumen Region arrived at the accident site.

At 02:25 Prosecutor for Tyumen Region arrived at the accident site.

At 02:26 fire fighting teams of the 40th fire station, 32th office of the Federal Fire Fighting Service for Tyumen Region (7 persons, 2 vehicles) arrived at the accident site.

At 02:29 staff of the Federal Security Service Office for Tyumen Region (6 persons, 2 vehicles), arranging custody of the accident site.

At 02:31 emergency response center was created as well as hot line communication.

At 02:33 the Mi-8T RA-22633 search and rescue helicopter owned by UTAir took off to evacuate 5 injured passengers to Roschino AD.

At 02:38 the Mi-8T RA-22633 helicopter landed at Roschino AD, the 5 injured passengers were disembarked and rendered first aid, one of the injured died during the transportation.

At 02:40 fire fighting teams of the 15th fire station, 32th office of the Federal Fire Fighting Service for Tyumen Region (8 persons, 2 vehicles) and 67th fire station (3 persons, 1 vehicle) arrived at the accident site.

At 02:46 a Mi-8T RA-22633 search and rescue helicopter took off from Roschino AD heading to the accident site.

At 02:50 the Mi-8T landed at the accident site and the injured were embarked with the help of the search and rescue group of the Tyumen Area Search and Rescue Service.

At 02:50 the inquiry team of the Committee of Inquiry, Russian Federation arrived at the accident site (6 persons, 2 vehicles).

At 02:59 the Mi-8T RA-22633 search and rescue helicopter took off from the accident site taking 7 injured passengers to Roschino AD.

At 03:03 the Mi-8T RA-22633 helicopter landed at Roschino AD, the 7 injured were disembarked and rendered first aid.

At 03:03 4 injured passengers were taken by ambulances from Roschino AD to the Regional Hospital No.2.

At 03:05 following the decision of the Head of search and rescue operations in order to enhance the search and rescue forces a Mi-8T RA-25221 helicopter departed from Nizhnevartovsk AD.

At 03:07 following the decision of the Head of search and rescue operations in order to enhance the search and rescue forces a "Ready for Actions" signal was sent via the ATC shift supervisor of Roschino AD to a Mi-8T RA-24592 search and rescue helicopter from Tobolsk AD.

At 03:12 a Mi-8T RA-22633 search and rescue helicopter departed from Roschino AD to the accident site.

At 03:15 the Mi-8T RA-22633 landed at the accident site.

At 03:22 a mobile control station arrived and deployed at the accident site (11 persons, 5 vehicles).

At 03:34 following the decision of the Head of search and rescue operations in order to enhance the search and rescue forces a Mi-8T RA-24592 search and rescue helicopter took off from Tobolsk AD.

At 03:50 the "Ready for Action" signal was cancelled for the Mi-8T RA-25307 search and rescue helicopter and the search and rescue group from Khanty-Mansiysk AD.

At 03:54 following the decision of the Head of search and rescue operations, due to worsening weather conditions along the flight route, the Mi-8T RA-25221 search and rescue helicopter owned by JSC Nizhnevartovskavia with a search and rescue group on board returned to Nizhnevartovsk AD.

At 03:55 7 ambulance brigades evacuated 7 injured passengers from Roschino AD to Tyumen Regional Hospital No.2.

At 04:03 the Ми-8T RA-22633 search and rescue helicopter took off from the accident site, one injured person was evacuated to Patrushevo helipad of the Regional Hospital No.1.

At 04:11 the Mi-8T RA-22633 search and rescue helicopter landed at Patrushevo helipad 1 injured person was disembarked and taken to Patrushevo Regional Hospital No.1.

At 04:17 the Mi-8T RA-22633 helicopter departed from Patrushevo helipad.

At 04:23 the Mi-8T RA-22633 helicopter landed at the base aerodrome of Roschino.

Within the time period between 02:15 and 04:23 the Mi-8T search and rescue helicopter registered RA-22633 conducted 7 flights and evacuated 12 injured passengers (1 of the injured died during the transportation) to Roschino AD and one injured person to Patrushevo helipad of the Regional Hospital No.1.

At 04:53 the Mi-8T RA-24592 helicopter landed at Roschino AD.

At 06:37 the Mi-8T RA-24592 departed from Roschino AD.

At 07:35 the Mi-8TRA-24592 landed at the base airport of Tobolsk.

At 09:40 following the decision of the Head of search and rescue operations the search and rescue operations were completed.

At 10:40 the evacuation of bodies from the accident site was completed and the search and rescue operations came to an end..

The search and rescue operations involved 20 persons and 2 vehicles from Roschino AD (Tyumen), 3 persons from Tyumen Area Search and Rescue Station of Federal Official Institution "Ural Aviation Search and Rescue Center", as well as 153 persons and 46 vehicles of various functional and areal offices of the Russian Unified Emergency Prevention and Recovery System.

In addition to that, the forces and facilities of the Ural Area Center and Main Office of the EMERCOM for Tyumen Region (82 persons, 12 vehicles, including a Mi-8 helicopter registered 32824) as well as of the areal subsystem of the Russian Unified Emergency Prevention and Recovery System for Tyumen Region (56 persons, 24 vehicles) were involved in the operations.

Additionally, following the decision of the top management of the Russian EMERCOM and Head of the Crisis Management Department, the search and rescue operations were participated by the human forces and facilities of the "Centrospas" group (11 persons), the Control Stations Support Center of the EMERCOM (4 persons, 2 vehicles), Urgent Psychological Aid Center (7 persons), the EMERCOM Federal State Unitary Aviation Enterprise (FSUAE) (13 persons, 1 vehicle, i.e. an Il-76 aircraft registered 76840).

The following human resources and facilities were made ready for action: the 294$^{th}$ Center for Extremely Risky Rescue Operations, called Leader (26 persons, 2 vehicles), the EMERCOM FSUAE (19 persons, 2 vehicles, namely an Il-76 registered 76845 and a Yak-42 registered 42441), the "Centrospas" group (25 persons, 3 vehicles), the Federal Fire Fighting Service for Tyumen Region (18 persons, 5 vehicles) as well as the medical service of Tyumen Region (84 persons, 28 vehicles).

The information on the activation of the COSPAS-SARSAT ELT, mounted on the ATR-72-201 VP-BYZ aircraft, was received by Bermuda as the State of Registry at 02:47 (after communication session with S10 satellite within the time period of 02:26 – 02:34). The COSPAS-SARSAT International Mission Control Center (Moscow) received the information from the French Mission Control Center at 02:55 (after communication session with S07 satellite within the time period of 02:32 – 02:44) and this information was transmitted to the State Search and Rescue Coordination Center (Moscow) at 02:58.

The Urals Search and Rescue Coordination Center received the information about the accident from the Tyumen (Roschino) airport Flight Control officer by phone at 01:48.

Since the accident occurred at 01:35 in the vicinity of the aerodrome the rescue operations were started just after the accident.

Because at the time when the information about ELT activation was received by the State Search and Rescue Coordination Center (Moscow) the search and rescue operations had already been started the information about ELT activation was not forwarded to the Urals Search and Rescue Coordination Center.

Within the investigation it has been established that the COSPAS-SARSAT alerts were received at the time indicated above because of the following reasons:

-within the time period 01:02 – 02:12 there were no COSPAS-SARSAT satellites over the accident area;

-the first communication session with S12 satellite within the time period 02:12–02:18 had limited angle of elevation (maximum value of ~5°), ELT activation was not detected by the COSPAS-SARSAT system;

-the first signal was received by the COSPAS-SARSAT system after communication session with S10 satellite within the time period 02:26 – 02:34 (maximum value of angle of elevation ~9°). The accident site position was not detected and the alert messages were transmitted at 02:47 to Bermuda (aircraft and ELT State of Registry) only. There was no information received by the International Mission Control Center (Moscow) from Bermuda;

-after the next communication session with S07 satellite within the time period 02:32 – 02:44 (maximum value of angle of elevation ~28°), at 02:55 the alert signal was received by the International Mission Control Center (Moscow) from French Mission Control Center with the accident site position 57.094N 065 15.7E - the area of responsibility of the Russian Federation. At 02:58 the alert signal was transmitted to the State Search and Rescue Coordination Center (Moscow) and to the Federal Service for Transport Oversight duty desk (Moscow).

In case of ELT registration in the Russian Federation database, International Mission Control Center (Moscow) would have received the first signal too (without accident site position), registered by the COSPAS-SARSAT system after the communication session with S10 satellite within the time period 02:26 – 02:34.

## 1.16. Tests and Research

### 1.16.1. Engineering Simulation

The engineering simulation was performed by ATR on request of the investigation team. The purpose of this simulation was to estimate the actual aircraft aerodynamics (drag and lift)

based on the DFDR parameters of the accident flight and to compare them to the type aircraft parameters. The six Degrees of Freedom simulation software was used for the simulation.

To calibrate the parameters and estimate the consistence of the simulation, the DFDR data available from the previous flight (Flight UTA119, from Surgut to Tyumen) was used. The simulation was based on the takeoff weight and CG data from the load and trim sheet. The SAT was +6ºC at the time of departure, i.e. there could be no contamination. The simulation revealed a good consistency of the simulated and recorded parameters (see Figure 41), thus validating the simulated aircraft motion during the takeoff run and takeoff. The simulation also revealed that before the rotation there was practically no forces on the control columns. During the rotation the control column forces were about 20 daN and then went to near zero after the climb pitch angle was established, which means the aircraft was stabilized.

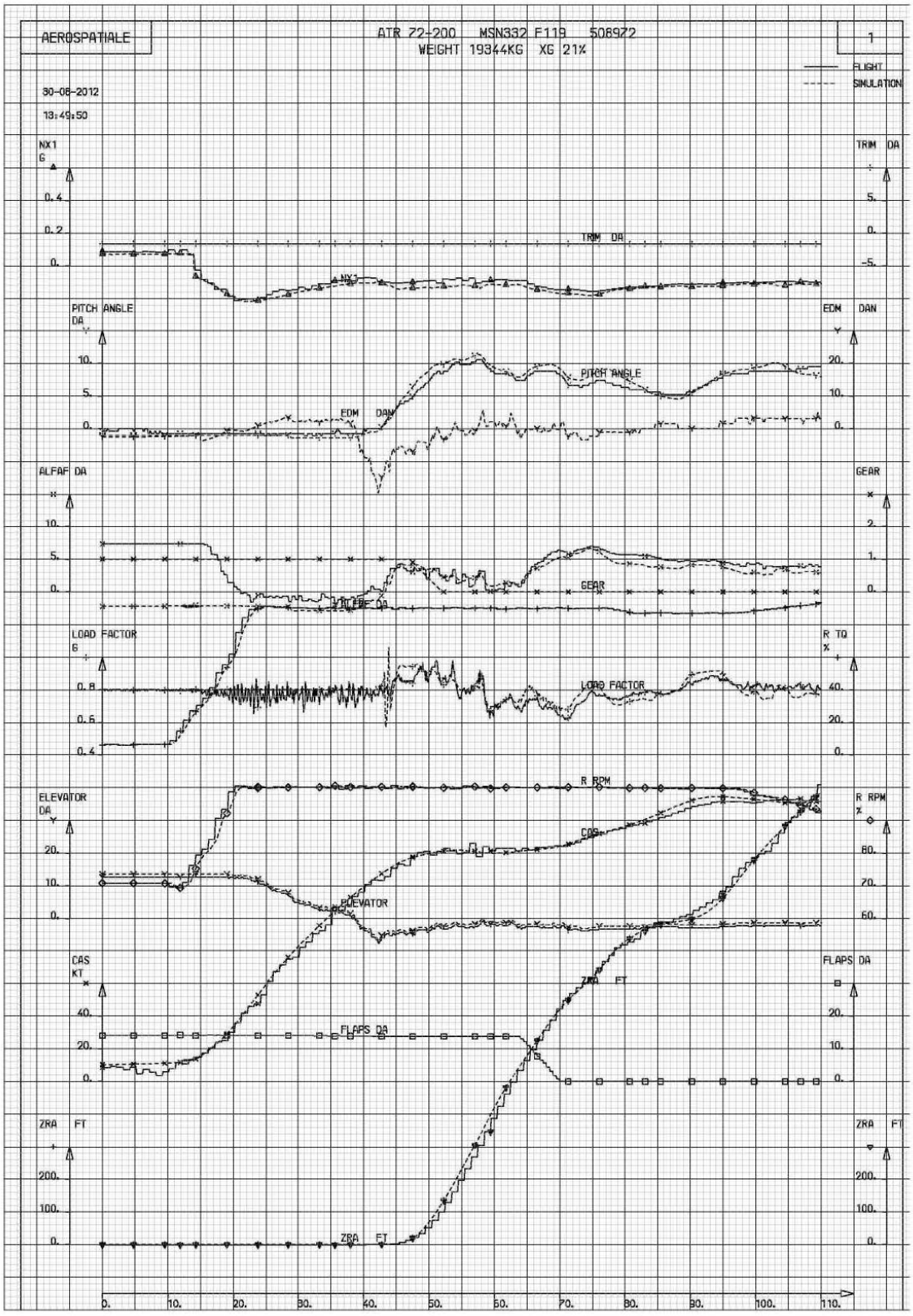



**Figure 41**. **Simulation compared to FDR, Flight UTA-119**

The simulation revealed that the actual drag and lift of the aircraft (Flight UTA-119) with flaps 15° (landing gear up and down) and flaps 0° (landing gear up) are well consistent with the aerodynamic data basis (Figure 42 and Figure 43).

Figure 1 : FLAPS 15° - LIFT VS ALPHA
Flight 119 & Data basis

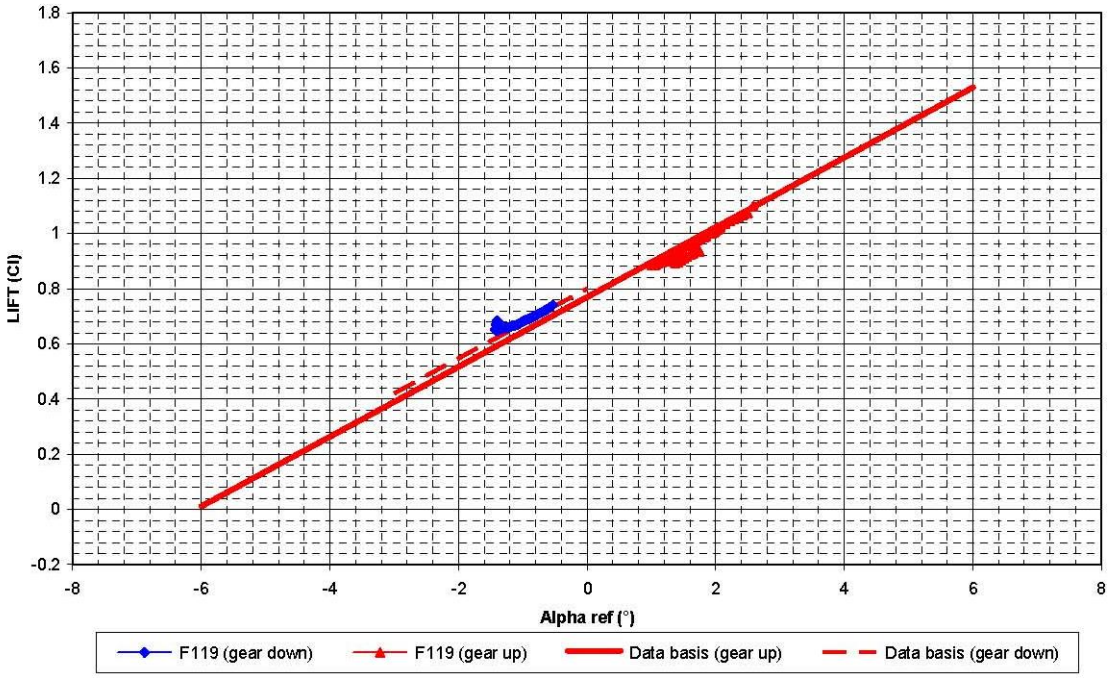



Figure 2: POLAR Flaps 15°
Flight 119 & data basis

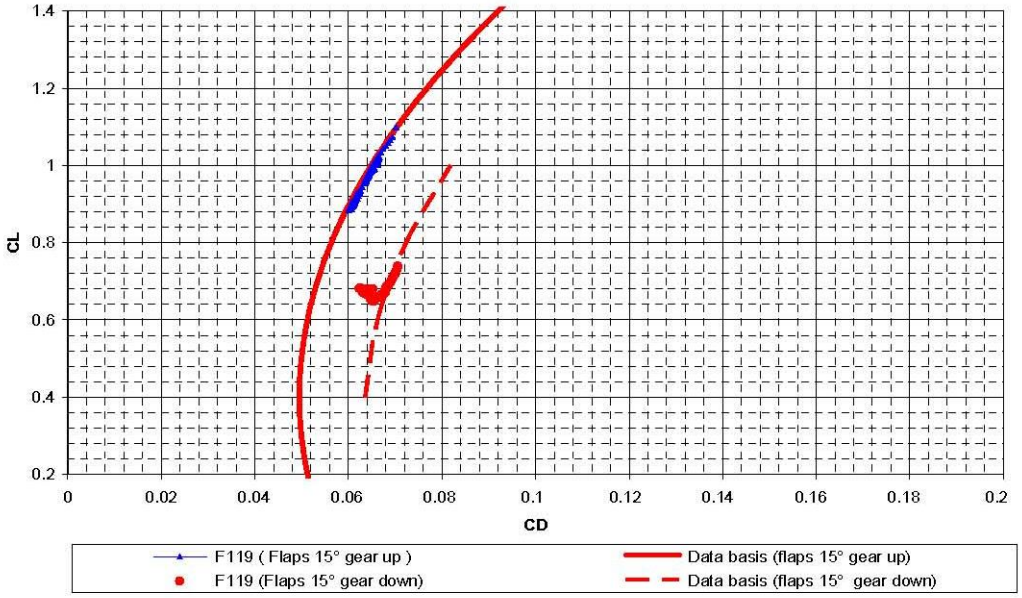
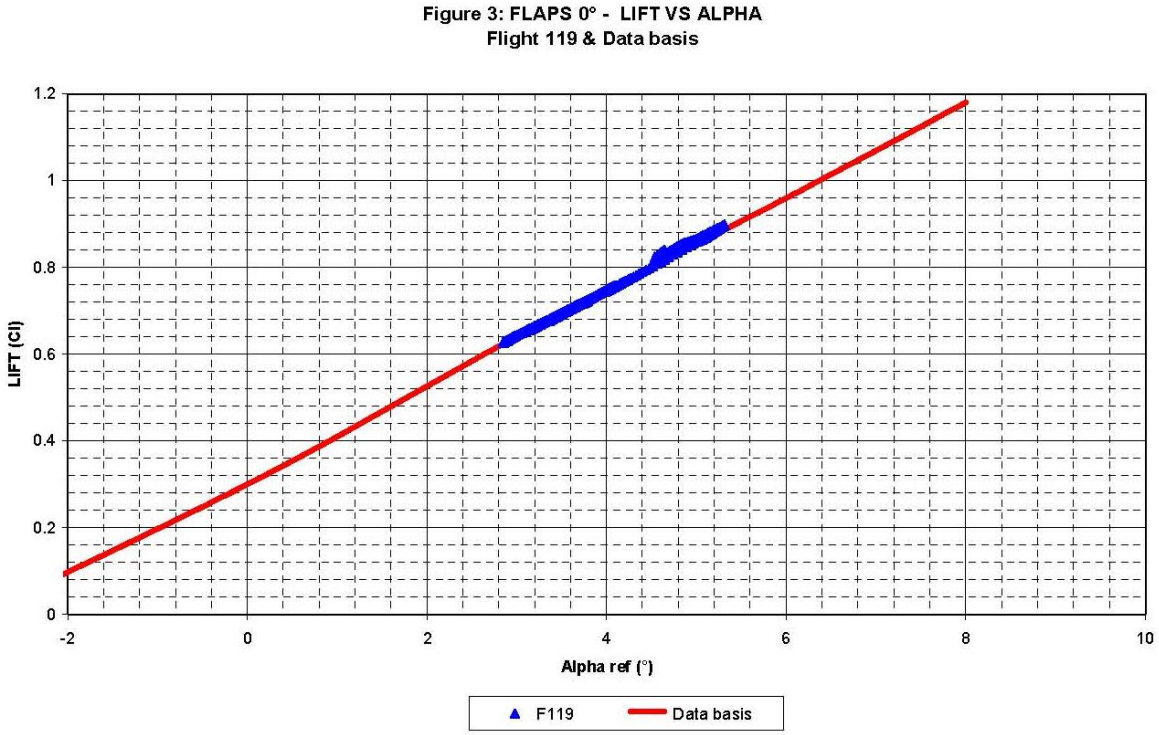



**Figure 42. Takeoff simulation Flight UTA-119 (Flaps 15°)**



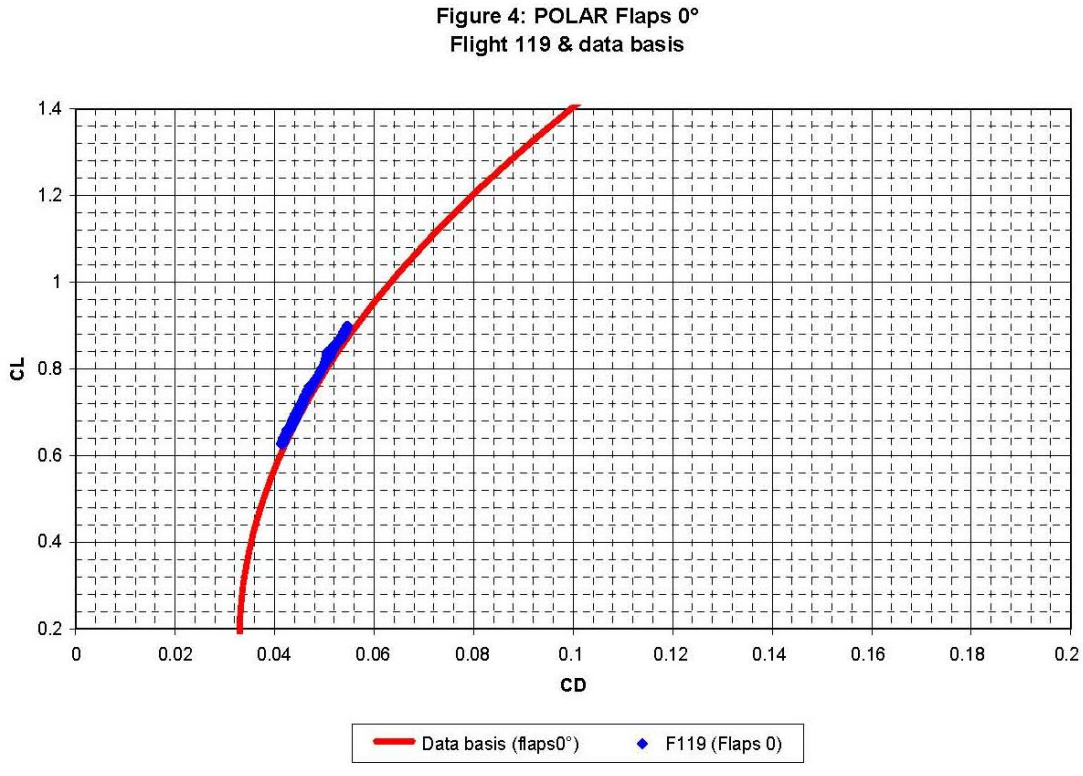




**Figure 43. Takeoff simulation Flight UTA-119 (Flaps 0°)**

The accident flight simulation (Flight UTA-120) showed that with the actually realized deflection of the flight control surfaces, engine thrust and the aerodynamic data basis, the simulation did not match the DFDR parameters (Figure 44).

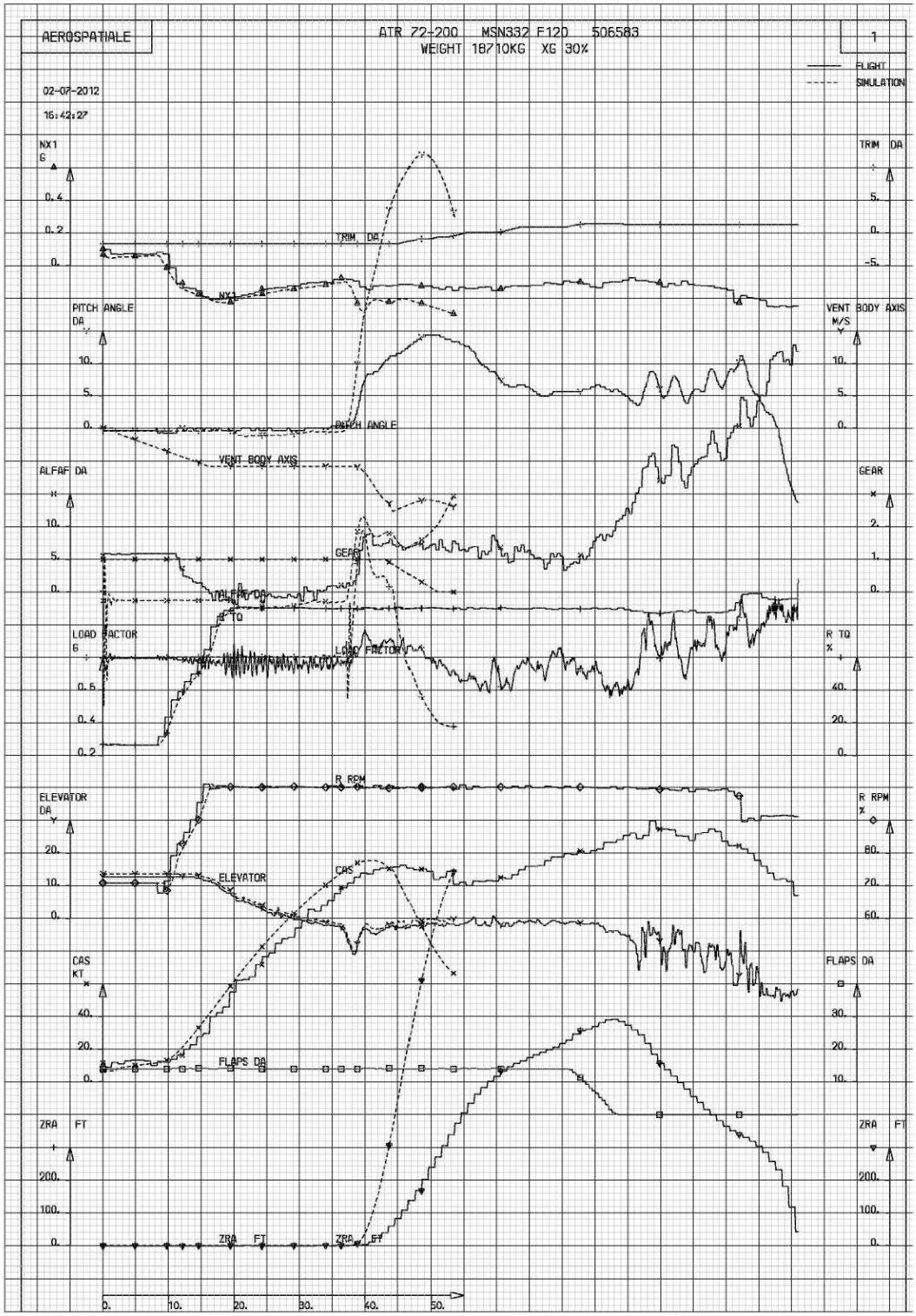



**Figure 44. Simulation compared to FDR Flight UTA-119 – without extra drag and lift**

At the next stage of the simulation the lift and drag were modified to make the simulation match the DFDR data taking into account the actual flight control inputs and thrust (Figure 45).

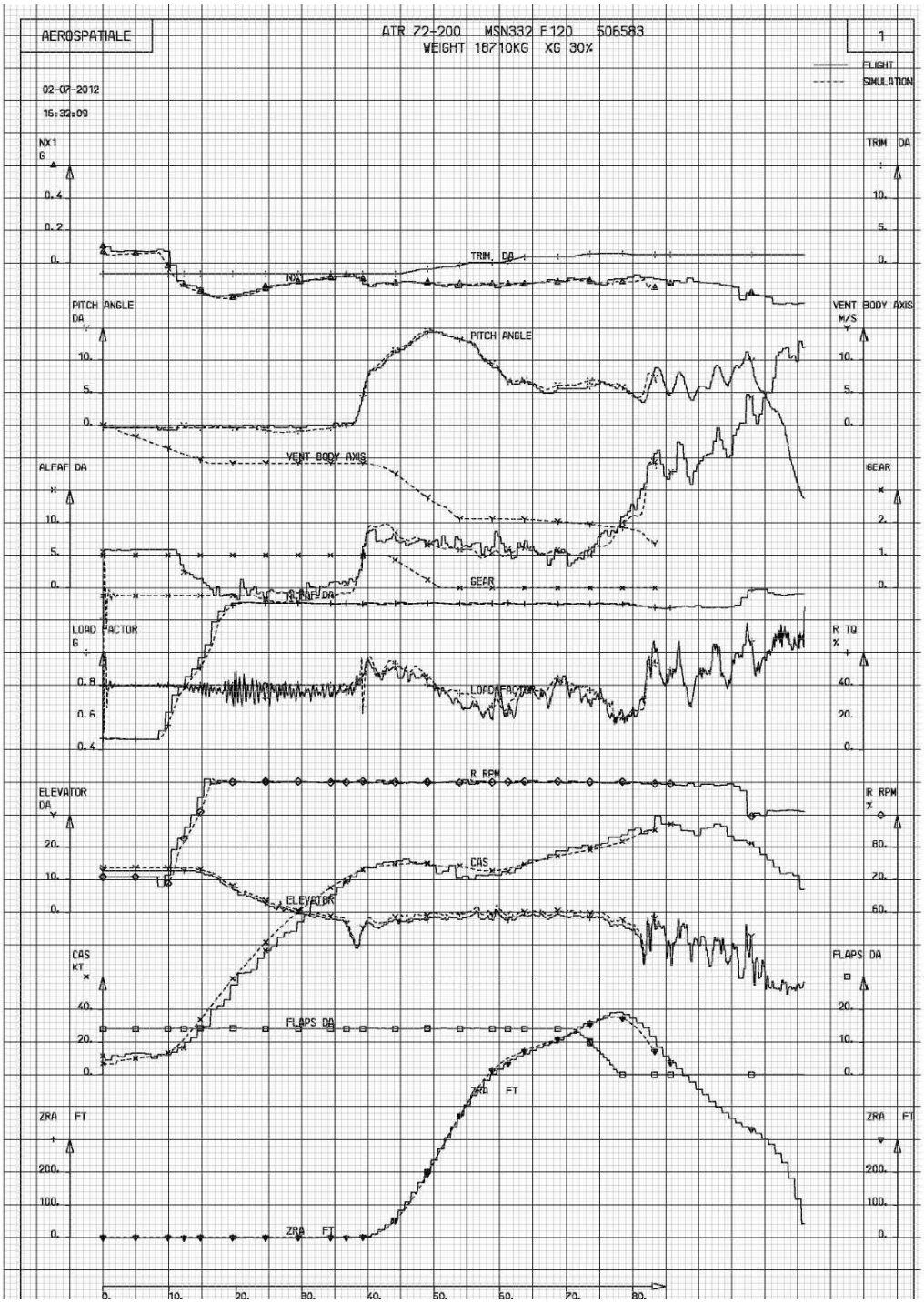



**Figure 45. Simulation compared to FDR Flight UTA-119 – with extra drag and lift**

The simulation revealed that during the takeoff run at angle of attack near 0°, a loss of lift and an increase of drag were $\Delta CL_0$= -0.23 and $\Delta CD_0$=0.05 (Figure 46). The graph analysis shows that at that phase of flight CL was reduced by approximately 25%, while drag was doubled. Further after the landing gear retraction the loss of lift remained more or less constant, while the drag increased with angle of attack, providing a $\Delta CD_0$=0.064 (Figure 46). After the flaps retraction the loss of lift still remained almost constant, while the drag increasing was $\Delta CD_0$=0.05 (Figure 47).

Figure 5: FLAPS 15° - LIFT VS ALPHA
Flight 120 & Data basis

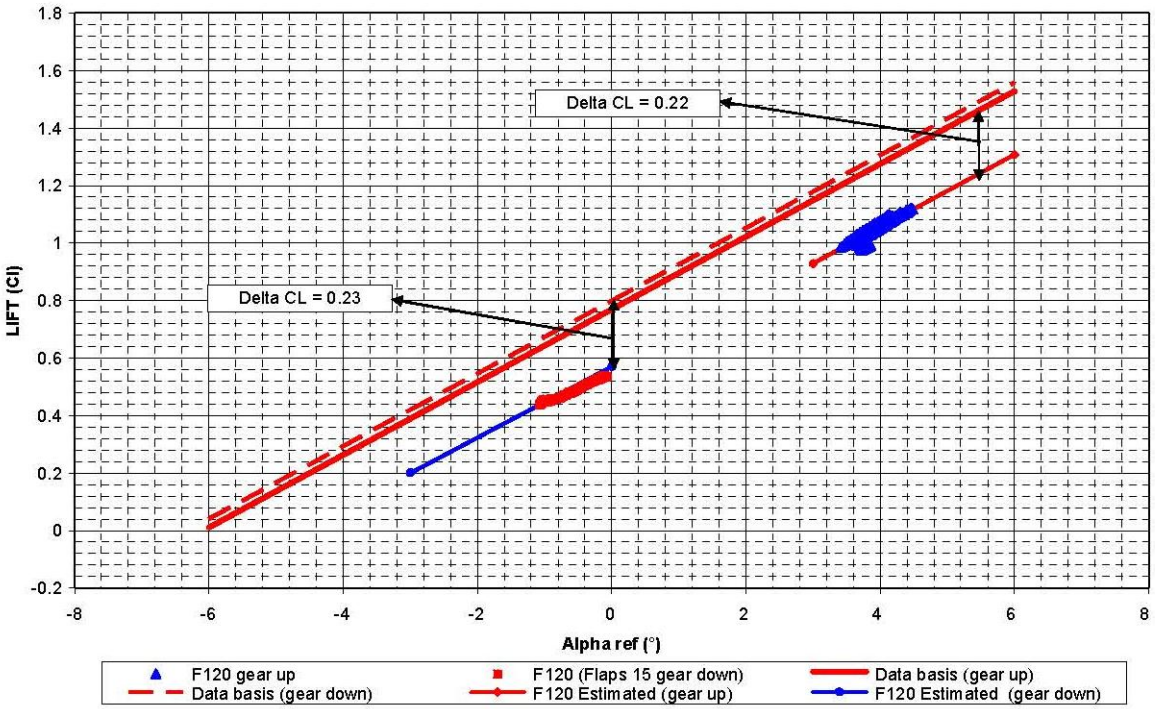



Figure 6: POLAR Flaps 15°
Flight 120 & data basis

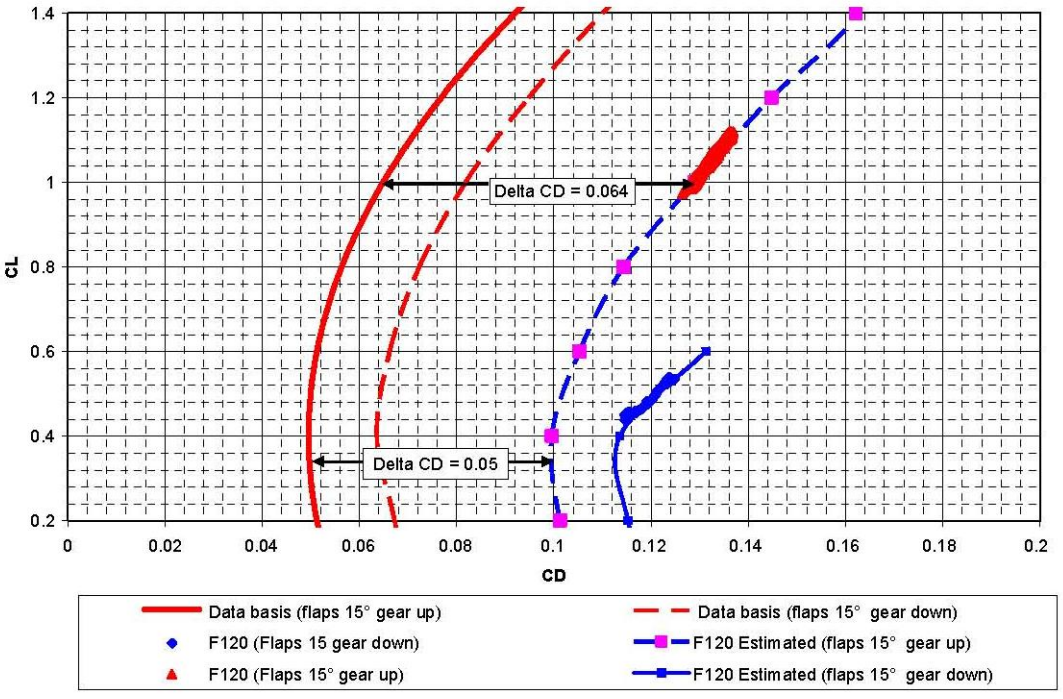



**Figure 46. Takeoff simulation Flight UTA-120 (Flaps 15°)**

Figure 7: FLAPS 0° - LIFT VS ALPHA
Flight 120 & Data basis

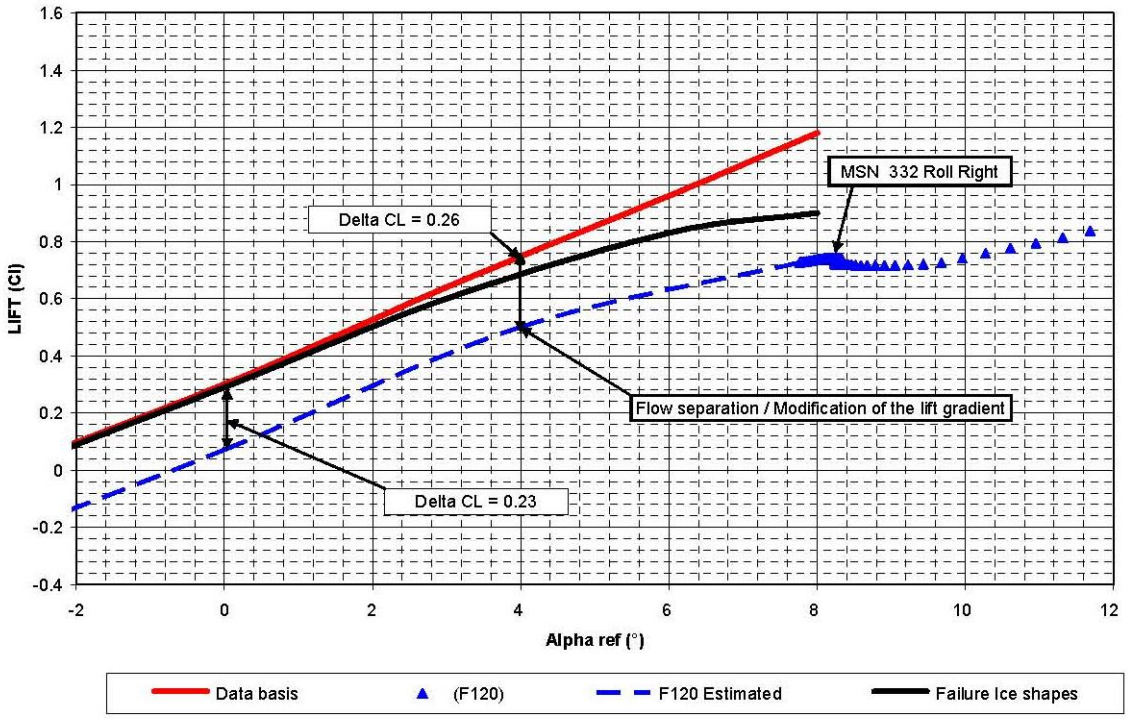



Figure 8: POLAR Flaps 0°
Flight 120 & data basis

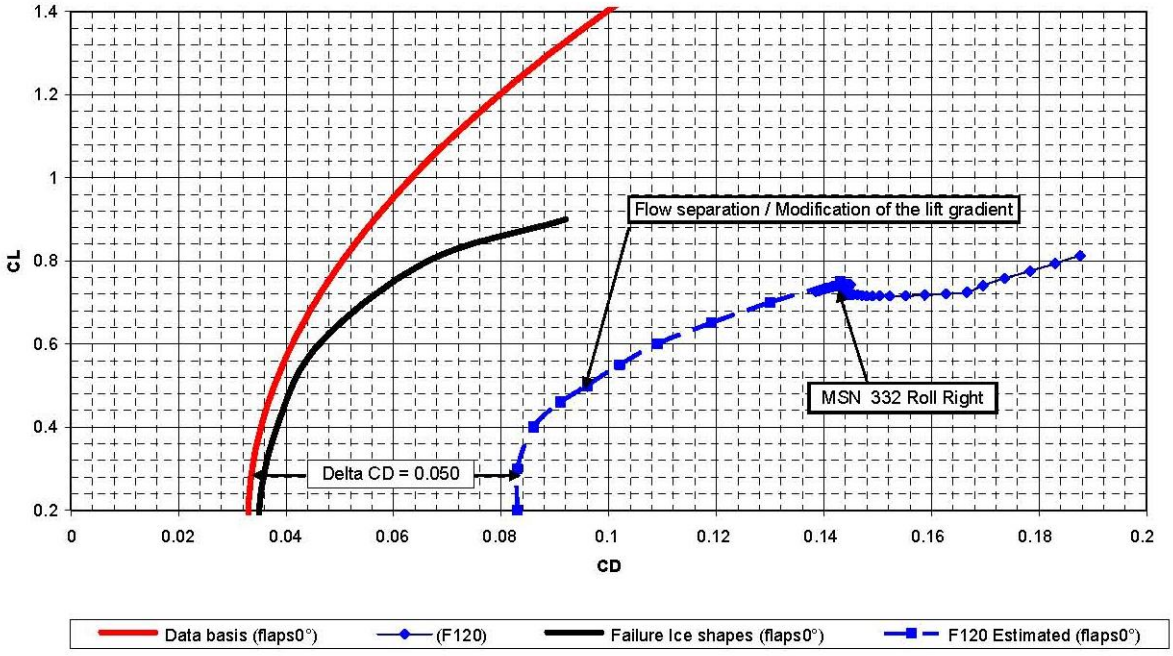



**Figure 47. Takeoff simulation Flight UTA-120 (Flaps 0°)**

When the aircraft has been contaminated on ground (with frost, snow or ice) the aerodynamic lift surfaces are affected and produce a loss of lift and an increase of drag. The other surfaces (fuselage, fairing, nacelles, etc.), when contaminated, produce additional drag due to modification of surface roughness and, consequently, friction. The angle of attack increase

does not change significantly the drag due to friction, but produces, because of early flow separation, a reduction of lift gradient, severe losses in maximum lift and large reduction in stall angle of attack.

First signs of flow separation appeared after 4° of angle of attack, and then the aircraft rolled right due to asymmetric loss of lift near 8° AOA.

Thus, the simulation revealed an inconsistency of the DFDR parameters (mainly the lift and drag) and the aerodynamic data basis for clean aircraft.

The significant change in control column forces after the liftoff (elevator trimmed to maximum pitch down) is typical for upper surface pollution of the tail plane, which results in a change of air flow around the elevator and, consequently, to a change of elevator hinge moment. According to the aircraft manufacturer's data, such incidents had occurred before. The plot below shows the simulated pilot's control column forces with basic hinge moment for a clean aircraft with DFDR elevator trim data. Figure 48 reveals that if the aircraft had been clean the crew would have experienced significant pitch up control column forces, while they actually trimmed the elevator for pitch down.

Simulation start: 1h 22mm 00

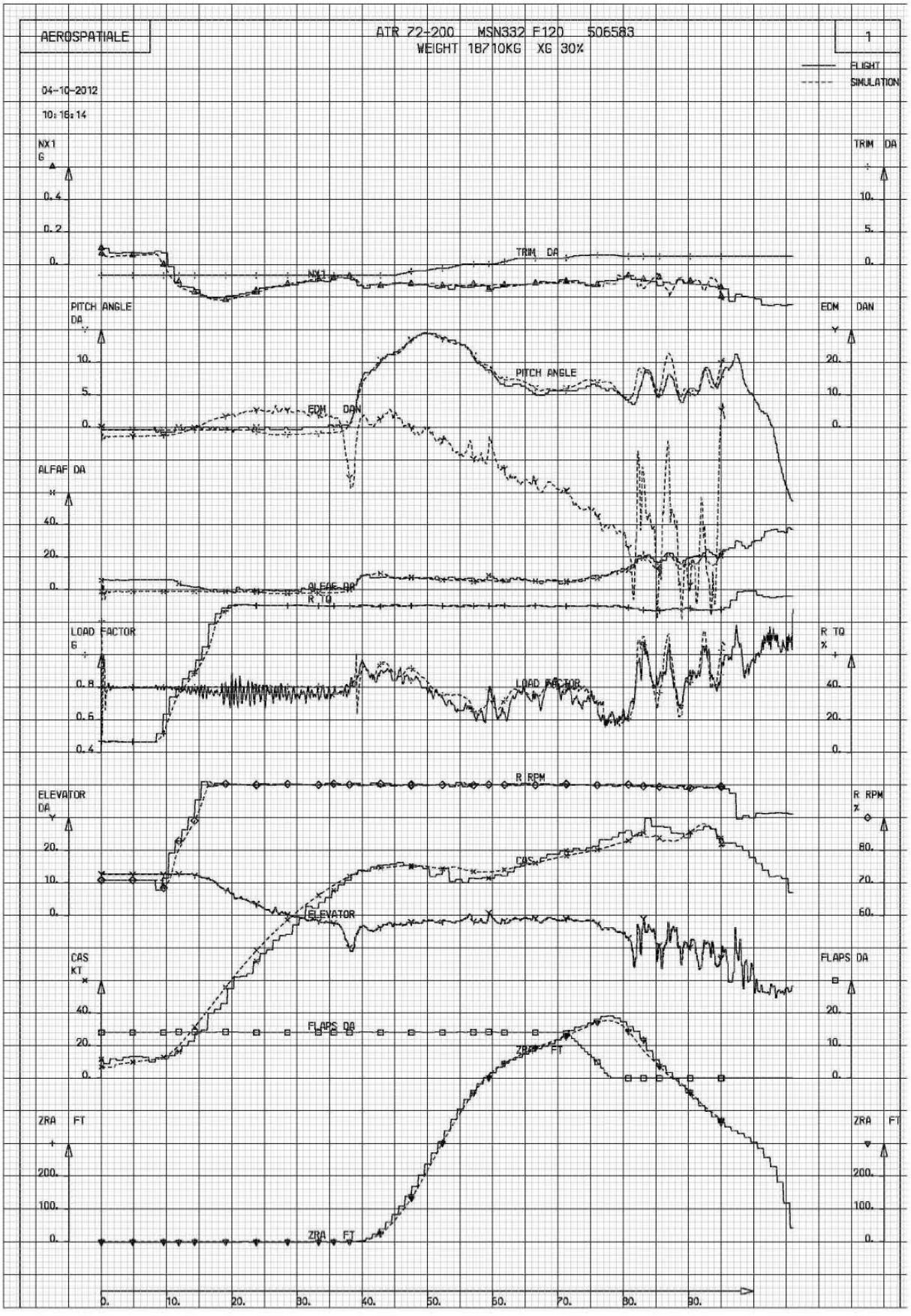



**Figure 48. Simulation of Flight UTA-120 with basic hinge moment**

A comparison of simulated results with ice shapes tests ("boots failures case" - ice shapes corresponding to 1.5 inch of ice on the leading edge protected with boots and 3 inches ice shapes on the leading edge unprotected areas, Figure 47) revealed that the performance degradation in the accident flight was significantly greater than in the boot failure case. Taking into account that the aircraft had stayed outside the night before, in ground icing conditions, and was not deiced before departure, its upper surfaces (wing, stabilizer and fuselage) were evidently completely contaminated, including during the takeoff run. According to the aircraft manufacturer's estimation, the contamination level in the accident flight in term of surface roughness was about 4 mm.

Another conclusion drawn in the course of the simulation was that having the actual aerodynamic parameters it was impossible, after the flaps retraction, to obtain the lift required to continue flight at the current speed. It could be drawn from Figure 49 that the AOA increase cause stall before reaching the required CL. Thus, it was impossible to recover without setting flaps 15°.

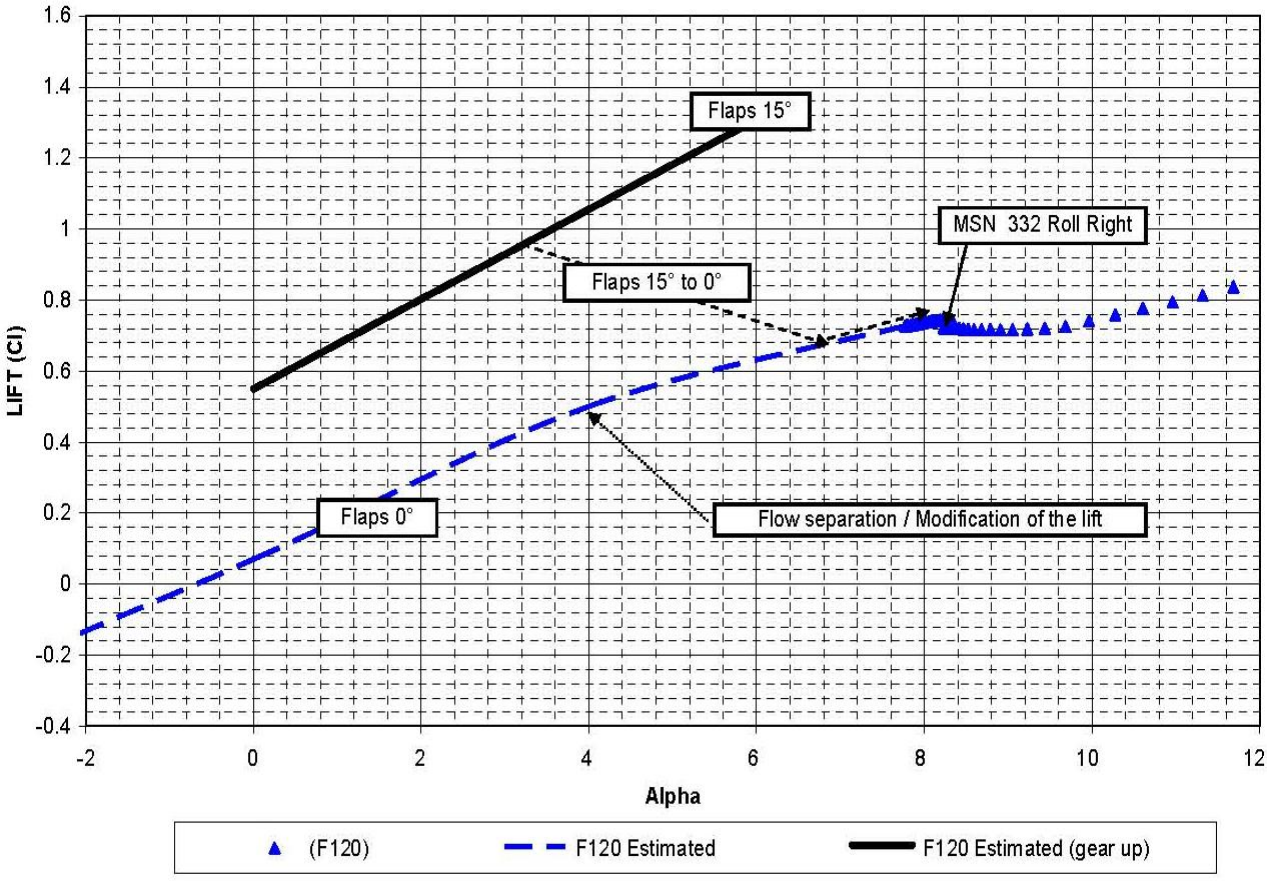



**Figure 49. Simulation of Flight UTA-120 (flaps 0°)**

### 1.16.2. FFS Test Flight

The FFS test flights were performed at the ATR facilities in Toulouse (France).

According to ATR, this FFS is used for training purposes only and simulates a clean aircraft. It is not possible to introduce in FFS the drag and lift computed with the engineering simulation for F120 with a polluted aircraft.

Nevertheless, the FFS has supplementary modules to simulate takeoff with the tailplane badly deiced as well as flight in conditions of normal and severe in-flight icing.

The analysis of drag and lift plots introduced in the FFS for severe icing conditions, and their comparison with the engineering simulation data (Figure 50) revealed that behavior of curves of CL versus alpha (AOA) in the FFS database and in the accident flight is almost similar (in linear range). They differ in absolute values (the curves are parallel) due to a difference in $CL_0$. The loss of lift after reaching the critical AOA as per the FFS database is more significant than in the accident flight.

The effect of the flaps extension (in the way it reduces the required angle of attack to reach the same CL) is comparable. Thus, the FFS test findings can be used to assess the possibility to recover the aircraft performance after the stall in the accident flight.

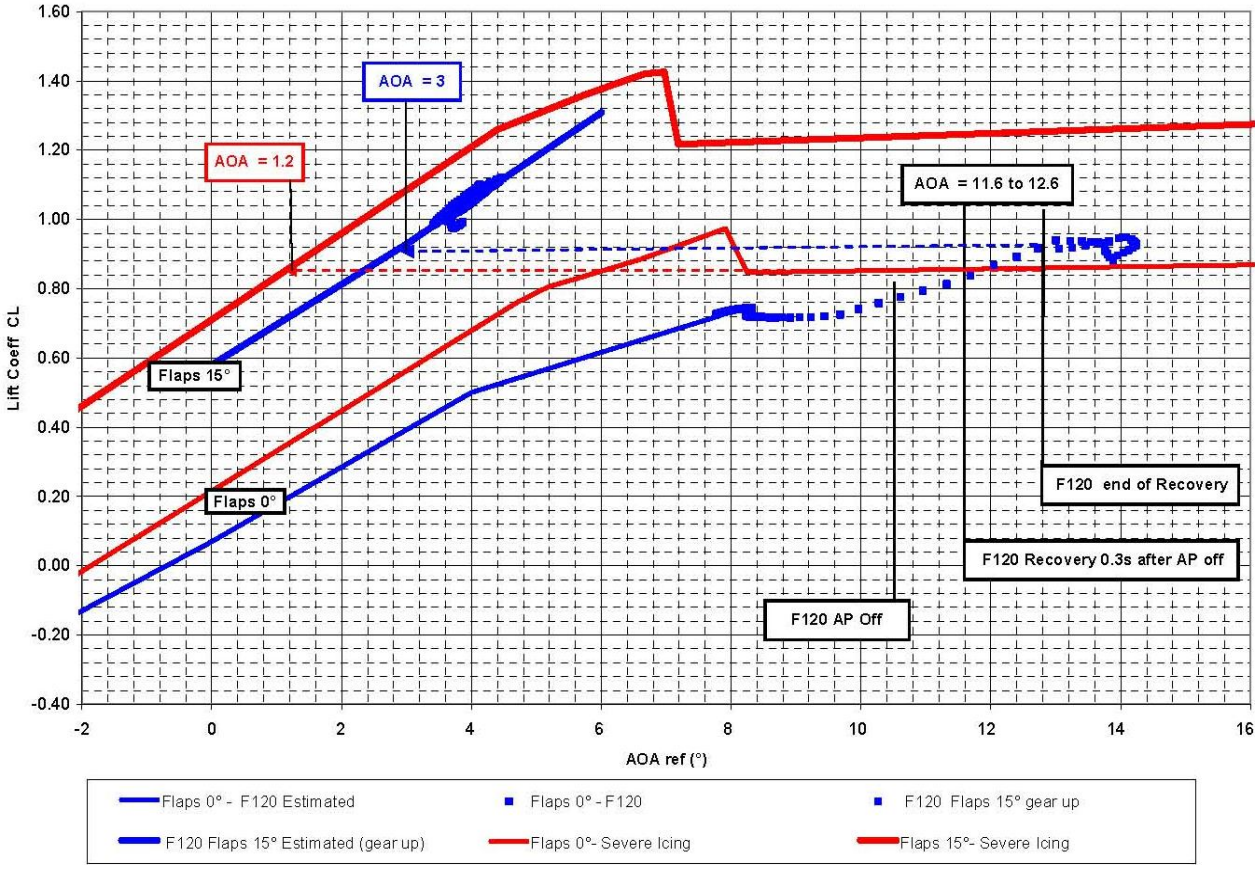



**Figure 50. FFS (severe icing) and FDR performance compared**

The FFS flights were performed, along with an ATR pilot-instructor, by an honored test pilot from GOSNII GA and a UTAir pilot-instructor.

The takeoff weight, trim and the weather conditions matched the actual accident flight values. The FFS program was divided into two parts:

**Part 1**

Normal takeoff with pitch trim of ≈ -0.7° pitch up corresponding to CG 30.72% MAC;

Normal takeoff with pitch trim of ≈ -1.7° pitch up corresponding to the one recorded in the FDR;

Takeoff with pitch trim of ≈ -1.7° pitch up and tailplane badly de-iced.

**Part 2 (stall recovery)**

In normal icing conditions: climb 140 kt, TQ 90% and NP 100% on engines 1 and 2, flaps 15°, gears up, autopilot ON, boots OFF, then flaps 0°.

The same was done for severe in-flight icing conditions.

The following results were obtained:

If the elevator is trimmed in compliance with the AFM recommendations, no extra trimming is required during initial climb.

If the aircraft is trimmed to pitch up more than recommended by FCOM it has a tendency to pitch up without pilot forces applied on the control column during takeoff run. After the takeoff, pilot flying needs to trim to pitch down.

If the aircraft takeoffs with contaminated tailplane it has an even greater tendency to pitch up without pilot forces applied on the control column. After the takeoff the pilot flying needs to perform extra trimming to pitch down.

In normal icing conditions, no significant effect was observed on the flight handling, the aircraft did not stall.

In severe icing conditions, the aircraft stalled after the flaps retraction. The crew was not able to recover without extending flaps. If the pilot flying performed the stall recovery as recommended in the AFM (push the control column, flaps 15°), with a 5-second delay needed to assess the situation and make a decision, the loss of altitude was between 300 and 400 ft.

### 1.16.3. Review of Standard Operating Procedures (SOP)

The review of the crew's SOP was performed by the investigation team based on the FDR and CVR recordings, the video of the airport as well as the ATR analysis (Doc. DT/CA-6590/12 of 21.11.2012).

Flight preparation, exterior inspection, preliminary cockpit preparation, and final cockpit preparation were assessed in terms of the SOP only by analyzing the available documents and video records. There are no FDR or CVR data for these phases.

According to the available information, the crew completed all the required procedures, including weather information receipt during the flight preparation stage.

The video analysis reveals that the exterior inspection was done by the PIC. The inspection was performed with certain deviations from the requirements of FCOM (Items 2.03.05 [external inspection] and 2.02.08 [additional requirements to external inspection under cold temperature]) as well as current internal UTAir regulations (flight preparation procedure (FOM Part A-8 Item 8.1.10), aircraft exterior inspection and De-Icing/Anti-Icing Program of UTAir Aircraft, Doc. РД-В6.022-02). The PIC made a rather brief inspection. For several seconds he stayed near the right engine, then proceeded along the sides of the fuselage, stopped at the left main gear and then went to the cockpit. This brief inspection could not allow the PIC to assess the condition of all aircraft elements in compliance with FCOM, including the condition of the upper surfaces. Thus, he could not have made a justified decision as to the necessity of de/anti-icing.

It was not possible to assess the crew actions during the cockpit preparation due to lack of objective data.

According to the SOP, during the Before Propeller Rotation procedures the crew should have announced the takeoff weight, CG, pitch trim setting for T/O and speed bugs (green bug ($V_1$), yellow bug ($V_r$), internal bug ($V_2$), white bug (flaps retraction in normal condition) and red bug (flap retraction in icing conditions)). Because CVR was switched on automatically during primary (right) engine start the information about completion of this procedure was not recorded.

The analysis of speed bugs position after the accident revealed that most obviously the yellow bug ($V_2$) and the red bug (minimum speed for flap retraction in icing) were correctly positioned. Other bugs are either absent or may have moved during the impact.

At the same time the crew failed to correctly set the pitch trim before the T/O. The actual elevator trim (≈ -1.65° pitch up) did not comply with the load and trim sheet data for CG of 30,72% MAC ((≈ -0.7° pitch up).

During the following flight phases, until the emergency situation arose, the crew complied with the SOP in general, with slight deviations that did not affect the accident.

It should also be mentioned, that during taxiing the crew selected on-board de-icing for over 6 minutes, which is neither recommended nor prohibited by the FCOM. While they watched the contamination removal the crew did not decide to return for ground de-icing, i.e. they did not comply with the clean aircraft concept envisaged by the regulations (AFM, FCOM, FOM).

As the emergency situation arises, the crew was not aware of the stall and did not perform FCOM Items 2.04.05 for stall recovery, which are memory items according to the SOP.

### 1.16.4. MFC Study

Upon a request from the investigation team, two multifunctional computes (MFC) found at the accident site were studied.

MFCs perform a number of functions on an aircraft, including support during the aircraft maintenance. To perform this function, the MFCs store, in their non-volatile memory, information on failures and defects for a number of aircraft systems, including the ice protection and flight control systems.

The MFC data readout was conducted at the facilities of their manufacturer, Airbus. The data were read out successfully from both MFCs.

The data analysis revealed no flight control or ice protection system defects during the accident flight. Neither were there any defects recorded that could have affected the outcome of the accident flight.

### 1.16.5. Fuel and Lubricants Analysis

In Conclusion No 101-2012/ЦС ГСМ-АК by the Federal State Unitary Enterprise State Research Institute for Civil Aviation POL Certification Center made by the results of the aviation fuel and oil samples quality, structure of the deposits on the fuel and oil filters, that were collected from the ATR-72-201 VP-BYZ A/C analysis, the following conclusions were made:

1. There were no complaints revealed concerning the quality of the fuel samples, collected on 02.04.2012, 26.03.2012 and 27.03.2012 from the vertical stainless steel tank-2000 No.26.

The values of the checked physicochemical quality indexes do not exceed the values of the GOST 10227-86 limitation.

2. As for the fuel samples, collected from the ATR72-201 VP-BYZ A/C main (inlet) fuel filter, the excesses were specified on the certain quality physicochemical indexes that can exist in fuel samples.

3. The oil samples, selected from the ATR72-201 VP-BYZ A/C oil system, were identified as the BP2380 oil. The values of the checked physicochemical indexes are on the level of the type values of the BP2380 oil.

The deposits, isolated of the fuel filter elements of the ATR72-201 VP-BYZ A/C have certain structural specific features: the higher content of the inorganic compounds and the presence of the great quantity of the water-soluble compounds.

### 1.16.6. Aircraft Trajectory Computation

The aircraft flight path was computed using the FDR and TAWS data.


**Figure 51. Flight trajectory and crew communications synchronized**

## 1.17. Organizational and Management Information

**UTAir Aviation, JSC**

UTAir is registered as a legal person, which, in accordance with the federal law "On state registry of legal persons", is recorded in the Unified State Register of Legal Persons under the state registry number of 1028600508991, Certificate 86 No.001650507 issued on 18.07.2008 by the Inter-District Inspection of the Federal Tax Administration No.1 for Khanty-Mansiysk Autonomous Region and Yugra.

UTAir activities include conducting internal and international commercial flight operations (Aircraft Operator Certificate No.006 issued on 21.09.2010 by FATA, Ministry of Transportation, RF). Flight operations involve the following A/C types: Tu-154M, Tu-134, Yak-40, An-2, Boeing 737-300/400/500/800, Boeing 757-200, Boeing 767, Gulfstream IV-SP, CRJ-200, Challenger-300, ATR 42/72, including R/Cs: Mi-8, Mi-8MTV/AMT, BO-105, AS-350/355. Aircraft are registered in the State Register of Civil Aircraft of Russia and the Bermudas, and have Certificates of Registration, Airworthiness Certificates and Noise Certificates.

The airline is approved for aircraft operations within the Russian Federation, Africa, Middle East, Europe, CIS countries, Middle Asia, Baltic states, Central and South-Eastern Asia, Oceania, North America and South America.

Base airdromes: Moscow (Vnukovo), Surgut, Tyumen (Roschino), Syktyvkar, Ufa, Khanty-Mansiysk, Cape Kamenny, Krasnoyarsk, Khabarovsk, Irkutsk, Samara.

The airline and its subsidiaries, apart from the flight operations, also perform aircraft repairs and maintenance. Their fleet included 223 airplanes and 338 helicopters.

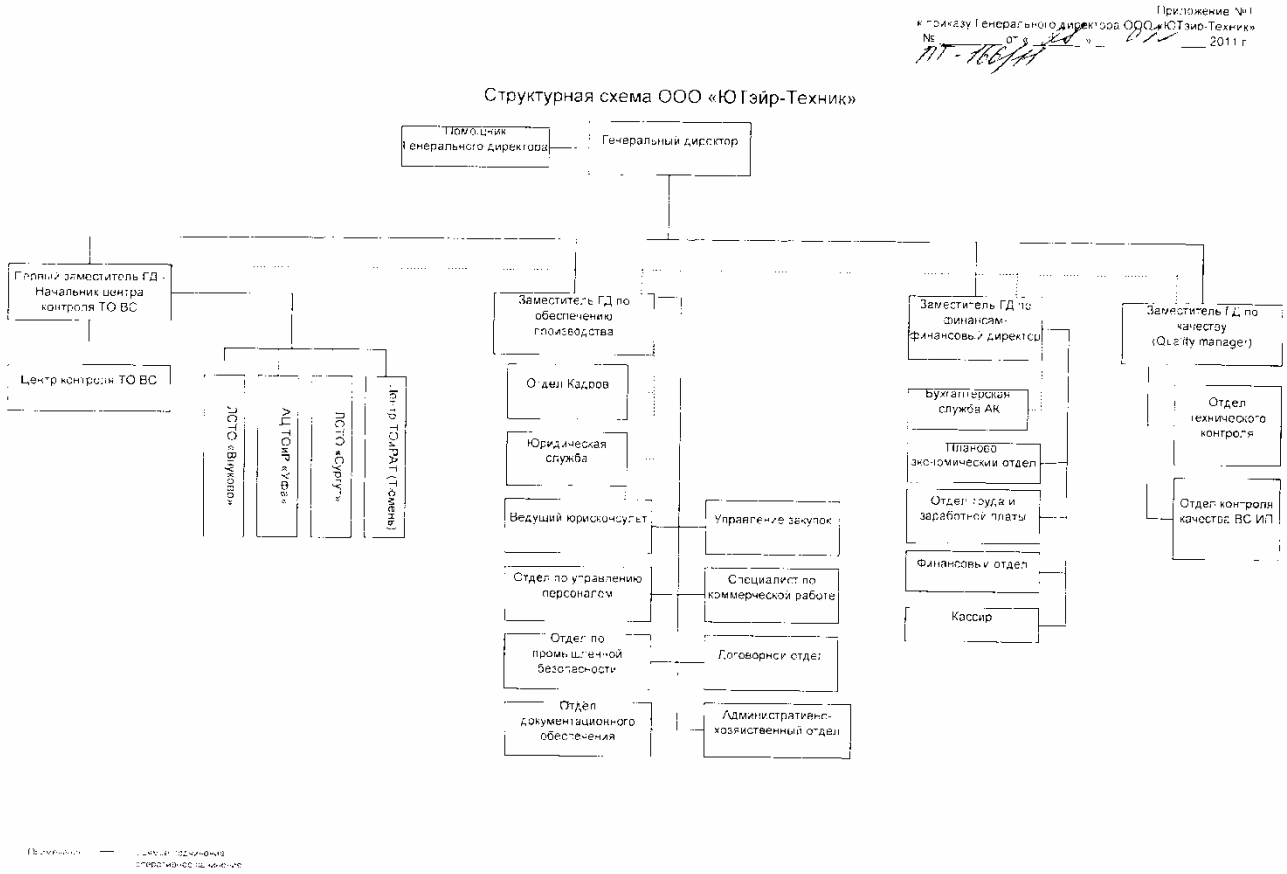
Monitoring of compliance by the airline with certification requirements is conducted by the Tyumen FATA ITO, MT RF, and regulatory oversight is conducted by the ROSTRANSNADZOR and the ROSTRANSNADZOR Office for Ural Federal District.

The latest unscheduled inspection of the base objects to check compliance with flight operations and maintenance regulations and rules was conducted in accordance with Directive No. ПМ -137-р of 03.10.2011 by the Head of the IAO AT, FATA from 11.10.2011 to 30.10.2011.

The Inspection Act remarks certain violations of the "Provisions on the Peculiarities of the Work and Rest Time of Flight Crews of Aircraft in the Russian Federation" (Order No.139 of 21.11.2005 by the Ministry of Transport, RF) as well as deviations in flight operations management with documents on pilots-instructors-examiners not being timely submitted.

In general, the inspection concluded that UTAir complies with the certification requirements for commercial aircraft operators.

**UTAir-Technic.**




In accordance with the Minutes of the UTair-Lising (Limited liability company) Oversight Council meeting No.34 of 17.12.2004 a joint decision to establish at Tyumen (Roschino) AD the UTAir-Technic company (Limited liability company) was taken, the main activity of which would be maintenance and repairs of aircraft. UTAir Technic holds Certificate 72 No.001360578, main registration number 1047200674652, entered into the State Register on 28.12.2004. The only stakeholder is UTair-Lising. Form of property – private. Russian Certificate of Compliance to FAP-145 No.2021110130, valid till 15.04.2013 was issued by FATA, MT RF. At the time of the accident, UTAir-Technic was approved for maintenance and repairs of Tu-134, Tu-154B/M, An-24/26, Yak-40, An-2, L-410, Yak-42, Gulfstream IV/V. The organization has subsidiaries in Surgut (Certificate of Compliance with FAP-145 No.2021110132, valid till 15.04.2013), Ufa (Certificate of Compliance with FAP-145 No.2021110224, valid till 21.06.2013г.), Vnukovo (Certificate of Compliance with FAP-145 No.2021110131, valid till 15.04.2013г.). At the time of the accident UTAir-Technic held a

European Certificate of Compliance with EASA-Part-145.0327, issued on 06.08.2008 and valid till 10.10.2012 and Bermudan Certificate of Compliance (BDCA) No.BDA/AMO293, valid till 14.07.2013 approving maintenance of ATR 42-200/300, ATR 72-100/200 and B737-300/400/500.

***Note:*** *After the accident, based on the EASA inspection results, the European and Bermudan Certificates of Compliance were suspended (for more detailed information see item 1.18.2).*

UTAir-Technic has a contract No.15/05 TO/-21-1T of 06.05.2005 for maintenance and repairs of UTAir aircraft and Agency Contract No.251 of 01.05.2005 with Roschino (Tyumen) AD concerning the provision by the Roschino AD of pertinent services when conducting maintenance of aircraft on the territory of the aerodrome and their mutual settlements.

**Maintenance**, for the purposes of the abovementioned Agency Contract with Roschino (Tyumen) AD (Item 1, Item 1.2), is understood as:

- *performing before departure and after-arrival checks*;

- *performing transit A-checks and other similar checks depending on the aircraft type;*

- *additional ground handling services upon request of airlines (de-icing with Arktika fluid, filling aircraft with oxygen, oil, etc.).*

The contract contains no mention of the quality control of services, provided by Roschino (Tyumen) AD. It does not stipulate the Agent's (Roschino AD) responsibility for providing specialists to operate de/anti-icing vehicles provided by the airport or the responsibilities of the contracting parties as to the training of the ground handling staff either.

As all the above mentioned operations, according to the contract, refer to **maintenance, including de-/anti-icing treatment,** all that is pertinent to staff training (including operators of de-/anti-icing vehicles), de-/anti-icing quality and quality control of aircraft readiness for flight in various operating conditions, refers to UTAir-Technic competence. The airport is responsible for providing operable de-/anti-icing vehicles with drivers as well as the de-/anti-icing fluids.

**Roschino (Tyumen) AP**

JSC Roschino Airport was founded as a result of restructuring of JSC Tyumen Airlines in the form of separation in compliance with Civil Code of the Russian Federation, the Federal Law "On Joint Stock Companies" and legal regulations of the Russian Federation. The Founder of the company is JSC Tyumen Airlines. The company is a legal successor of the JSC Tyumen Airlines as per the division balance sheet.

In compliance with the Federal Law "On State Registration of Legal Persons", an entry concerning JSC Roschino Airport, No.1027200783070 was recorded in the Unified State Register of Legal Persons on 22.08.2002.

JSC Roschino Airport was registered in the Interregional Inspection of the Federal Tax Agency No. 5 for the biggest tax-payers of Tyumen Region, TIN 7204660086, tax registration reason code 723150001.

Address: 23, Sergey Ilyushin Str., Tyumen, Tyumen Region, Russian Federation, 625033.

The Federal Energy Commission of the Russian Federation, in accordance with their Decision No. JIA-1182/13 of 13.04.2004, informed the investigation team, that JSC Roschino Airport is included in the Register of Transport Natural Monopolies Subjects, entry number 72/2/2, and is subject to state regulations and oversight.

JSC Roschino Airport, that holds a Certificate of Compliance for airport services, is the main aerodrome service provider at Roschino (Tyumen) AP. It also holds Certificate Registration No.69.

JSC Roschino Airport was founded with a purpose of airport services such as servicing of departing and arriving aircraft, commercial servicing of passenger, cargo and mail transportation on international and internal routes.

Organization activities (OKVED):

**63.23.1** – Airport terminal operations, airport management;

**63.23.3** – Runway operations;

**63.23.4** – Aircraft ground handling services.

JSC Roschino Airport conducts its activities at Roschino (Tyumen) AP, which is an international airport.

JSC Roschino Airport is a contracting company (Agent) that supports ground handling to aircraft of UTAir by providing de-/anti-icing vehicles and fluids.

The airport possesses 3 de-/anti-icing vehicles, stores de-anti-icing fluids (DAF), provides brief theoretical and in-depth training of de-/anti-icing vehicle operators of UTAir-Technic, LLC. Based on the training results, the Airport General Director issues an order to authorize staff of UTAir-Technic for de-icing vehicle operations. Based on this order, an order is issued by the General Director of UTAir-Technic, LLC that authorizes the above staff for de-/anti-icing. However, neither of the orders mentions the A/C condition assessment, de/anti-icing treatment quality control or communications with the A/C crew.

**Personnel Training Center, NPP**

The Organization Exposition of the Nonprofit Partnership "Personnel Training Center" defines that the Personnel Training Center was founded in order to assist its members in such activities that are connected with achieving certain training goals. The Founders of the Center are legal persons, including UTAir.

Legal address: 2, Andrey Tupolev Str., Tyumen.

The PERSONNEL TRAINING CENTER holds a Certificate for Training Activities No. 153 issued by the Deputy Head of the Russian CAA on 30.12.2009.

The Department for Training Licensing, Accreditation, Oversight and Control for Tyumen Region granted the Personnel Training Center License No.7221 of 13.07.2012 for training activities, including training:

- according to the ATR 42 transition training program for flight crews;
- according to the ATR 42(72) to ATR 72(42) transition training program for UTAir flight crews;
- according to recurrent language training program for UTAir flight crews.

In compliance with Order No. 298 "On the Implementation of ICAO International Standards for English Language Proficiency of Flight Crews" of the Ministry of Transport, RF of 12.09.2008, the raters/examiners of the Personnel Training Center that had undergone special training, were authorized for testing flight crews in order to rate their language proficiency in accordance with ICAO scale.

## 1.18. Additional Information

### 1.18.1. Flight Operations at UTAir

The structure of the Flight Department is provided in the chart below.


Based on the findings of inspections conducted by commissions of Ob ITO AT, FATA, the level of flight operations management complies with the certification requirements.

However, in the course of the investigation of the accident involving the ATR 72-201 VP-BYZ, the investigation team remarked a number of deviations in the work of the top flight officers and instructors that should be paid close attention to.

According to their annual report, in 2011 UTAir continued gathering pace as to the amount of operations. Within 2011 the passenger turnover increased by 39.3% comparing with 2010, passenger transfer by airplanes and helicopters increased by 31.3%, cargo transfer increased by 32.7%, and mail transfer increased by 25.2%. Total fleet flight time was 310640 hours, 17.8% more than in 2010.

In 2011 the number of such aircraft as Boeing 757-200, Boeing 737-400/500, CRJ-200, ATR 72 increased, while the fleet of Russian manufactured Tu-154M was reduced. This consequently led to a change in flight hours.

An increase in workload, transition to new aircraft types as well as regulation requirements as to the rest and work balance of flight staff made the Flight Department commission additional flight personnel and intensify the use of flight crews.

In 2011 the greatest amount of flight hours for a flight crew was:

- on CRJ-200 type – 726 hours (increased comparing to 2010, particularly due to a double increase of the aircraft number, by 98%, compared to 367 flight hours in 2010);

- on ATR 42/72 – 704 hours (decreased comparing to 2010 due to an increase of crew number by 19%, compared to 789 hours in 2010.);

- on Boeing 757-200 – 584 hours (increased by 42,8% compared to 2010);

-on Boeing 737 – 575 hours (decreased comparing to 2010 due to an increase of crew number by 13%, compared to 664 hours in 2010).

***Note:*** *The PIC had 895 flight hours in 2011, 704 hours in 2010, 737 hours in 2009. The F/O had 896 flight hours in 2011, 396 hours in 2010.*

In accordance with Order No.91 of 16.06.2008 by the Ministry of Transport, RF "On Introducing Changes to Order No.139 of 21.11.2005 by the Ministry of Transport", the following changes were introduced to the FOM of UTAir, Chapter 7 "Flight, work and rest time of flight crews" (Provisions on the peculiarities of work and rest time of flight crews of UTAir:

Item 11. The duration of flight time when performing flights on all types of aircraft cannot exceed 80 hours within one calendar month (in the previous edition it ran: "within 28 successive days"), 240 hours within 3 months, 800 FHs within a calendar year (previously: "and 800 hours within 365 successive days").

Item 12. The duration of flight time established by Item 11 of these Provisions, with written consent of the crew member and taking into account labor unions' representative opinion, can be increased up to 90 FHs within one calendar month, up to 270 hours within 3 months, and up to 900 hours within a calendar year.

***Note:*** *UTAir airline has its own flight staff labor union. The Airline labor union is not included in the Russian flight staff labor union.*

Since the crew members were employed by the company they had high flight workload. In 2011 the PIC and the F/O almost reached the extended annual flight hour standard. It should be noted that after Order No. 139 of 21.11.2005 by Ministry of Transport, RF "On the Approval of Provisions for Work and Rest Time Balance of Civil Aircraft Flight Crews of the Russian Federation" was issued, the extension of sanitary standards for flight crews is made without any participation of aviation medical staff, and no approval of the flight division doctor is required. The only requirement is an agreement of the crew member and an airline labor union representative.

The extensive flight program of the Airline was provided not only by increasing the number of flight crews but also by intensifying workloads in accounting periods (extending monthly sanitary flight time standards) and untimely allowance of vacations for flight crews.

Thus, the PIC involved in the accident had 111 unused vacation days:

- from 21.07.2009 to 20.07.2010: 26 days unused;
- from 21.07.2010 to 20.07.2011: 51 days unused;
- from 21.07.2011 to 01.04.2012: 34 days unused.

The F/O had 123 unused vacation days:

- from 08.10.2009 to 07.10.2010: 46 days unused;
- from 08.10.2010 to 07.10.2011: 51 days unused;
- from 08.10.2011 to 01.04.2012: 26 days unused.

The granting of annual scheduled vacations to flight staff is stipulated by Item 4 of the Staff Contract of UTAir for 2012-2014.

***Note:*** *Item 4.7. In compliance with Article 115 of the Russian Labor Code, all the Airline employees are granted an annual scheduled paid vacation of 28 calendar days…*

*Item 4.8. Apart from the regular vacation, additional vacations are granted to employees that are exposed to occupational hazards…, with specific occupations…, with irregular working hours…, working in the Far North… .*

*Item 4.9. The regular annual vacation determined with the vacation schedule can, upon agreement between the Employer and the Employee, be transferred to a different time period. It is also possible to transfer the vacation to the following year, upon agreement with the Employee, due to operational need. Non-granting of the annual regular vacation within two successive years is prohibited.*

Working without a timely granted vacation accompanied with significant workload within accountable time periods leads to the crews' fatigue accumulation, which can result in lack of concentration, absent-mindedness and, consequently, errors in aircraft handling and decision-making.

The Airline did not comply with the requirements to split flight shifts determined by Order No. 139 of 21.11.2005 by the Ministry of Transport, RF concerning both the PIC and the F/O. Thus, in March 2012 the PIC and the F/O had 5 split shifts – on March 2, 5, 17, 18 and 27, 2012 (not more than two split shifts a month are permitted). After three of the split shifts (March 17, 18 and 27, 2012) the pilots were not granted required rest time.

***Note:*** *Order No.139 of 21.11.2005 by the Ministry of Transport, RF:*

*Item 29. When the flights are performed with the minimum crew composition, a*

*crew member can have a split duty shift, upon their agreement.*

*The break period between the two parts of the split shift is not included in the duty time.*

*The duty time is split by the Employer based on the local regulation approved with consideration to the opinion of a selective labor union body.*

*Item 30. Not more than two split shifts are allowed within an accounting work time period and not more than two successive flight shifts.*

*Item 31. The total duration of the split duty time shall not extend the duration of the flight shift established by Item 16 and 17 of these Provisions.*

*Item 33. After two split shifts in succession, the crew shall be granted rest of at least 48 hours at their base airport.*

It should be noted that the deviations in the Airline's flight crews' work and rest time management were not once noted by the Tyumen FATA ITO, Ministry of Transport, RF in their inspection reports.

The intensive manner of flight crew training is evidenced by the figures in the analysis of the Airline's Flight Operations management in 2011.

The number of crews flying Boeing 757-200 type aircraft increased more than twice (13 in 2010 and 28 in 2011), those flying Boeing 737 almost doubled (97 in 2010 compared to 180 in 2011), those flying CRJ-200 doubled (13 in 2010 and 28 in 2011), those flying ATR 42/72 increased by almost 27% (43 in 2010 and 59 in 2011).

The number of crews flying Mi-8, Mi-26, AS-355 and AS-350 increased as well.

Within 2011 the total crew number flying all types of aircraft in the Airline's fleet increased by 280 crews (only an insignificant part of the flight staff came from other airlines).

These figures assume that the Airline's instructors had significant workload as to the flight crew training.

Within 2011, 176 PICs and 225 pilots were commissioned, 440 pilots underwent transitional training (which corresponds to a number of graduates of two flight schools).

The Airline's top flight operation management is staffed by 85%; there are not enough pilots-instructors (53 are employed while the staff list envisages 63 instructors).

**The increase in the Airline's work amounts that required constant increase in the number of trained crews as well as the actual number of commissioned crews (PICs and first officers) on all aircraft types (excepting Russian manufactured aircraft) affect the quality of training of flight crews for independent flights when SMS is inefficient.**

The safety analysis of UTAir Airline revealed that the number of incidents caused by deviations in the flight crew operations was reduced from 24 incidents in 2010 to 11 incidents.

However, 8 out of the officially recorded 11 incidents are more or less related to the crews' lack of training (hard landings, inappropriate flight operations, failure to maintain assigned approach parameters, runway excursions, unawareness of the Boeing 737-800 layout, which led to tailstrike during the takeoff) and 3 of them were related to direct violations of the established flight rules and discipline (violation of the weather minima, alcohol abuse on the day before the flight).

The Airline does not make sufficient use of flight recorders data for prevention purposes.

The percentage of flights monitored with the help of an express analysis was 98.9% in 2011. The Analysis states that the number of detected deviations reduced by 25% percent compared to 2010.

After analyzing 21695 on ATR42/72 (16 PIC were commissioned, that meant new crews) only 26 deviations (violations) were detected (the main ones involved failure to maintain appropriate roll and pitch angles during takeoffs and landings, errors in filling the memory unit passport), which is doubtful.

Only on the flight recorder of the ATR72-201 VP-BYZ involved in an accident on 02.04.2012 there were 6 cases found of the usage of the on-board de-icing system[3] during taxiing, which is not envisaged by the FCOM. Analysis of a number of flights of other ATR aircraft revealed similar flight crew actions. Some pilot-instructors also commit such actions.

There were 461 deviations revealed as to the commissioning of 400 pilots in 2011 (176 out of which were PICs).

The debriefings conducted in the air squadrons and flight divisions have not become a good school for improvement of flight operations quality.

A check of the content of the debriefings in the 1st Flight Division (Surgut) and 3rd Flight Division (Tyumen) revealed almost the same deviations. The actual content of debriefings is not consistent with the debriefing plan. Flight data analysis is not paid sufficient attention to. There are almost no reports on the errors and training level of the commissioned PICs and crew members during the debriefings. The reports are mostly limited by stating facts (there are no remarks on the flight analysis data, commissioning is continued, etc.). It is not planned to consider and show flight recorder data of certain flights during debriefings (including records of commissioning flights and first solo flights) with explanations of PICs performing the flights in

[3] The de-icing mode ground activation monitoring is not included in the approved Events express analysis list

question. Top managers of various departments, recorded as attending debriefings, often do not speak during debriefings. Most of the debriefing time is dedicated not to flight analysis, improvement of flight crew training methods, and enhancing flight safety, but to studying various directives from bodies of different level. Training materials to study various accident causes are mostly limited to FATA information.

During seasonal training of the flight crew insufficient attention is paid to studying practical aerodynamics issues and physical essence of various phenomena, particularly related to the reduction of aerodynamic performance of aircraft in icing conditions in flight and, especially, due to ground icing.

As the investigation team analyzed the available documents concerning commissioning of the PIC and the F/O, an organizational and training deviation was detected. The Airline uses flight training tasks for commissioning purposes, the form of which does not make it possible to determine the weather conditions in which the approach is performed (cloud base, visibility), the landing system used, the type of approach used (automatic mode, flight director mode, radar, visual approach), the instrumental flight hours are not counted, the visibility during takeoff is not recorded. Piloting mistakes are not recorded. There is only one rating mark granted: "Excellent. After commissioning, in accordance with the program, the applicant is granted initial weather minima of 80x1000, takeoff visibility 400 m (considering the simulator training with the minima of 60x550). After 15 flights the pilot is granted the minimum of 60x550, takeoff visibility 200 m. All these actions comply with the established commissioning program. However, it is not possible to check if the commissioned pilot really operated in these actual weather conditions with the specified minima (80x1000) with the help of the training task.

Real-life landings in actual weather minima conditions are not paid so much attention to. Approaches performed within the assigned minima when conducting independent flights are not counted.

Based on the results of commissioning it is not possible to determine if the commissioned pilot was trained on the "De-Icing/Anti-Icing Program of UTAir Aircraft" and if they are aware of the clean aircraft concept.

These issues are in the responsibility of the top flight operations management when conducting flights with their flight crews.

***Note:*** ***De-Icing/Anti-Icing Program of UTAir Aircraft, РД-В6.022-02***

*P.7.1* ***Functions of the company departments***

***Flight Department shall:***

*- monitor performance by flight personnel of procedures connected with application of de-/anti-icing fluids and stipulated by the Company documents as well as AFM, FCOM;*

*- arrange the Program study and training process for flight personnel;*

*- arrange training and testing of flight personnel with regard to evaluation of meteorological conditions selection of aircraft treatment method, monitoring of applied de-/anti-icing methods, verification of de-/anti-icing fluids compliance and estimation of the fluid holdover time.*

### 1.18.2. Results of UTAir-Technic audit performed by EASA

In May 2012 EASA performed the audit of the UTAir-Technic base structures in the Tyumen and Moscow Vnukovo APs. By the results of the audit on May, 25 2012 EASA addressed the letter to the UTAir-Technic management where it is, in particular, stated that the quantity and the seriousness of the shortcomings, revealed in course of the audit gave occasion to the previously issued maintenance organization approval suspension.

In course of the audit there were 25 certain shortcomings revealed including the two of the first (highest) level of significance. By the results of the audit EASA made the conclusion that the UTAir-Technic internal audit could not reveal the shortcomings stated in the results of EASA check, despite the UTAir-Technic quality manager claims of the enterprise conformity to the requirements, established by EASA. Rather serious shortcomings were revealed both in the aircraft maintenance organization and carry-out and in quality system functioning within the enterprise. This is the evidence of:

- failure to identify and correct the shortcomings (discrepancies) in course of the internal audit;
- critical weakness of the enterprise quality system, that does not allow ensuring that the UTAir-Technic activity is in compliance with the MOE and EASA Part 145 requirements;
- failure of UTAir-Technic to ensure that the carried out maintenance continues to comply with the standards of EASA Part 145.

### 1.18.3. Significant Extracts from Available Current Regulations on De-/Anti-Icing and Staff Training

**ICAO Recommendations (DOC 9640 AN/940)**

**Chapter 2. The Clean Aircraft Concept**

2.1. During conditions conductive to aeroplane icing during ground operations, takeoff shall not be attempted when ice, snow, slush or frost is present or adhering to the wings, propellers, control surfaces, engine inlets or other critical surfaces. This is known as the **"Clean Aircraft Concept"**. In this document, the Clean Aircraft Concept deals solely with fixed wing aeroplanes.

2.2. Any deposit of ice, snow or frost on the external surfaces of an aeroplane, except as permitted in the flight manual, may drastically affect its performance due to reduced aerodynamic lift and increased drag resulting from the disturbed airflow. Furthermore, slush, freezing snow or ice may cause moving parts, such as control surfaces and flap-actuating mechanisms, to jam, thus creating a hazardous situation. **These adverse effects on the aerodynamic properties of the airfoil may result in a sudden departure from the commanded flight path and may not be preceded by any cockpit indications or aerodynamic warnings to the pilot.**

**Chapter 3. Aeroplane Icing on the Ground**

3.1. Many atmospheric and ambient conditions can cause aeroplane icing on the ground. The principal conditions are frost, snow, freezing fog, freezing drizzle, freezing rain, and rain, drizzle, fog or high humidity combined with the cold-soak effect. The latter type of icing can occur at ambient temperatures well above the freezing point. It is also important to understand that mixed and changing atmospheric conditions can overlap during aeroplane operations on the ground, requiring constant vigilance by **both flight and ground crews**.

3.2. Other conditions that are conductive to icing contamination on aeroplane surfaces are:

a) operations on ramps, taxiways and runways contaminated by water, slush or snow. These **substances** may be deposited on aeroplane surfaces by wind, aeroplane operations, jet blast, or ground support equipment; and

b) warm aeroplane surfaces exposed to frozen precipitation during below-freezing conditions. **The warm aeroplane surfaces may cause melting and refreezing of the precipitation.**

**Chapter 6. De-Icing/Anti-Icing Check Procedures**

6.1. The pilot-in-command is responsible for insuring that the aeroplane complies with the Clean Aircraft Concept prior to take-off. Certain checks are required before an aeroplane can be safely dispatched. These checks can be grouped under three main headings:

a) checks prior to the application of de-icing/anti-icing fluids;

b) checks after the application of de-icing/anti-icing fluids; and

c) special checks.

**Checks Prior to the Application of De-Icing/Anti-Icing Fluids**

6.2. The first check in this process is the walk-around or pre-flight check, normally accomplished by the ground or flight crew. The aeroplane critical surfaces, fuselage and landing gear shall be checked for ice, snow, slush or frost in accordance with an approved operator plan. If ice, snow, slush or frost is discovered, de-icing/anti-icing of the airplane must be carried out.

**Checks after the Application of De-Icing/Anti-Icing Fluids**

6.3 A check to ensure compliance with the Clean Aircraft Concept is made immediately following the application of de-icing/anti-icing fluids and is carried out by a qualified person in accordance with the **approved operator plan and procedures**.

6.4 The pre-take-off check, which is the responsibility of the pilot-in-command, ensures that the critical surfaces of the aeroplane are free of ice, snow, slush or frost just prior to take-off. This check shall be accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings or other surfaces.

6.5 The pre-take-off check procedures are a critical part of the ground operation and become the only means by which the pilot-in-command can insure that the aeroplane is in compliance with the Clean Aircraft Concept prior to take-off. If stipulated by the regulatory authority, aeroplane manufacturer, or operational specification or if requested by the pilot-in-command, an external check of aeroplane critical surfaces shall be conducted by qualified ground personnel.

6.6 The pilot-in-command has the responsibility to continually monitor the weather and aeroplane condition to ensure compliance with the Clean Aircraft Concept. If this requirement cannot be satisfied by either an internal or external check of aeroplane critical surfaces, then another de-icing/anti-icing of the aeroplane must be accomplished. **Special equipment or procedures may be required** to carry out this check at night or under severe weather conditions.

**Chapter 7. Regulatory Authority**

7.1 The regulatory authority ensures that every operator shall have an approved de-icing/anti-icing program or procedures. The program shall require that operators comply with the Clean Aircraft Concept.

7.3 The de-icing/anti-icing program shall clearly define areas of responsibility for the operator. **All persons involved in ground de-icing/anti-icing activities shall be trained and qualified in the procedures, communications and limitations of their area of responsibility**.

The de-icing/anti-icing program shall cover all locations within the operator's route network including de-icing/anti-icing accomplished **by subcontract**.

**Operator**

7.4 Ground de-icing/anti-icing is, technically, a part of the operation of the aeroplane. **The person in charge of the de-icing/anti-icing procedure is responsible for accomplishing this procedure and verifying the results of the de-icing/anti-icing treatme**nt. Additionally, the de-icing/anti-icing application information reported to the flight deck crew is also **part of the technical airworthiness of the aeroplane**.

7.5 **The person responsible** for the de-icing/anti-icing process must be clearly designated, trained and qualified. This person shall **check the aeroplane for the need to de-ice**, **shall initiate** de-icing/anti-icing, if required, and **is responsible for the correct and complete de-icing/anti-icing treatment of the aeroplane**. The final responsibility for accepting the aeroplane after de-icing/anti-icing rests, however, with the pilot-in-command.

7.6 The pilot-in-command has the responsibility to ensure compliance with the Clean Aircraft Concept. The ground de-icing crew share this responsibility by providing an aeroplane that complies with the Clean Aircraft Concept. To ensure compliance, the pilot-in-command shall evaluate:

a) actual and forecast weather conditions;

b) taxi times and conditions;

c) de-icing/anti-icing fluid characteristics; and

d) other relevant factors.

This information is used to determine the estimated holdover time. The pilot-in-command is responsible for continually monitoring the condition of the aeroplane after de-icing/anti-icing has been completed and for ensuring that the aeroplane complies with the Clean Aircraft Concept at the time of take-off.

**7.7 The de-icing/anti-icing procedures, including those subcontracted by the operator, shall be subject to quality inspections as part of the operator's quality assurance programme.**

**Chapter 10. De-Icing/Anti-Icing Communications**

10.1 The communications between ground and flight crews are an integral part of the de-icing/anti-icing process and must be included in every de-icing/anti-icing procedure.

10.6 After de-icing\/anti-icing and prior to departure, the flight crew must receive **an "all clear" signal from the ground crew** that it is safe to taxi.

**Chapter 13 Training of Personnel**

13.1 De-icing/anti-icing procedures must be carried out only by trained and qualified personnel.

13.2 Both initial and recurrent training for flight crews and ground crews are to be conducted to ensure that all such crews obtain and retain a thorough knowledge of ground de-icing/anti-icing policies and procedures, including new procedures and lessons learned.

Training subjects are to include, but are not limited to:

a) recognition of relevant weather phenomena;

b) **effects of frost, ice, snow and slush on performance, stability and control;**

c) basic characteristics of de-icing/anti-icing fluids;

d) general techniques for de-icing (removing deposits of frost, ice, snow and slush from aeroplane surfaces) and for anti-icing;

e) de-icing/anti-icing procedures in general, specific measures to be performed on different aeroplane types, and procedures specifically recommended by the operator, aeroplane manufacturer or fluid manufacturer;

f) **types of checks required and procedures and responsibilities for checks;**

g) de-icing/anti-icing equipment operating procedures, including actual operation of equipment;

h) **quality control procedures;**

i) **techniques for recognizing frozen precipitation on aeroplane critical surfaces;**

j) health effects, safety precautions and accident prevention;

k) emergency procedures;

l) fluid application methods and procedures;

m) use and limitations of holdover time guidelines;

n) de-icing/anti-icing codes and communication procedures;

o) **special provisions and procedures for contract de-icing and anti-icing (if applicable);**

p) environmental considerations for de-icing and anti-icing operations, i.e. locations for de-icing and anti-icing, reporting spillage, and hazardous waste control; and

q) new procedures, new developments, and lessons from the previous winter.

13.3 Additionally, training for ground personnel shall include procedures and methods for the storage and handling of de-icing and anti-icing fluids.

13.4 **The operator shall maintain accurate records of the training and qualifying of both flight and ground personnel. This proof of qualification shall be for both initial and annual recurrent training**.

**Chapter 15. Quality Assurance Programme**

**Operators** shall establish a quality assurance programme to ensure correct de-icing/anti-icing operation at all stations where applicable. The program shall include at least the elements listed below.

a) **Auditing** of all parts of the de-icing/anti-icing operation is required to check the ongoing conformance with all regulations issued by authorities, operators, manufacturers and handling agents.

b) **Training of all personnel involved in the de-icing/anti-icing operation is carried out to guarantee the correct performance of all related tasks.**

c) Methods and procedures have to be defined to allow the clear and safe accomplishment of all the tasks that are necessary for de-icing/anti-icing an aeroplane.

d) Training records of all de-icing/anti-icing personnel are necessary to guarantee that all training and skill requirements are fulfilled.

e) Qualification of all de-icing/anti-icing personnel is required to ensure correct performance of all tasks.

f) Publications are required for the aeroplane de-icing/anti-icing operation to ensure the correct accomplishment of all tasks.

g) Equipment and fluids have to be maintained in such a way that the correct quality is ensured.

**De-Icing/Anti-Icing Regulations of the Russian Federation**

At the time of the accident there was no basic state-level regulatory document as to de-icing and anti-icing in the Russian Federation. Airlines and airports, based on recommendations of ICAO, IATA and other international organizations developed their own de-icing/anti-icing standards and programs.

State Standard GOST P 54264-2010, “De-Icing/Anti-Icing Methods and Procedures “ was developed, approved and implemented by Order No.1070-ст of 23.12.2010 by the Federal Agency of Technical Regulation and Calibration, but in fact it has only been effective since 01.07.2012.

Since 1995 there has been a number of advisory guidance documents (Guidance of GOSNII GA, 1995 “On Enhancing Quality of De-Icing/Anti-Icing Before Takeoff” – Doc. No.24.9-67 ГА of 06. 08.2001; Guidance on Ground De-Icing/Anti-Icing – Doc No.24.9-16ГА

by the Department for Continued Airworthiness of 23.01.2003; "Ground and Flight Crew Training Program on De-Icing/Anti-Icing" developed by the State Flight Safety Center, Federal Transport Oversight Agency on 14.05.2005; Recommendations for the development of Instruction on De-Icing/Anti-Icing – a document of the State Flight Safety Center for Air Transport of 20.02.2007. In 2009, the Russian Federal Aviation Rules FAP-128 was introduced, with the following stated in Item 2.14:

**"Takeoff is prohibited if there are deposits of frost, slush or ice on the surfaces of wings, fuselage, flight controls, empennage, propellers, windshield, powerplant or on pressure ports, if not stated otherwise in the AFM".**

Since starting of operation of western-made aircraft the notions of "maintenance" and "ground handling" have been separated. As a result, de-icing/anti-icing operations are now related to ground handling, which means that one of the critical processes of continued airworthiness can be assigned to a contracting agent whose personnel have lower professional level than maintenance staff. However, the assigned responsibility of the ground handling staff did not cover the before takeoff de-icing/anti-icing quality assurance. Thus, contractors do not bear any responsibility for the aircraft airworthiness, and at the same time they are to determine if the aircraft is airworthy.

The basic document on aircraft maintenance and repairs in the Russian Federation, FAP-145 (1999) does not contain any requirements as to de-icing and anti-icing. However, Item 9.1 of this document runs, that the maintenance organization shall have all the necessary **airworthiness documentation**, in order to properly accomplish their assigned duties.

The definition of "maintenance" in Item 2, Item 4 implies that ***it is a combination of operations to provide continued airworthiness of aircraft when preparing it for flights***, as well as when servicing the aircraft and its components after flights, during storage and transportation.

**Current Documents on Ground Handling and De-Icing/Anti-Icing of UTAir Aviation**

**UTAir Flight Operations Manual**

**Item 16.5. Instruction for de-icing (anti-icing) and control over these procedures performance**

**(2) AC anti-icing rules and procedures**

… De/anti-icing procedures start and finish by thorough outward inspection of the AC. It is particularly important in the dark time of the day…

… When the crew arrives in order to perform a flight on the AC the technical personnel in charge of the AC preparation for takeoff shall report to the PIC about the result of the AC surface inspection and the readiness of the AC for takeoff.

After accomplishing preflight inspection the PIC and the technical personnel take a coordinated decision on the necessity of deicing procedures or its rejection.

AC deicing necessarily takes place if the PIC and the technical personnel do not take a coordinated decision on deicing rejection.

The sub-contractor organization specialist informs the PIC about the planned deicing fluid concentration before the AC deicing starts and the PIC has the right to demand if he considers it necessary a higher concentration of deicing fluid in the mixture.

The technical personnel as agreed with the PIC proceed from the meteorological conditions, kinds of fluids and equipment available defines the method of AC deicing (whether there should be one or two stages).

**(4) AC de/anti-icing responsibility and quality control**

The crew shall not perform take-off if the aircraft surface is covered with ice, rime-frost or slush. The aircraft PIC shall not perform a flight unless he/she made sure that all aircraft surfaces are clear of any deposits that may influence aircraft aerodynamic properties and controllability or the fluid holdover time elapsed.

When the aircraft is on ground the technical staff shall take measures to protect the aircraft form icing and snow contact with internal airframe cavities, engines, air-oil cooler and avionics units through timely usage and application of covers, plugs, service fluids and other protection means stipulated by the operational documentation for the aircraft type.

**The officer in charge of AC maintenance and the person releasing the AC to flight are responsible for:**

- the monitoring of the results of de-/anti-icing procedures;
- the monitoring of AC surface cleanness after accomplishing anti-icing procedures;
- the monitoring of the inspection of pressure instruments after anti-icing procedures;
- the reliability of the information for the PIC on the condition of AC surfaces;
- timely and correct documentation drawing.

**The PIC is responsible:**

- for the calculation of the protective action time taking into consideration the given peculiarities of a certain airport (the handling start + documents drawing + engine start + towing and/or taxiing);
- for the correctness of decision taking in identifying the method and kind of handling;

- for the correctness of the decision to take off or to go back for repetitive handling;

- for AFM, FCOM of the operated AC type requirements.

The responsibility for the de/anti-icing procedures in places available for the crew inspection is on the PIC, if de/anti-icing was conducted before the crew arrived. In places not available for control the PIC can estimate the quality of de/anti-icing procedures based on the technical personnel report.

**The officer in charge of AC maintenance or the person releasing the AC to flight is responsible for the absence of icing at places not available for the crew inspection.**

The check of the results of the performed de/anti-icing operation before the AC lines-up shall be conducted at every level of responsibility transfer.

When accomplishing de-/anti-icing just before the engine start and also when the manufacturer specified de-/anti-icing in special places for the AC handling, after ramp handling, before taxiing to line up, **the final control of handling quality is accomplished by the technical personnel releasing the AC**.

In this case after AC handling completion the crew receives from the technical personnel member releasing the AC to flight the following information via the radio:

- the confirmation of handling quality and completeness

- the type of fluid;

- the ratio between fluid and water;

- the time of the final stage of de/anti-icing procedure commencement.

The PIC having received the information and having the table of protective action time of the fluid on board can calculate the time allowance of the fluid protective action to perform taxiing and line-up.

Taking the final decision to takeoff after the completed de-/anti-icing is on the PIC. If, on the other hand, the ground personnel reports the PIC that there are snow and ice deposits on critical AC surfaces, the PIC shall not take the decision to takeoff before the snow and ice deposits are removed.

Starting from the moment when taxiing commences the responsibility for observing the holdover time shall lie with the aircraft PIC. Under the conditions of continuous icing safe taxiing and take-off shall be accomplished before DAF protective action time expires.

If there are freezing precipitations in case of possible delays during taxiing and line-up and also when the time of DAF protective action time expired, the crew shall demand to inspect the AC complete surface. For this the crew needs the help of the ground personnel. Depending on the results of the inspection re-handling takes place.

All the personnel taking part in de-/anti-icing shall be responsible for the quality of the accomplished task.

The person taking the final decision to permit takeoff is responsible for quality of acceptance of performed de-/anti-icing procedures upon final inspection of the AC and accuracy of de-/anti-icing code data, handed over to the AC PIC.

Upon completion and prior to takeoff PIC is responsible for AC airworthiness by means of environmental conditions control, AC surfaces visible from the cockpit and evaluation of sufficiency of applied fluid protective action time in current weather conditions.

**Warning:**

In case of uncertainty that A/C surfaces are clear from icing prior to takeoff, or when the holdover time of de-icing/anti-icing fluids is not sufficient for safe flight performance, the crew shall require to inspect the entire aircraft surface or recurrent de/anti-icing performance.

The aircraft PIC shall not be entitled to take a decision to perform a flight without de-icing/anti-icing, if the ground service considers such de-icing/anti-icing necessary. But the PIC is entitled to require aircraft deicing/anti-icing even if the ground service does not consider such de-icing/anti-icing necessary, as well as to require retreatment at any stage of pre-flight preparation. This requirement shall be followed by the engineering and technical staff.

**(5) Communication during AC de/anti-icing procedures and documents drawing**

Prior to the start of de-icing/anti-icing operations the ground personnel and flight crew shall make sure that the aircraft configuration conforms to the manufacturer's recommendations and operator's procedures.

After the de-icing/anti-icing operations and corresponding aircraft inspection aimed at ensuring that it conforms to the Clean Aircraft Concept requirements, the flight crew shall receive the following information:

a) type of fluid;

b) fluid and water ratio (not required for Type I fluids);

c) time when the final de-icing/anti-icing stage started;

d) confirmation that the aircraft conforms to the Clean Aircraft Concept requirements.

This information shall be registered and handed over directly to the flight crew as per the above procedure. This information can be communicated orally or in writing; below are some examples of such communication:

a) «Type II, 75/25. 16.30. Aircraft clean check is performed»;

b) «Type I, 16.30. Aircraft clean check is performed».

Upon completion of de-icing/anti-icing operations the aircraft PIC, co-pilot or flight engineer shall record the information provided by engineers into the aircraft logbook (FTLB):

A. For the AC manufactured in Russia:

- in the line “Failures and defects detected during flight” of chapter IV of the logbook for example:

De-/anti-icing Type II, 75/25, 16.30, 0.20, 16.45 which means:

Type II – type of fluid;

75/25 – ratio between fluid and water (for Type I it is not necessary);

16.30 – the time of the final stage of de-/anti-icing commencement;

0.20 –DAF holdover time (hour, minutes) (when there is no de-/anti-icing or its conditions are no longer present the line is left blank);

16.45 – takeoff time.

B. For foreign-manufactured AC:

- an entry is made in “GRD De/anti-icing” FTLB line:

Type II, 75/25, 16.30, 0.20, which means:

Type II – type of fluid;

75/25 – ratio between fluid and water (for Type I it is not necessary);

16.30 – the time of the final stage of de-/anti-icing commencement;

0.20 –DAF holdover time (when there is no de/anti-icing or its conditions are no longer present the line is left blank).

Takeoff time in Departure Time (UTC): Start of Taxiing (OUT) and Takeoff (OFF) line.

In all cases of aircraft de-icing/anti-icing operations an attachment shall be attached to the Aircraft Line Maintenance Job Card to be kept together with the Job Card in the handling agent’s documentation.

Notifications with regard to de-icing/anti-icing operations (i.e. the fluid protective action time, taxiing time, traffic intensity, etc.) and exchanged by flight crews and ATC during winter flights and aerodrome de-icing/anti-icing operations shall be communicated in accordance with the communication procedures set forth in the ATC operations schedule.

Only ground personnel who has practical skills and have undergone standard checks for their safe fulfillment shall be authorized to perform de-icing/anti-icing operations.

The responsibility for safe performance of the above operations shall lie with the personnel performing such operations.

**(6) The order of control of on ground de/anti-icing operations performance by the AC personnel**

The control of on ground de/anti-icing operations performance is for the Flight Directorate and is done by the specialists of senior flight, instructor and inspector personnel:

- When the said specialists perform flights as part of the crew for the purpose of checks, flight personnel training and when there is a necessity for on ground de/anti-icing operations;

- By checking the entries about de/anti-icing operations (iaw art. A, B) when performing flights as a part of the crew;

- By checking the entries about de/anti-icing operations (iaw art. A, B) when conducting scheduled and unscheduled AC inspections;

- By analyzing PIC reports on performing flights and the subsequent comments.

**Manual on Ground Handling, UTAir**

Order No.П-490 of 11.05.2011 by the General Director of UTAir introduced the Airline's Manual on Ground Handling, Doc. РД –Б3.001-03, based on requirements of , IATA Airport Handling Manual (AHM), Airline's Flight Operations Manual, IOSA Standards Manual, Doc. РД-В6.022-02 "De-Icing/Anti-Icing Program of UTAir Aircraft", approved by Order No. П-2415/9 of 04.12.2009 by UTAir General Director and other regulatory documents and recommendations of the Russian Federation.

Edition No.3-РД-Б3.001-03 (Manual on Ground Handling) superseded Edition No.2 РД-Б3.001-02.

The requirements of the Manual on Ground Handling are extended to the Airline's employees, Airline's subsidiaries, its representatives and contracting agents that conduct ground handling (airports).

This document is applied to ground handling of the following UTAir aircraft types: Tu-154M, Tu-134, Yak-40, Boeing 737, Boeing 757, ATR 72, ATR 42, CRJ-200. It is available for UTAir-Technic that acts as a contracting agent that conducts maintenance and ground handling, as well as AC repairs for UTAir Aviation.

**Item 9.6. De-Icing/Anti-Icing**

9.6.1 All de-icing/anti-icing operations on aircraft owned by UTAir are accomplished in compliance with Doc. РД-В6.022 "De-Icing/Anti-Icing Program of UTAir Aircraft" (hereinafter referred to as the Program).

Every airport where Airline's aircraft are serviced, every work station where de/anti-icing is conducted, shall have available the current edition of this Program in an appropriate format.

The Program is sent to airports of the Airline's operation along with this Manual. Copies of the Program are sent to the Airline's airports of operation by the Department of Aerodrome and Ground Handling Management.

**Item 12. Main Requirements for Ground Personnel Training**

**12.1 General**

12.1.1 Ground handling of the Airline's aircraft can be only accomplished by responsible personnel, after proper training (initial and recurrent training) and on-the-job training passed before they are authorized to perform their respective duties in accordance with the regulations of the national civil aviation authorities.

12.1.2 There shall be a job description for each employee of the ground handling agent, taking into consideration their functions.

The job descriptions shall reflect the following requirements for the ground handling personnel:

- appropriate initial training (higher, secondary, special training, etc.);
- appropriate qualification papers, licenses, diplomas, certificates authorizing them for ground handling activities;
- knowledge of required legal and technical regulations;
- appropriate work experience.

12.1.3 Any kind of training (initial, transition, recurrent training) of the ground handling personnel shall be conducted in the established time periods but at least once in 36 months except hazardous goods training.

12.1.5 Personnel training on various operational aspects shall be conducted at certified training centers. Training programs used by the training center shall be stated in its certificate (license).

The certification procedure as well as approval of the training programs for ground handling personnel and their syllabus are established by the national aviation authorities.

12.1.6 After the completion of a training cycle the training center shall issue documents confirming completion of the ground handling training course (certificate and on-the-job training card). The certificate and on-the-job training card shall contain information on their date of issue and specific operations authorizations of the trained personnel.

12.1.7 Training programs shall include all training aspects and be adapted to different ground handling personnel categories.

12.1.8 All kinds of ground handling authorizations shall be issued to pertinent personnel by the ground handling agent by an order in case documents confirming successful completion of training programs and on-the-job training are available.

12.1.9 Training of personnel involved in ground handling shall include:

- recurrent accreditation or assessment by use of written or oral examinations to check theoretical knowledge;

- a possibility to practically demonstrate appropriate knowledge, professional training application and skills required to perform their duties, pertinent procedures and equipment maintenance standards.

Personnel rating **is conducted at least once a year**.

12.1.10 A ground handling agent shall ensure that the professional training of ground handling personnel is properly documented. Pertinent documents shall be maintained by the Agent in a proper order in compliance with the record and control system that provide storage of records confirming ground handling personnel training for at least three years.

12.1.11 Ground handling personnel training data shall be constantly updated and include the following:

- employee's surname;
- date of completion of the latest training course;
- description of training materials used for the training purposes, their copies or reference to them;
- name and address of the training organization;
- a copy of the certificate granted to the employee (certificate, on-the-job training card) confirming their training, on-the-job training and assessment.

12.1.12 All the documents shall be stored by the ground handling organization in compliance with the national regulations of the ground handling organization and records shall be kept in a such a way as to provide:

1) Identification;

2) Legibility;

3) Data processing;

4) Search and storage;

5) Data security and safety;

6) Data removal.

**12.2 Training Centers**

12.2.1 A training center is an establishment of supplementary professional training that holds a **Certificate and License** in a format required by the national aviation authorities, providing professional training, transition training and recurrent training of aviation personnel in compliance with the current regulations.

A training center shall have personnel training programs that include initial, transition and recurrent training in order to provide effective operations of the trained ground handling personnel.

The main objective of the training center in the course of initial and recurrent training of ground handling personnel is to provide facilities for continuous training in all aspects.

12.2.2 A training center is responsible for the quality of each aviation expert training. In order to accomplish the designated tasks, the training center shall have:

- laboratories equipped with training vehicles, reference materials, functional and procedure simulators, other educational facilities as well as methodological documentation and multimedia;
- FFS for different aircraft types as well as maintenance and ground handling simulators;
- a possibility to use aircraft and aerodrome facilities for ground handling staff on-the-job training;
- teachers and instructors in staff;
- a library containing required books, training materials and appropriate equipment;
- rooms for teachers, instructors and handling staff.

12.2.3 After a successful completion of the training cycle, graduates of the training center are granted a document on the completion of the training course confirming compliance of the content, level and quality of training on a certain operational aspect.

The document is signed by the head of the training center and registered in a special logbook, stored in the training center.

**12.3 Program Requirements**

**12.3.1 General**

12.3.1.1. Ground handling personnel training programs are developed by training centers depending on the certain types of training (theoretical, simulator, on the job) and are approved by national aviation authorities.

Training programs shall be compiled in such a way as to provide ground handling personnel with training consistent with their functions.

12.3.1.4. The content of the training course shall provide theoretical training required to perform pertinent duties, procedures and application of equipment related to certain ground handling personnel functions.

12.3.1.5. In order to provide continuous improvement and efficiency of training, the ground handling Agent shall have a procedure that would ensure the content of the ground handling personnel training program is revised and updated on a regular basis considering the established requirements **at least once a year.**

**12.3.6 UTAir De-Icing/Anti-Icing Program**

12.3.6.1 An Agent that carries out de-icing/anti-icing operations shall have a **procedure** to ensure that the ground handling personnel involved in de-icing/anti-icing for the Agent, including external subcontractors are trained the following:

- general de-icing/anti-icing procedures and special handling to be applied to various types of aircraft;

- application of equipment required for de-icing/anti-icing procedures including current procedures;

- weather phenomena;

- effect of frost, ice, snow, slush on the aircraft performance;

- ways of aircraft contamination detection;

- basic characteristics of de/anti-icing fluids, including causes and results of their degradation and residues;

- basic ways (techniques) of ice, snow and slush removal from the aircraft surfaces and de/anti-icing procedures;

- **types of checks and responsibilities;**

- precaution techniques;

- de-/anti-icing fluid application and holdover time limitations;

- environmental issues;

- new procedures and their development, lessons learnt from previous season;

- ground to flight deck crew communication;

- **quality assurance procedures;**

- de-icing/anti-icing codes;

- procedures and ways of fluid storage and their handling;

- keeping records.

Training (initial, transition and recurrent) of ground handling personnel involved in de/anti-icing operations shall be conducted regularly in compliance with the regulations of the national civil aviation authorities, at least every 36 months.

In addition to the provisions of the Manual on Ground Handling, the Program, Doc. РД-В6.022-02 contains requirements to ground handling personnel training, ways of assessing the

aircraft condition, and decision-making process as to whether de-icing/anti-icing should be conducted, as well as responsibilities of the ground and flight deck crews. The Program also specifies the respective functions and responsibilities of Agents, Contracting Organizations, Flight, Technical and Inspection Departments as to ensuring quality of personnel training and oversight of ground handling of aircraft in terms of flight safety.

**Chapter 1 Program Scope**

This Program defines the requirements for the process and procedures of de-icing/anti-icing treatment of UTAir aircraft with fluid on the ground. This document is based on the Clean Aircraft Concept.

**Aircraft de-icing/anti-icing forms and integral part of procedures performed by the ground personnel, technical engineers and aircraft crew members to ensure flight safety.**

The Program applies to flight crews and handling company personnel providing de-icing/anti-icing services to UTAir aircraft.

This document shall be used for the training of the Airline's and Contractor's personnel.

***Note:*** *UTAir-Technic has a contract with UTAir as to maintenance of Airline's aircraft (Contract No.15/05TO/21-1T of 06.05.2005 and Supplementary Agreement No. 41 to the Contract of 14.01.2008). Ground handling of foreign-made aircraft owned by UTAir Aviation, including de-icing/anti-icing is also conducted by UTAir-Technic that has an Agency Contact No.251 of 01.05.2005 with Roschino AP, according to which UTAir-Technic has taken over the responsibility for de-icing/anti-icing. The airport provides de-icing/anti-icing vehicles as well as availability and storage of de/anti-icing fluids (Contract No.249/20T of 01.05.2005, 23.05.2005г.).*

**Chapter 7 Communication, Cooperation and Functional Support of the Program**

**Commercial Department shall**

Arrange contacts with airports as to aircraft de/anti-icing.

**Technical Department shall**

Arrange audits of the companies providing DAI services at airports.

**Flight Department, Inspections Department shall**

Provide inspections of aircraft.

**Flight Deck Crew shall**

- assess weather conditions;
- control de-icing/anti-icing operations;
- be aware of fluid characteristics, holdover times and taxi conditions.

**The DAI contractor shall**

- provide dispatch of DAI vehicles;
- provide DAI fluid application;
- keep records of all operations;
- arrange initial and transition training of personnel;
- provide handling vehicles;
- buy DAI fluids;
- arrange quality assurance.

**Chapter 8 Procedures for De-Icing/Anti-Icing. Personnel Duties and Responsibilities.**

8.1 When the crew arrives on an aircraft before the flight, the technical personnel responsible for the aircraft pre-flight preparation shall report to the PIC about the results of the aircraft surfaces inspection and the aircraft readiness for departure.

8.2 After pre-flight inspection, the PIC and technical personnel shall make a mutual decision to establish the need for the aircraft de-icing/anti-icing.

8.3 Should the aircraft PIC and technical personnel fail to reach a mutual decision about the need for de/anti-icing, the aircraft de/anti-icing shall be carried out on a mandatory basis. After the aircraft de/anti-icing, the responsibility for making the final decision to fly lies with the PIC.

8.4 Contractor's employee shall report to the PIC before de/anti-icing treatment about the scheduled concentration of de/anti-icing fluids…

…After completion of de/anti-icing procedures, the **member** of technical personnel responsible for the aircraft departure shall inform the PIC via intercom about the time when the final step of the aircraft treatment began as well as about the type and concentration of the de/anti-icing fluid applied.

8.5 In coordination with the PIC… the **technical personnel** shall determine the method of the aircraft de-icing/anti-icing treatment… and give the following instructions to the dedicated vehicle operator…

8.6 **The technical personnel preparing the aircraft for departure**, shall be responsible for ensuring that:

- the aircraft surface is clear after de-icing/anti-icing treatment;
- the information about the aircraft surface condition reported to the PIC is reliable;
- the paper work is carried out timely and correctly.

8.8 **The PIC shall bear responsibility for**:

- calculation of fluid holdover time taking into account particular airport features…;

- the decision to take off or **return for retreatment**;

- compliance with the AFM and FCOM requirements of the operated type of aircraft;

- study of this Program.

8.9 The aircraft PIC shall be responsible for accepting the de-icing/anti-icing work performed on the aircraft areas which can be examined by the crew, if de-icing/anti-icing procedures were carried out before the crew arrival. As for the places that are not accessible to the crew for examination, the PIC can assess the quality of de-icing/anti-icing work based on the technical personnel report**.**

**8.10 The aircraft maintenance supervisor and the person signing the aircraft release to flight** shall be responsible for the de-icing/anti-icing supervision. They shall check the pressure instruments after de-icing/anti-icing is completed. The above officers shall be responsible to ensure that the aircraft areas that cannot be inspected by the crew are clear from icing.

8.15 After that and before the aircraft take-off the PIC shall be responsible for the aircraft airworthiness through monitoring of the environmental conditions, viewing the aircraft surfaces visible from the cockpit and estimating the sufficiency of the holdover time of the applied fluid in the particular weather conditions.

**Chapter 17. Quality Assurance Program**

The quality assurance program includes checks (audits) aimed at ensuring that:

a) all regulations set forth by the competent authorities, operators, manufacturers and handling companies are observed;

b) all training procedures for all personnel categories engaged in aircraft de-/anti-icing are available and documented;

c) a system is in place to ensure that aircraft de/anti-icing equipment is properly prepared, repaired and maintained in a serviceable condition;

d) up-to-date manuals, documents and reference books required for ensuring aircraft de/anti-icing treatment are available and used with a view to ensuring proper performance of all work.

**UTAir-Technic Regulatory Documents**

**De-Icing/Anti-Icing Procedures for ATR 42/72 Company Standard CTII 310-06**

**Line Maintenance Procedures for Contamination Removal**

This Instruction for Technical Personnel as to Aircraft De-Icing/Anti-Icing (hereinafter referred to as the Instruction) is developed in compliance with the Aircraft Maintenance Manual,

Flight Crew Operations Manual, Instruction on Maintenance and Repairs for Civil Aviation of Russia (IMR CA-93), Flight Operations Instruction for Civil Aviation of USSR (FOI CA-85), international standards ISO 11075; ISO 11076, ISO 11077, ISO 11078, recommendation of AEA working group, SAE AMS1424, SAE AMS 1428, Directives of the Russian Federal Air Transport Service, recommendations of the State Research Institute of Civil Aviation, aircraft dispatch schedules, and the Airline's Maintenance Management Manual.

This instruction is a regulating document that specifies the cooperation and sharing responsibility between the flight deck and ground crew during de-icing/anti-icing operations at airports of the Russian Federation included in the UTAir operations geography.

**1. General**

1.2. Aircraft dispatch operations include snow removal from the aircraft surfaces in case of heavy snowfall or during long stays on ground, as well as de-icing/anti-icing procedures.

Aircraft ground icing is presence/accumulation of ice/frost on the aircraft surfaces on the ground or accumulation of moisture on its surfaces that in the ambient weather conditions (i.e. at AOT lower than +5°C) are frozen before the aircraft takes off.

1.3. Technical staff responsible for the aircraft dispatch shall check all the aircraft surfaces for contamination, particularly the wing's surface and leading edge.

In case there is contamination on the aircraft surfaces or negative effect of weather conditions conductive of ice accumulation, personnel responsible for aircraft dispatch shall take appropriate measures for aircraft de-icing/anti-icing...

…After the flight crew arrives at the aircraft, the person in charge of aircraft dispatch (engineering staff or ground handling personnel of the departure airport), and the PIC make a joint decision as to the need to de-ice/anti-ice the aircraft on the basis of the external check of the aircraft surfaces condition considering the actual weather conditions at the time of departure.

1.6. After the preflight check of the aircraft the PIC makes a decision agreed with the technical staff on the need of de/anti-icing.

***Note:*** *If the PIC and the technical personnel of the contracting agent or representative of the ground handling service of the departure airport (in case technical personnel is not present at the non-base airport) disagree on the need of de-icing/anti-icing, de-icing/anti-icing is conducted in a mandatory way.*

1.8. If a decision is taken not to conduct de-icing/anti-icing, the person responsible for aircraft dispatch (engineering staff or technical representative of the ground handling service of

the airport where there is no maintenance company) shall immediately inform the airport line dispatcher.

**5. Procedure Description**

5.1. Aircraft de-icing/anti-icing at departure airports is conducted by qualified and trained personnel in accordance with an internal de-icing/anti-icing procedure.

**6. De-Icing**

6.3. The quality of de-icing and condition of the aircraft surface thereafter shall be controlled by the technical personnel and a flight crew member…

Maintenance engineering personnel or, at out-of-base airports that do not house any maintenance organizations, ground handling service of the departure airport is responsible for preparing the aircraft for de-icing/anti-icing, including towing the aircraft to the de/anti-icing site and removal of snow from the aircraft surfaces.

**7. De/Anti-Icing Quality Control**

The maintenance man in charge or technical representative of the airport ground handling, responsible for the UTAir aircraft dispatch, check the cleanness of the aircraft surfaces after the de/anti-icing visually from the ground, but, if needed, shall use a ladder or de-icer's platform to get access to the aircraft surfaces and check their condition.

If there are no remarks on the quality of de-icing, a qualified maintenance man or technical representative of the airport ground handling, responsible for the aircraft dispatch, informs the flight deck crew on the completion of de-icing/anti-icing and reports via intercom the information so that it could be recorded in the FTLB.

**8. Documentation**

8.1.1. If decision is made not to de-ice/anti-ice, the PIC writes a refusal from de-icing/anti-icing in the FTLB in the following way: at the end of the pre-formulated (by the maintenance company personnel or aerodrome ground handling service representative) text, in the «Action» field of the FTLB, the PIC writes «Not required», puts his identification number and confirms this note with his signature.

8.1.2. A maintenance engineer or technician of the contracting company or representative of the airport ground handling service, in such case, shall tear the white copy of this page out of the FTLB with a confirmed PIC's signature and put this copy into the package of airline's job cards for certain maintenance of the aircraft in question in order to transfer the whole package of job cards to the dispatch office of UTAir Technic.

8.2.1. After the completion of the de-icing/anti-icing procedure, assessment of the de-icing/anti-icing quality and condition of aircraft surfaces, the de-icing/anti-icing vehicle operator

fills in the following fields of the Check List held by the engineer or technician of the contracting maintenance company who supervises the de-icing/anti-icing process: «Fluid Type», «Fluid to Water Ratio», «Amount» of applied fluid in liters, time of fluid application UTC, «Areas of Application», in accordance with the actual application data and signs the checklist specifying their surname (and a stamp if they have any).

8.2.2. Engineer/technician of the maintenance company checks the quality of de-icing/anti-icing and the aircraft surfaces condition, and then checks if the Checklist is completed by the de-icing vehicle operator entirely and correctly, fills the «Control» field in the Check List, specifies the time of de-icing/anti-icing completion, confirms the quality of the procedure with his signature and surname.

***Note:*** *CTII-310-06 of UTAir-Technic does not comply with the requirements of the Manual on Ground Handling of 2009 and De-Icing/Anti-Icing Program of UTAir Aircraft. Thus, the de-icing/anti-icing section lacks qualification requirements to personnel involved in aircraft de-icing/anti-icing operations, training and on-the-job training programs and names of training centers. In accordance with the existing documents of UTAir-Technic (Contract between UTAir-Technic and Roschino Airport), UTAir-Technic has taken on responsibility for de-icing/anti-icing of aircraft arriving to and departing from Tyumen Airport (Roschino), including aircraft owned by UTAir Aviation. According to the contract, de/anti-icing treatment is part of maintenance operations.*

*In accordance with CTII310-06, the responsibility for documentation and transfer of information to the flight deck crew lies with the engineering and maintenance personnel responsible for the aircraft dispatch.*

*The order of maintenance documentation for de-icing/anti-icing specified in the CTII 310-06 does not comply with the Flight Operations Manual, Manual on Ground Handling and De-Icing/Anti-Icing Program of UTAir Aircraft. The established order of aircraft dispatch in terms of determination of the need to conduct de-icing/anti-icing was violated. Maintenance personnel did not take part in the aircraft dispatch, neither did they check its airworthiness.*

### 1.18.4. Eye-Witness Explanations Confirming Presence of Contamination on the Aircraft Surface

Dispatcher of the UTAir-Technic Dispatch Group:

*«…about 05:40[4] I contacted the dispatcher of the ground handling vehicle base and confirmed request for Arktika fluid for all UTAir flights…».*

Reference extract (signed by the handling vehicle service of Roschino AP):

*«Roschino Airport Ltd. has three de-icing/anti-icing vehicles… According to the schedule of providing service vehicles and devices for autumn and winter period of 2011-2012 there shall be provided 2 de-icing/anti-icing vehicles on a daily basis…*

*On 01.04.2012, due to unfavorable weather forecast, the handling vehicle service decided to provide and extra, third, vehicle on the night of 01.04.2012 to 02.04.2012…»*

Explanatory note of the Mercedes 2045 vehicle driver of 05.04.2012:

*«…at about 07:00 or 07:05 in the morning I approached the ATR 72 aircraft, Flight 120…at Stand 3. When a technician arrived, I left the vehicle and he said that they are not going to de/anti-ice and asked to move to Stand 2. …I reported the handling vehicle service dispatcher immediately that Flight 120 refused to de-/anti-ice».*

Explanation of the Mercedes 2045 vehicle driver of 04.04.2012:

*«…I had been to 3 aircraft before that. The first one was not very contaminated, while the second, ATR, that was positioned on the 1st stand, had snow and ice on the wings… Then I moved to a Boeing owned by Yamal Airlines. Its technician also made a long de/anti-icing treatment and used about 560 liters…»*

Explanatory note by an engineer of Yamal maintenance service:

*«On 02.04.2012… before departure… we treated three …Boeings 737, as there was…heavy snow for the whole night and by the morning there was a shift from positive to negative temperature. There was thick layer of snow on the stabilizers and wings, with a crust of ice under the snow».*

Explanatory note of the PIC of B-737 owned by Yamal Airlines:

*«During the preflight check there was ice detected on the aircraft wing surface. On agreement with the maintenance crew, the aircraft was subject to complete de-icing/anti-icing treatment».*

Explanatory note of the PIC of B-737 owned by Yamal Airlines:

*«…During the preflight check I detected… slush on the wing surface. I decided to conduct de-icing/anti-icing… After the de-icing/anti-icing treatment, we took off without any deviations».*

Explanatory note of the PIC of B-737 owned by UTAir Aviation:

[4] Local time.

*«As a result of the preflight check I decided that de-icing/anti-icing is needed… based on the presence of snow on the surface of wings, fuselage and stabilizer... as well as OAT being close to zero. After the de-icing/anti-icing I requested towing…».*

Explanatory note of the PIC of ATR 72 VQ-BLI owned by UTAir Aviation:

*«…As we approached the aircraft, the technician did not report anything concerning the readiness of the aircraft for the flight or on the presence of contamination on the aircraft surfaces.…I conducted the preflight check of the aircraft… during the check I detected a layer of snow, about 3 cm thick, on the surface of the fuselage, elevator and wing… I decided to conduct de-icing/anti-icing…».*

*«The last time I saw the ATR 72 VP-BYZ on 02.04.2012 at about 06:00… it was on Stand 3, there were slush deposits on its wings and fuselage similar to the slush deposits on my aircraft and on the airfield surface…».*

Explanatory note of the PIC of ATR 42 owned by UTAir Aviation:

*«On 02.04.2012… I performed Flight UTA22. …Upon arrival on the stand, during the preflight check I saw snow on the wing edge. I assumed that there was ice on the wing as well, and decided to conduct de-icing/anti-icing…».*

Explanatory note of the PIC of CRJ 200 owned by UTAir Aviation:

*«On 02.04.2012 I was conducting Flight UTA221… During the preflight check I saw that the aircraft surface was covered with ice and snow. I decided to conduct de-icing/anti-icing…».*

Explanatory note of the PIC of Boeing 737-500 VQ-BJM owned by UTAir Aviation:

*«On 02.04.2012 I was performing Flight UTA46… Before the departure, upon my request, the aircraft was de-iced/anti-iced, as during the preflight check I detected a 3 mm layer of slush on the surfaces of the wing, stabilizer and fuselage. There was no preliminary snow removal performed by the ground crew…».*

Explanatory note of the PIC of ATR42/72 owned by UTAir Aviation:

*«On 02.04.2012 I performed Flight UTA299. During the preflight check I detected a 2-3 mm layer of snow adhering to the metallic part of the wing, as hard as ice, that could not be scratched off by fingernails, similar snow was present at the propeller blades and spinner. I failed to reach the stabilizer, as the ladder was too short. I requested de-icing/anti-icing treatment, which was performed».*

### 1.18.5. Information on De/Anti-Icing of Other Aircraft on 02.04.2012.

REFERENCE
02.04.12 – Departures of aircraft from 04:00 to 08:00 hrs, their arrival at Roschino AP and treatment with Arktika deicing fluid. Local time given.

| Flight No. | AC | AC reg. number | Route | Takeoff (schedule) | Takeoff (actual) | De/anti-icing | Arrival Flight No. | Time of arrival | Date |
|---|---|---|---|---|---|---|---|---|---|
| S7202 | A319 | VPBHJ | Moscow (DME) | 0605 | 0610 | Not treated | S7201 | 0447 | 02.04. |
| UT261 | ATR-75 | VQBLI | Nizhnevartovsk | 0610 | 0615 | Treated 0603 | UT262 | 1706 | 01.04. |
| UT299 | ATR-42 | VPBPK | Khanty-Mansiysk | 0615 | 0620 | Treated 0610 | UT222 | 1855 | 01.04. |
| SU1503 | A320 | VQBCM | Moscow (SVO) | 0635 | 0635 | Not treated | SU1502 | 0505 | 02.04. |
| YC147 | B 735 | VPBRU | Nadym | 0640 | 0647 | Treated 0636 | YC148 | 1558 | 01.04. |
| YC145 | B 735 | VPBRS | Novy Urengoy | 0650 | 0708 | Treated 0652 | YC242 | 2303 | 01.04. |
| UT454 | B 734 | VQBID | Moscow (VKO) | 0715 | 0722 | Treated 0708 | UT453 | 0101 | 02.04. |
| YC10 | B 735 | VQBNM | Salekhard | 0700 | 0732 | Treated 0707 | YC156 | 0641 | 30.03. |
| UT120 | ATR 72 | VPBYZ | Surgut | 0730 | 0733 | Not treated | UT119 | 2342 | 01.04. |
| UT223 | ATR 75 | VQBLK | Novy Urengoy - Salekhard | 0735 | 0744 | Treated 0730 | UT320 | 2207 | 01.04. |

### 1.18.6. Information on the Movement of De/Anti-Icing Vehicles[5]

On the basis of the reference extracts concerning aircraft de/anti-icing on 02.04.2012 issued by the handling vehicle service of Roschino Airport and maintenance service spreadsheet (maintained by the UTAir-Technic dispatch group), the movement schedule of de/anti-icing vehicles operated by UTAir-Technic staff, Shift 4.

| **AC type, Flight** | **Stand** | **Vehicle type, operator** | **Handling Vehicle Service** | **Dispatch Group** |
|---|---|---|---|---|
| | | | **Start/end** (local time) | **Time of vehicle request** (local) |
| A-319 VP-BHJ, S7-202, Siberia Airlines (transit) | 12 | - | Refused, transit | |
| ATR 2 VQ-BLI, UTA-261 | 1 | Mercedes (aviation mechanic) | 05:45/06:00 | 05:40 |
| ATR 42 VP-BPK, UTA-299 | 15 | Tempest (shift supervisor) | 05:45/06:10 | 05:40 |
| A-320 VQ-BCM, SU-1503, Aeroflot Airlines, transit) | 13 | - | Refused, transit | |

[5] Local time is used in this Section.

| AC type, Flight | Stand | Vehicle type, operator | Handling Vehicle Service | Dispatch Group |
|---|---|---|---|---|
| B-734 VQ-BID, УТА-454 | 11 | Tempest (shift supervisor) | 06:45/07:00 | 05:40 |
| ATR 72 VP-BYZ, UTA-120 | 3 | Mercedes (aviation mechanic) | Refused to de/anti-ice. De-icer arrived at 06:59, and left at 07:09 | 05:40 |
| ATR 72 VQ-BLK, UTA-223 | 2 | Tempest (shift supervisor) | 07:10/07:30 | 06:48 |
| B-737 VQ-BJM, УТА-462 | 10 | Tempest (shift supervisor) | 07:30/07:45 | 07:28 |

### 1.18.7. Accidents Caused by Ground Icing and Aircraft Stall

According to the data provided by the ATR 72 designer and manufacturer, there have been a number of incidents during takeoff with residues of ground icing that, among other factors, caused the aircraft to return to the departure airport. There had never before been accidents involving ATR 42/72 aircraft caused by residues of ground icing.

At the same time, within the history of the world and Russian aviation, there have been a number of accidents with different aircraft types one of the causes of which was lack of de/anti-icing.

On 9.03.2000, at 05:43 UTC, at Sheremetyevo Airport, at daytime, VMC, after takeoff with magnetic heading of 247° (right RWY) in order to perform a charter passenger flight JGJ-9651, a Yak-40D RA-88170 owned by Vologodskoye Aviation Enterprise crashed.

The aircraft arrived at Sheremetyevo at 06.03.2000 and was on stand on March 7, 8 and 9. The weather at Sheremetyevo on March 7 and 8 was unfavorable, there was strong wind up to 14-17 m/sec, sleet, OAT varied from +0.1°C to -3,7°C.

On March 8, 2000 and during the aircraft dispatch preparation in the morning of March 9, the maintenance crew only swept snow off the aircraft, but did not de-ice.

The engineering staff did not check the removal of ground icing from the aircraft before the takeoff.

The mandatory «Supplement to the job card for line maintenance of aircraft and helicopters» for contamination removal issued by the Directive of the Ministry of Civil Aviation, USSR No.526U of 31.07.1985 was not filled.

The Yak-40D aircraft registered RA-88170 was handed over from the maintenance staff to the flight deck crew without any remarks at about 04:45. The PIC did not give any guidance to the maintenance staff as to the de-icing/anti-icing of the aircraft.

After the aircraft lifted off, at a low height, with an angle of attack lower than critical, the aircraft started intensive banking that the crew could not compensate by applying flight controls. According to the conclusion drawn by the investigation team, loss of lift performance due to ground icing influence was one of the causes of the aircraft stall.

Several accidents (at Vnukovo, Almaty, Yerevan) caused by lack of de/anti-icing took place involving CRJ type aircraft. Information on these and other accidents can be found in the Final Reports of investigation teams that are can be viewed on the following links:

- http://www.mak.ru/russian/investigations/2007/report_n168ck.pdf;
- http://www.mak.ru/russian/investigations/2007/report_d-arwe.pdf;
- http://www.mak.ru/russian/investigations/2008/crj-100lr.html.

Based on the results of investigations of a number of such accidents there have been numerous recommendations given to the certifying agencies and aircraft manufacturers to reconsider the existing procedures of determining the presence of ground icing and checking its removal before flight and to consider the practicability of introducing a requirement to equip aircraft, whose aerodynamic characteristics are susceptible to negative effect of ground icing, with a automatic detection system that would detect hazardous ground icing and warn the crew thereof[6].

### 1.18.8. Information on the PIC's Initial Training at a Flight School

The investigation team, along with a representative of Tyumen IAO AT, FATA, scrutinized the content of the program of flight school student training specialized in «Flight Operations» in 2008 as to the following subjects: aviation meteorology, aerodynamics, flight safety, and also studied the training and assessment system and at Ulyanovsk Flight School. The investigation team also checked the PIC's academic progress (he graduated in 2008) and requested the PIC's personal characteristics from the dean of Faculty for Flight Operations and Air Traffic Control. According to the available information, the PIC was generally characterized

[6] This recommendation was first published in the Final Report of AAIB UK (Item 4.7) based on the investigation of an accident involving a CL600-2B16 registered N90AG that occurred on 4 January 2002 at Birmingham Airport.

in a positive way, but did not have the best marks. At the final exams on aerodynamics and physics he got «3» (Satisfactory), in the course of his studies he also had certain problems while studying flight operations and English.

The training at the flight school is conducted by qualified experience teaching staff. The knowledge of students is assessed with extensive use of both computer-based testing and oral interviews on the basis of examination papers. In the course of the training a wide range of educational techniques are used: lectures, workshops, laboratory works, etc.

At the same time, the investigation team believes it would be appropriate to pay special attention to certain aspects of the training process. Thus, there are good guidance manuals that reflect in-flight and ground icing. However, an interview with the school graduates revealed that they had insufficient knowledge on the icing types and ice shapes accumulated on the aircraft surface in flight. It is necessary to increase requirements to the assessment of knowledge and focus the students' attention on the weather phenomena that are hazardous for aircraft and use investigations data on accidents involving weather effect.

In the course on aerodynamics, not enough time is dedicated to the study of ground icing influence on the aircraft performance and its behavior when taking off with a contaminated wing and stabilizer, as well as to the use of investigation materials on accidents caused by ground icing at takeoff due to unsatisfactory de-icing/anti-icing or to other typical factors. The interview with students in their last year of studies revealed that they are not fully aware of the physical essence of changing aerodynamic characteristics and contaminated aircraft behavior in flight.

As for the «Flight Safety» subject, the training program (including such issues as Airworthiness and Aircraft Maintenance) not enough attention is drawn to the ground handling, de-icing/anti-icing of aircraft and their preparation for flight in case of contaminated aircraft.

This situation resulted from insufficient time granted for training on specific, crucial aviation subjects such as aerodynamics, piloting, meteorology and flight safety, which is noted by the teaching staff of the Ulyuanovsk Flight School.

### 1.18.9. English language proficiency assessment

Considering that all the mandatory (AFM, FCOM, AMM etc.) and most of guidance documents (Cold Weather Operations etc.) for the ATR 72 aeroplane is in English, the investigation team, with assistance of a qualified independent language expert[7], has assessed the

[7] The evaluation was performed by an active English language proficiency rater of the Russian Federation approved by the Russian CAA, delegated expert on behalf of the Russian Federation to the ICAO Proficiency Requirements in Common English Study Group, expert of Special Group on Education and Training of the European and North Atlantic Office (ICAO), member of the Council of the International Civil Aviation English Association.

English language proficiency of the flight crew members[8]. The team also analyzed the existing regulatory documents for civil aviation of the Russian Federation that establish requirements to the English language proficiency as well as training programs used for the training of the flight crew members.

It should be noted that the flight crew members were not authorized for international flights, so the provisions of the Russian Federal Aviation Rules «Requirements to flight crews of civil aviation aircraft of the Russian Federation as to performance of international flights» approved by Order No.90 of 9 July 2007 by the Ministry of Transport, RF (further referred to as FAP-90) were not applicable to them.

Order No. 148 of 11.12.2006 by the Ministry of Transport, RF approved FAP «Requirements to flight crews as to transition training for other (new) aircraft types of civil aviation» (further referred to as FAP-148). These rules determine that «applicants that are subject to transition training for other (new) civil aircraft types, whose operation manuals are written in English, shall demonstrate their English language proficiency to a degree that would be sufficient to understand the above manuals and perform pertinent operational procedures». It should be mentioned that neither this document, nor any other regulation of the Russian Federation, determine the criteria for assessing the English language proficiency as «sufficient». The safety recommendation[9] issued by the investigation team involved in the investigation of the accident of the Boeing 737 registered VP-BKO on 13.09.2008 was not followed.

| | |
|---|---|
| ***Note:*** | *The Ministry of Transport order No. 453 of 28 December 2012 "Concerning the Introduction of Amendments to Certain Ministry of Transport Legislative Acts and Annulling the Certain Ministry of Transport Legislative Acts" (registered in the Ministry of Justice on February, 18 2013, officially published in Rossiiskaya Gazeta on February, 27 2013, is coming into force after 90 days from the date of publication) the mentioned FAP-90 and FAP-148 are considered to be annulled. The requirements of the necessary English language proficiency level of the crew members that perform the international flights are included in FAP-147. At the same time, after the annulling of the FAP-148, there are no requirements of the English language proficiency within the* |

[8] The ground handling staff involved in the aircraft preflight preparation did not show any English language proficiency.

[9] Safety recommendation was to develop and implement qualification requirements to the English language proficiency for flight crews that operate aircraft having operational documentation written in English as well as for the maintenance staff that provide maintenance of such aircraft.

| | |
|---|---|
| | *transition to the foreign aircraft, which documentation is issued in the English language only, in the Russian Federation civil aviation regulatory documents.* |

As the PIC was trained at the flight school, he had certain problems with the English language. In his first year he was granted a «credit», in the second, third and fourth year he was granted a «Satisfactory» , and in his fifth year he received a «4» (Good).

The F/O had a «Satisfactory» for English at the flight school.

The PIC's personal data file contains the following documents related to his English language training:

Certificate No. 3991 of 29.08.2008 confirming his being trained at the flight staff training courses of technical English. The Certificate was issued by the Personnel Training Center, with a «5» (Excellent).

Certificate No. 1390 of 8.10.2010 confirming his training at the flight crew training courses of English for international flights authorization (transition from Level 2 to Level 3, ICAO language proficiency rating scale). The Certificate was issued by the Personnel Training Center. Grades: General and Aviation English - «Good» , Radiotelephony English - «Good» .

Minutes No. 998 of 15.10.2010 of the Qualification Test to rate the English language proficiency. In all the 6 profiles designated by the ICAO scale (Pronunciation, Structure, Vocabulary, Fluency, Comprehension, Interactions) he was rated Level 4[10]. This means his overall English language proficiency was also rated as Level 4. According to the explanation given by the Airline's representatives, after he underwent training for ICAO Level 3, the pilot learned on his own and was able to confirm Level 4. However, there was no pertinent rating mark in his Flight Crew Member License.

The F/O's personal data file contains the following documents related to his English language proficiency:

Minutes No. 297 of 25.12.2008 of the Qualification Test to rate the English language proficiency. In two of the 6 ICAO language profiles he was rated Level 2, and in the other 4 - Level 3, with the final score at Level 2.

Certificate No. 5800 of 06.02.2009 confirming his training at initial flight crew training courses for international flights authorization, issued by the Personnel Training Center. English is assessed at «4» (Good).

[10] Below is attached the assessment of the PIC's rating test record by an independent expert.

Certificate No. 624 of 20.03.2009 confirming his training at flight crew training courses in Technical English, issued by the Personnel Training Center. English is assessed at «Satisfactory» .

Certificate No. 16628[11] of 16.12.2010 confirming his training at the flight crew training courses in English for international flights (transition from ICAO Level 3 to Level 4). The Certificate was granted by the Personnel Training Center. Grades: General and Aviation English – «4» (Good), Radiotelephony English – «Good» . There was no language proficiency rating after the training. There are no rating marks in his Flight Crew Member License either.

In order to assess the real level of the English language proficiency, an independent language rater (information on the rater is given above), upon request of the investigation team, made an assessment of the available materials concerning the pilots' English language training and testing using the audio records of the qualification test, as well as an assessment of the Training Program for Civil Aviation Flight Crews of the Russian Federation for international flights, Edition of 2008 (hereinafter referred to in this Item as the Program).

The rater was asked to assess the following:

1. Whether the flight crew training programs in the English language were appropriate.
2. What the PIC's level of English language proficiency was.
3. What the F/O's level of English language proficiency was.
4. Whether their level of English language proficiency was sufficient to read and understand texts of the flight operations manuals written in English.

**Re: Question 1.**

The expert conclusion states, that the Program, in terms of the English language training, contains the following:

A) Program of initial training of flight crews in General and Aviation English.

B) Program of recurrent training of flight crews in English for International Flights.

C) Program of training in Aviation Technical and General English for Flight Engineers.

D) Program of training of flight crews for testing to rate the Aviation English language proficiency.

E) Methodology.

F) Recommended educational facilities and literature.

[11] In accordance with the Certificate, the training lasted from 08 November to 16 December 2010. At the same time, from 14.12.2010 to 17.12.2010 the F/O was undergoing simulator training abroad.

Syllabus:

| Subjects | Number of academic hours (hours) | | | | | |
|---|---|---|---|---|---|---|
| | Level training: | | | | Recurrent training | |
| | 0 to 1 | 1 to 2 | 2 to 3 | 3 to 4 | 4 | 5 |
| 1. General and Aviation English | 180 | 120 | 120 | 120 | 120 | 120 |
| 2. Radiotelephony | | 60 | 60 | 132 | 30 | 30 |
| 3. Exam (0,5 academic hour per person) | | | | | | |
| Course hours | 180 | 180 | 180 | 252 | 150 | 150 |
| Total hours excluding exam | 792 | | | | 150 | 150 |

It should be noted that ICAO scale does not have any Level 0, but starts with Level 1. Thus, either the training was based on some other scale, or the Program developers did not take into account all the provisions of ICAO documents. Furthermore, ICAO Level 1 is described as «below the Elementary level», while Level 2 is considered as the initial rating level[12].

According to FAP-90, the duration of the training course shall be «not less than 180 hours for one level, until Level 4 is achieved» (the analyzed Program envisages 120 hours), while Radiotelephony shall be studied beyond the level training (in the analyzed Program Radiotelephony is included into the course of General and Aviation English).

Radiotelephony, being the language for specific purposes, shall be studied after the trainees achieve such a level of language proficiency as to be able to communicate on common, concrete and work-related topics, which is consistent with at least ICAO Level 3. However, the analyzed Program provides Radiotelephony training starting with the Level 1 to Level 2 training. It should be noted that Level 1 implies the applicant cannot demonstrate even memorized phrases, while at Level 2 they only know a limited number of memorized words, phrases and basic structures.

Item 2.3 of the analyzed Program considers various means of knowledge assessment. Particularly, it implies that the exam shall check General and Aviation English as well as Radiotelephony. The developers of the Program state that «every language parameter is assessed, including Pronunciation, Structure, Vocabulary, Fluency, Comprehension, Interaction», which is «in full compliance with the ICAO language profiles».

[12] The description of ICAO rating scale levels in all the six language profiles is given in ICAO Doc. 9835 "Manual on the Implementation of ICAO Language Proficiency Requirements" (hereinafter referred to as Doc. 9835).

At the same time, Item 6.2.8.6 of ICAO Doc. 9835 runs: «The use of ICAO standardized phraseology is an operational skill that is taught by qualified aviation operational specialists and is acquired to the required level of proficiency by trainee pilots and controllers during operational training. Teaching and testing standardized phraseology are operational issues, not a language proficiency issue. It follows that a test designed to evaluate knowledge or use of standardized phraseology cannot be used to assess plain language proficiency». Thus, the second part of the used test cannot be appropriate to evaluate general and aviation language proficiency.

The list of topics studied during the training up to Level 4 embodies only an insignificant part of the lexical domains specified in Appendix B to Doc. 9835. It is assumed impossible for the students to acquire all the required vocabulary if the lexical domains are not even specified in the training program.

Appendix B to Doc. 9835 also provides a wide range of communicative language functions that shall be managed by pilots. The analyzed Program does not contain any mention of communicative functions.

In the analyzed Program, the study of grammar structures is not based on distinguishing basic and complex structures (as implied by the ICAO scale and specified in Appendix B to Doc. 9835), but implies methods typical of out-of-date study books.

Regarding Question 1, the expert came to the following conclusions:

1. Some of the Program's provisions deviate from the requirements of the Russian Federal Aviation Rules «Requirements to flight crews of civil aviation aircraft of the Russian Federation as to performance of international flights» approved by Order No.90 of 09.07.2007 by the Ministry of Transport, RF. The content of the Program does not fully comply with Item 1 and 3 of the «General» section of the Program.
2. It seems difficult to achieve ICAO Level 4 using only this Program.

**Re: Question 2**

The expert conclusion remarks that the available audio record of the PIC's rating test was made up of three parts (total duration 21 minutes and 21 seconds, according to the Program requirements - 30 minutes):

- Part 1 - 9 minutes 41 seconds;
- Part 2 - 5 minutes 31 seconds;
- Part 3 - 6 minutes 09 seconds.

In Part 1 the PIC told about his family, flight experience, effect of thunderstorms on flight operations, why he studied English, about the language in which the manuals he used are written, and the language used among the crew members.

From the very beginning, the PIC demonstrated memorized speech that was not interrupted by the examiner. The objective of a qualification test is no to check the applicants' ability to memorize texts and reproduce them, but to assess the language proficiency of the test taker both in formulaic and spontaneous speech.

It should be noted that a number of words were pronounced with significant mistakes. At the same time the test taker used a great deal of idiomatic expressions. However, the usage of idioms shall only be assessed in spontaneous speech, as it cannot be an evidence of a high level of language proficiency if used in formulaic speech. This can be considered as the wish of English language teachers to have their students assessed higher.

When the test taker reproduced memorized utterances, his speech tempo raised up to 150 words per minute at times, while a simplest question of the examiner concerning his flight experience made the tempo fall as low as 60 words per minutes, which is significantly lower than the ICAO recommended tempo of 100 words per minute. The same happened when the test taker was asked on the effect of turbulence on the flight performance. This can be evidence of the applicant's hesitation during transition from memorized text to spontaneous speech.

The second part of the rating test contained role play to demonstrate use of radiotelephony English,that consisted of routine radio communication during start-up and taxiing request. Two complications were provided, the first one concerning reduced visibility during taxiing, which was reported to the examiner by the test taker, the examiner asked if he needed a follow-me car which was affirmed by the test taker, and there was no further development of the situation; the second complication was an engine problem which was reported by the test taker as «flameout», and being asked about his intentions, replied that they were returning to the aerodrome of departure. There was no further development of the situation.

During the radio exchange, the test taker's speech was erratic and hesitant even in the simplest situations.

Part 3 of the rating test started with a video about 3 minutes and 25 seconds long. After that the test taker was asked questions concerning the video. The test taker started answering with hesitation, the examiner suggested him hints of the correct answers and corrected him in case his answers were wrong. If the test taker was thinking over the answer, the examiner paraphrased questions using plainer language and speaking slower.

Regarding Question 2, the expert made a conclusion that according to the available samples of ratable, not memorized speech of the test taker, his level of English language proficiency can be assessed as being lower than Level 4.

**Re: Question 3.**

The expert conclusion remarks that the available audio record of the F/O's rating test was made up of three parts (total duration 25 minutes and 36 seconds, according to the Program requirements - 30 minutes):

The audio record of the exam consisted of three parts:

- Part 1 - 9 minutes 35 seconds;
- Part 2 - 8 minutes 37 seconds;
- Part 3 - 7 minutes 24 seconds.

It was revealed that Part 2 contained a record of an exam taken by another person. Part 2 of the rating test of the F/O was in the third audio file, while Part 3 of the F/O's test was missing. According to the information of the Personnel Training Center, the third part cannot be recovered.

In Part 1 the F/O told about his family, where he lived, when he graduated, about his hobby and what he did in Tyumen, about his daily routine and how long it took him to get to the training center, the number of lessons he had a day and what he did after the classes, whether computers are useful in his study of English, etc.

From the very beginning of the test the F/O demonstrated memorized speech that was not interrupted by the examiner. The questions were asked at a slow tempo.

The examiner constantly corrected the test taker, gave him hints when he was considering an answer. There were a number of questions that implied only a Yes/No answer, so was of no value for the language proficiency rating. The test was more like a personal class, but not a check of knowledge.

The second part of the rating test contained role play to demonstrate use of radiotelephony English that consisted of routine radio communication concerning request for takeoff clearance. The test taker could not pronounce the letter code of ATIS information «Whiskey», he did not know what to say when contacting the Delivery, Apron and Ground Control; instead of the callsign Aeroflot 106 assigned by the role play legend, he uttered the callsign as Aeroflot 160. As complications were introduced, the F/O was at a great loss and could only communicate with hints from the examiner.

The test taker demonstrated a limited use of standard phraseology and made long pauses in the simplest situations.

Regarding Question 3 made a conclusion, that on the basis of the available samples of spontaneous, non-memorized speech of the F/O, his language proficiency can be assessed as being in between the higher boundary of Level 2 and the lower boundary of Level 3.

**Re: Questions 2 and 3.**

When answering these questions, the expert also enumerated a number of drawbacks both in the format of the test and in the work of the examiners.

The examiners made numerous corrections of the test takers' answers in case they made mistakes, which is prohibited during the testing.

The examiners deviated from ICAO standard phraseology and made mistakes in the use of radiotelephony. When there was no standard phraseology the examiners used plain English without any consideration of the requirements to radio communication, when they corrected the test takers they did not use ICAO phraseology. There were also some common mistakes in their use of plain English.

During one of the test parts, the examiner's speech lasted longer than the test taker's speech, which is inappropriate for a rating test.

The questions were simplified, the examiners suggested variants of answers that the test takers were only expected to agree with.

It should be also mentioned that in both cases, both the examiner and the rater were staff of the same company (Personnel Training Center), which, in certain circumstances (the need of client or founding airlines in pilots to conduct international flights) does not exclude subjective rating of the language proficiency[13].

On the whole, the expert drew a general conclusion that the used test format did not comply with the requirements to a language proficiency rating test specified in ICAO Doc. 9835 «Manual on the Implementation of ICAO Language Proficiency Requirements».

**Re: Question 4.**

Regarding Question 4, the expert made the following conclusions:

1. The actual English language proficiency level of the PIC and the F/O did not allow them to completely understand training materials presented in the English language.
2. Acquiring General and Aviation English language proficiency of ICAO Level 4 by pilots does not guarantee that they would absolutely understand training materials as well as manuals and other documents written in English.

At present ICAO requirements to the English language proficiency refer only to speaking and listening skills, and are only applicable to civil aviation pilots and other flight crew members involved in radio exchange, as well as air traffic controllers and aeronautical station operators. Reading and writing skills are not included in the list of requirements. Therefore, the

[13] UTAir is one of the founders of the Personnel Training Center, NPP.

qualification test cannot provide an answer to this question, as it does not (and should not) contain tasks that would check writing and reading skills.

However, as the language is being taught, both reading (to a greater degree) and writing skills are used. A person who actually can demonstrate general and aviation language proficiency of ICAO Level 4 is competent enough to understand texts on work-related topics written in simple language.

At the same time, e.g., the expertise of the available ATR training materials concerning cold weather operations reveals that the level of language used there was not simple at all. For example, the section dealing with icing contains complex structures and vocabulary: "Icing is defined by any deposit or coating of ice on an object caused by the impact of liquid hydrometeors usually supercooled" (page 7); "Deposit of ice, which generally assumes the form of scales, needles, feathers or fans and which forms on objects whose surface is sufficiently cooled, to bring about the direct sublimation of water vapor contained in the ambient air" (page 8); "No air bubbles are captured during the process giving clear ice a compact texture and a transparent aspect" (page 9) etc.

Use of such materials requires quite a competent use of the language. Comparing the language proficiency level needed to read manuals written in English with the ICAO scale, in such profiles as structure and vocabulary it should be higher than Level 4.

### 1.18.10. FAP «Certification of Airports. Procedures»

Item 1.5 provides a definition of airport activities subject to certification. Among others, «maintenance support, that is a complex of operations to provide timely and high-quality aircraft maintenance» is to be certified. There is no mention of the «ground handling» in this document. Thus, the document must be reconsidered taking into account the actual airport practice, paying special attention to A/C de-icing/anti-icing including availability of deicers, de-/anti-icing fluids and personnel training.

### 1.18.11. Of the aviation organizations inspection order

In the ICAO Safety Oversight manual (Doc No 9734AN/959) items 3.6.1 – 3.6.3 it is stated that the effectiveness of a safety oversight system and the implementation of national and international Standards need to be supported by guidance material which will provide the technical experts with guidance on how to accomplish their specific functions. Such approaches

to the evaluation and logging of inspection results are for example applied by IATA within the implementation of the IOSA program.

In Russian Federation the Federal Aviation Regulations "Certification Requirements to private persons and legal entities functioning as the commercial air transport operators. Certification procedures" are enacted and approved by the Ministry of Transport Order No 11 of February, 4 2003 and the Federal Aviation Regulations "Aeronautical equipment maintenance and repair organizations" approved by the Russian Federation Federal Aviation Service Order No 41 of February, 19 1999 determine the requirements and criteria that a civil aviation entity shall meet to receive approval for flight and maintenance operations.

In elaboration of the Federal Aviation Regulations stated guidance that describe the methods of the evaluation of the applicant conformance to the certification requirements together with the methods of the monitoring planning before certification inspections start was not developed. Currently as a consequence of this the unified and overall concept of the evaluation of the organization conformance to the certification requirements is not ensured.

For example in the "Aeronautical equipment MRO certification Procedure" approved by the Russian Federation Federal Aviation Service Order No 287 of December, 30 1997 the content of the "Personnel" specification (Annex 1 to the Procedure) that is to be monitored within the aeronautical equipment MRO certification is limited to "the availability of the pertinent staff". Such a general statement allows the excessively common and superficial approach to personnel training evaluation.

The absence of the guidance materials on how to comply with the certification regulations and principles as well as about supervision of the certificate or licenses holders that implies the conformance evaluation standard procedures (including the documentation evaluation) and the procedures on the manifestation of the operability (the requirement of the Doc No 9734AN/959) items 3.6.3) does not guarantee revealing of the present deficiencies in course of the inspections performed by the authorized authorities. In such a way the last certification inspection of UTair Aviation was performed by the Tyumen Interregional Territorial Directorate of Federal Air Transport Agency on October, 31 2011 whereas the last the last approval as maintenance organization for UTair Technic was issued by Federal Air Transport Agency on March, 27 2012 by the letter No 03.03-215. The performed inspections did not reveal the existing deficiencies, including the aircraft ground handling organization aspects and the concerned personnel qualification.

# 2. Analysis[14]

## 2.1. The analysis of the clauses of the documents that determine the aircraft anti-icing/de-icing procedure and the requirements for the personnel qualification together with their accomplishment in relation to the accident flight

The International Civil Aviation Organization (ICAO) has issued the Document 9640 "Manual of Aircraft Ground De-icing/Anti-icing Operations", second edition, 2000 (further referred to as Doc 9640). The document determines that the State regulatory authority ensures that every operator shall have an approved de-icing/anti-icing program or procedures. The program shall require that operators comply with the Clean Aircraft Concept.

The Clean Aircraft Concept realization implies three major stages: the evaluation of the aircraft condition and decision-making for applying anti-icing/de-icing procedure, the aircraft treatment and its quality control, the following control of the aircraft condition up to the line-up.

Doc 9640 defines that the de-icing/anti-icing procedures, including those subcontracted with the operator shall be subject to quality inspections as part of the operator's quality assurance program.

In the Doc 9640 it is noted, ground de-icing/anti-icing is, technically, a part of the operation of the aeroplane. Additionally, the de-icing/anti-icing information reported to the flight crew is also a part of the technical requirements to aeroplane airworthiness. Correspondingly, the Doc 9640 defines, that all the persons, responsible for the de-icing/anti-icing process on ground, must be trained and qualified personnel in the domain of procedures and communications and be aware of the frame of their responsibility.

The trained and qualified ground staff employee responsible for the de-icing/anti-icing procedure, shall check the aeroplane for the need to de-ice, and, if required, initiate de-icing/anti-icing; the employee is responsible for the correct and complete de-icing/anti-icing treatment of the aeroplane. The final responsibility for accepting the aeroplane after de-icing/anti-icing rests, however, with the pilot-in-command. The pilot-in-command has the responsibility to ensure compliance with the Clean Aircraft Concept. The ground de-icing crew share this responsibility by providing an aeroplane that complies with the Clean Aircraft Concept. For the accomplishment of the stated provisions the de-icing/anti-icing procedures shall be carried out only by trained and qualified personnel. Initial and recurrent training for flight crews and ground crews is to be conducted to ensure that all those crews obtain and retain thorough knowledge of

[14] History of the flight is given above in section 1.1

ground de-icing/anti-icing policies and procedures, including new procedures and lessons learned. The training objective is to instill the stable knowledge and skills including:

- effects of frost, ice, snow and slush on performance, stability and control of the aircraft;

- methods of recognition of the iced deposits presence on the aircraft critical surfaces;

- de-icing/anti-icing procedures in general and specific measures to be performed on different aeroplane types and procedures specifically recommended by the operator, aeroplane manufacturer or fluid manufacturer.

It is also determined, that accurate records of the training and qualifying of both flight and ground personnel shall be maintained. The proof of qualification shall be for both initial and annual recurrent training.

In item 2.14 of the FAP-128 it is stated: «The takeoff is prohibited, if there is frost, snow or ice on the upper surface of the wing, fuselage, controls, empennage, propellers, windshield, power plant or pressure instruments pressure ports, unless otherwise stipulated by the flight manual», in other words there is a requirement of the Clean Aircraft Concept accomplishment.

On the date of the accident there was no state-approved basic official valid regulation in the Russian Federation in the domain of de-icing/anti-icing policies and procedures. There is a corresponding section in the Regulations on Technical Operation and Repair of Aircraft Equipment in Civil Aviation, issued 1993, however, according to the letter No 03.02.-805 of the Russian Federation Civil Aviation Authority Aircraft Continued Airworthiness Directorate general manager from 20.09.2012, the mentioned document cannot be considered as being of effect, because it had not been subject to the state registration and had not been published according to established procedure.

In FAP-145 the set of operations, related to aircraft airworthiness assurance, including during the pre-flight preparation, is determined as maintenance. The aircraft de-icing/anti-icing is a part of assurance of aircraft airworthiness, so according to FAP-145, the procedure shall be related to the maintenance and, correspondingly, shall be carried out by the qualified personnel and be under control within operators and subcontracting organizations (maintenance service centers) SMS.

***Примечание:*** *The separation of the notions "maintenance" and "ground handling" exists in international documents. So, the Commission Regulation (EC) № 2042/2003 dated November 20, 2003 which is devoted to aircraft and its components airworthiness in Article 2 reads:*

*(h): 'maintenance' means any one or combination of overhaul, repair,*

*inspection, replacement, modification or defect rectification of an aircraft or component, with the exception of pre-flight inspection;*

*(j): 'pre-flight inspection' means the inspection carried out before flight to ensure that the aircraft is fit for the intended flight.*

*Also The Executive Director of the Agency Decision №2003/19/RM dated November 28, 2003 on acceptable means of compliance with the above mentioned Directive reads that The performance of ground de-icing and anti-icing activities does not require a Part-145 approval.*

On the date of the accident the airline companies and airports independently worked out the de-icing/anti-icing policies on the basis of available documents by ICAO, IATA and other international organizations, aircraft manufacturers together with domestic guidelines (see Chapter 1.18.1).

Nowadays international policy for the pre-flight de-icing/anti-icing treatment (including EASA policy, as it is the organization that issued the initial type certificate for aircraft) does not demand the de-icing/anti-icing to be carried out by the maintenance organizations, certified under PART 145, and by certified personnel (trained and certified under PART 147). Thus, the aircraft de-icing/anti-icing procedure and its quality control is considered as ground handling, is not related to maintenance and may not be part of the certified engineering and technical personnel responsibilities. It is necessary to note, that according to Technical Operation and Repair of Aircraft Equipment in Civil Aviation, issued 1993 the procedure in question is a part of aircraft maintenance.

EASA regulations and recommendations in force assign the responsibility for aircraft de-icing/anti-icing to the operator, who shall get the corresponding recommended procedures from the aircraft manufacturer (type certificate holder) and make certain that its personnel or the external organization staff, that render aircraft de-icing/anti-icing service is properly qualified to carry out the procedure in question.

The aircraft manufacturer has worked out the aircraft de-icing/anti-icing job card (AMM JIC 12-31-12-PTN-10000). The job card is included in Aircraft Maintenance Manual (AMM) in Servicing section, together with other procedures, considered important from the point of view of flight safety (the oil system servicing , hydraulic system servicing etc). Upon the investigation team's request the aircraft manufacturer pointed out, that the aircraft de-icing/anti-icing is considered a part of the aircraft continued airworthiness, and therefore there shall be no

difference in training, qualification, licensing of the personnel, that performs maintenance and servicing.

UTAir de-icing/anti-icing policy at the time of the accident was governed by the Chapter 16.5 «Instruction for de-icing (anti-icing) and control over these procedures performance» of the Flight Operations Manual A-16 Part, by the Ground Handling Organization Manual section 9.6 «Ground aircraft de-icing/anti-icing» and by the "De-icing/anti-icing Program of UTAir Aviation" (hereafter referred to as Program), approved by the General Manager order. Main provisions of these documents worked out taking into account the above-mentioned domestic and international data, are based generally on the Clean Aircraft Concept and do not contradict each other[15].

The "De-icing/anti-icing Program of UTAir Aviation" allows the possibility of de-icing/anti-icing procedure being performed by a subcontracting servicing company (the external organization, the agent). Meanwhile it is stipulated, that the organization in question shall have the most recent edition of the Program in an applicable format. The Program shall be available to the airline crews, to the management and de-icing/anti-icing personnel as well. Within the case studied, the external organization at the Tyumen (Roschino) airport that carried out the de-icing/anti-icing procedures was UTAir-Technic. The Program was available in UTAir-Technic.

The Program assigns the auditing of the subcontracting organizations, which carry out de-icing/anti-icing, to the airline's Technical Directorate. The data on such auditing of UTAir-Technic were not given to the Commission.

UTAir-Technic has worked out and brought into action the Instruction on ATR 42/72 ground handling that contains the De-icing/anti-icing section with the note, that the procedure in question is carried out in compliance with the Procedures on ATR 42/72 de-icing/anti-icing (hereafter referred to as Procedures), that were also worked out and brought into action by UTAir-Technic. The Procedures were brought into action in 2006 and since then have not been updated in spite of the fact that the Program current edition was brought into action in 2009 with the last changes implemented in 2011. There is no Clean Aircraft Concept notion in the Procedures. Among the documents, by which the Procedures authors were guided, there is no Doc 9640, Flight Operations Manual or Ground Handling Organization Manual specified. Although the Procedures provisions as far as the ground de-icing and aircraft condition control is concerned, in general, comply with the Program, there are discrepancies with the mentioned documents requirements as to filling in the documentation and informing of the crew about the

[15] Certain contradictions are noted further through the text.

aircraft surface cleanness. Insufficient control from the UTAir departments on the activity of UTAir-Technic made for the disorderliness, oversimplification and lack of control of the services, provided by the UTAir-Technic.

It is worth noting, that in compliance with the Procedures requirements, the de-icing/anti-icing quality control shall be carried out by the maintenance personnel and only in case of their absence in the off-base airport the works can be carried out by a ground handling employee.

The aspects of de-icing/anti-icing within UTAir-Technic are also stated in Maintenance Organization Exposition part 2 approved by EASA (No EASA.145.0327 of 11.10.2011) in compliance with the European Commission Regulation No 2042/2003 part 145 MOE.

According to section L2.2.2 «De-icing procedure/icing prevention» of the MOE, the de-icing/icing prevention shall be carried out by the subcontractor. The same mention of the subcontractor (maintenance subcontracting organization) for aircraft de-icing/anti-icing can be found in the Procedures as well.

Within the maintenance organization structure, that is published in UTAir-Technic MOE part 1 section 1.5, the maintenance workshop (for Russian manufactured aircraft), in which the shift personnel worked that was in charge of ATR 72-201 VP-BYZ ground handling, was not declared, because it was not within the scope of work, assessed by EASA in compliance with the European Commission Regulation No 2042/2003 Part 145.

Thus, according to the UTAir documents as to de-icing/anti-icing the subcontractor and UTAir-Technic maintenance personnel should have been responsible for the corresponding procedure. In fact the works in question were carried out by the UTAir-Technic ground handling (not maintenance) personnel (there is the Agreement between UTAir-Technic and Roschino Airport, JSC upon the delivery of the special purpose vehicles for de-icing/anti-icing procedures and fluids by the airport). It is necessary to note that it was the audit of the Tyumen (Roschino) airport that has been carried out by the UTAir Technical Directorate. The audit was performed 27.10.2011, including the aircraft de-icing/anti-icing aspects. According to the inspection protocol, the issues of personnel training were not considered within the audit, it was only the documents, special purpose vehicles and fluids that were checked.UTAir-Technic has submitted the records of the documents study by the maintenance workshop (for Russian manufactured aircraft) personnel as a part of 2011-2012 autumn-winter period preparation.

The investigation team concluded that the organization of autumn-winter period preparation, personnel technical training, knowledge check and documenting results need radical improvement. The example of formalism may be given in the results of the knowledge check:

within two days mostly by one examiner a total of 65 persons were checked for provisions of 17 documents.

The analysis of training of the personnel, that carried out the ATR 72 VP-BYZ ground handling, revealed, that all the specialists, except the aircraft mechanic, were certified aviation specialists that underwent aviation professional training in educational institutions for civil aviation or had the working experience of more than 10 years.

Approved list of aviation personnel positions in the Russian Federation does not have "aircraft mechanic" position, for which the aircraft mechanic was employed. With that the aircraft mechanic was not subject to the Federal Aviation Regulations FAP-147 requirements.

At the same time, in compliance with Chapter 1 "Aircraft airframe and engines mechanic" of the Ministry of Labor Regulation of 13.04.2000 No. 30 "On approval of the unified rating and skills guide for jobs and occupations, edition 53, Section "Aircraft operation and flight tests", there is a requirement for the aircraft mechanics to undergo obligatory training "according to the established special program". The aircraft mechanics special training program has not been worked out by the federal government authorities (Ministry of Transport of the Russian Federation, FATA).

The requirement for a person being appointed as the aircraft mechanic to have undergone an aircraft mechanic course on the basis of a special program in certified educational institutions can be also found in Para 1.3 of the aircraft mechanic job description No. OT-42/9. In the course of the investigation it has been established, that this very requirement has not been fulfilled – the aircraft mechanic underwent training within UTAir-Technic, which is not a certified center.

For the ground handling personnel training the Program of the technical personnel training for the ATR 42/72 after-arrival, ramp and before-departure ground handling (for the airports where there is no certified staff) was developed in UTAir-Technic and was approved on 22.05.2008 by the Continued Airworthiness Oversight Department for Civil Aircraft of the Federal Agency of Transport Oversight and agreed by UTAir on 19.05.2008 (further referred to as Educational Program). This Educational Program implies the personnel training in theoretical knowledge acquisition and practical field experience within 16 hours (9.5 hours for training in theoretical knowledge acquisition and 5.5 hours for practical field experience). As far as the aircraft icing and de-icing/anti-icing aspects are concerned, the program stipulates not more than 30 minutes of the theoretical knowledge acquisition.

As far as the ground handling is concerned, UTAir has worked out the Ground Handling Manual. Its Para 5.1 stipulates that all personnel, agents, airline representatives, servicing

organizations staff that are responsible for aircraft ground handling are subject to the Ground Handling Management Manual requirements.

The Educational Program of UTAir-Technic ground handling personnel contradicts the Ground Handling Management Manual content. As it follows from the Ground Handling Management Manual Para 12.1.5 and 12.2.1, the personnel training on all the courses shall be organized within certified training centers. The syllabuses, on the basis of which the personnel training is carried out shall be indicated in the center's activity certificate (license). The personnel that were in charge of the ATR 72 VP-BYZ ground handling were trained within UTAir-Technic, which is a non-certified training center. In addition, in violation of the Ground Handling Manual Para 12.2.2 provisions, the relevant training and teaching personnel did not take part in the training.

As UTAir-Technic is not a certified training center, the personnel, trained under the Educational Program, got just the statements including the course description with training hours, which, as it follows from Ground Handling Management Manual Para 12.2.3, cannot be considered as compliance confirmation of the content, level and quality of the training within the specified type of activity. The Tyumen (Roschino) airport special vehicles service, within which the UTAir Technic personnel undertook the on-the-job training, is not a certified training center either.

The above-mentioned Educational Program was not adapted for different categories of the personnel that were in charge of ground handling, as set out in the Ground Handling Management Manual Para 12.1.7. Consequently, the aircraft mechanic, who had no working experience in civil aviation, undertook the training in the same volume as the other technical staff who had greater experience not only in civil aircraft ground handling but in maintenance too.

The Ground Handling Management Manual Item 12.3.6 stipulates the necessity of the maintenance personnel proficiency training under the “Aircraft de-icing/anti-icing” syllabus. These requirements were not accomplished – all the shift maintenance personnel did not undertake the proficiency training under this syllabus (it was the only the airframe and engines mechanic who undertook the proficiency training, the certificate validity expired in 2010).

In compliance with the Ground Handling Manual Para 12.3.6.1 requirements, the agent, which acts for de-icing/anti-icing, must have the procedure, which assures that the ground handling personnel in charge of aircraft de-icing/anti-icing (including subcontractors), undergoes the training on the following subjects:

- general aircraft de-icing/anti-icing procedures and the special measures which are to be taken on different aircraft types;

- the equipment operating procedure to carry out the aircraft de-icing/anti-icing, including the effective procedures;

- weather phenomena;

- the influence of the frost, ice, snow, slush on the aircraft performance;

- the methods of the identification of the snow and ice contamination on the aircraft surfaces;

- the basic characteristics of the de-icing/anti-icing fluids, with the causes and results of their disintegration (degradation) and the residues;

- the main methods (technique) of de-icing and anti-icing;

- the types of checks/inspections and pertinent responsibility;

- precautions;

- the fluid use and the holdover time limitation;

- environmental aspects;

- new procedures and their development, the study of the previous season experience;

- the interaction of the crew and the ground handling service;

- quality control procedures;

- de-icing/anti-icing codes;

- the procedures and methods of the fluids storage and their handling;

- documentation procedures.

Within the applied Educational Program the half-an-hour of lectures were insufficient for the aircraft mechanic to study properly all the aspects mentioned in Ground Handling Manual Para 12.3.6.1.

The ROSTRANSNADZOR Letter of 08.08.2007 No. 5.6-601ГА, transferred earlier to all operators contained the recommended syllabus of the ground handling and flight personnel training within the course “The aircraft ground de-icing/anti-icing treatment”, designed for 30 hours of study. Depending on the specialist background and qualification the syllabus in question could be shortened down to 6 hours.

Thus, the level of training of the UTAir-Technic personnel involved in ATR 72-201 VP-BYZ ground handling did not meet the Ground Handling Manual requirements and did not ensure accurate accomplishment of the flight safety requirements within the aircraft pre-flight preparation.

In its turn, as it has been already mentioned above, UTAir Aviation, JSC did not provide the proper audit of the UTair-Technic's compliance with the Ground Handling Management Manual requirements, stated in its Para 11.2.3, which did not allow revealing the above-mentioned violations.

In compliance with the Doc 9640 Para 13.4 the qualification of the personnel, responsible for the aircraft de-icing/anti-icing, shall be proved within the annual recurrent training. This recommendation was not considered by UTAir-Technic. Upon the completion of the Educational Program in 2010, the aircraft mechanic and the other personnel in charge of ATR 72-201 VP-BYZ ground handling did not undergo the de/anti-icing recurrent training.

It is worth mentioning, that in compliance with the Ground Handling Management Manual Para 12.3.6.1 the training (initial, recurrent and transition training) of the ground handling personnel as far as the aircraft de-icing/anti-icing is concerned shall be organized at least once in 36 months, unless otherwise stipulated by the state regulatory authorities requirements. As it has been already mentioned above there were no such requirements in the Russian Federation at the time of the accident.

Thus, the indicated shortcomings as far as the personnel training is concerned, except the violation of the standards of UTAir Aviation in UTAir-Technic and UTAir Aviation, are related to the shortcomings of the Russian regulations in force, which did not contain the provisions for the personnel training involved in aircraft de-icing/anti-icing.

The Russian requirements for the personnel training procedure and aircraft de-icing/anti-icing can be found in State Standard (GOST) P 54264-2010 «The system of aircraft maintenance and repair. Aircraft de-icing/anti-icing methods and procedures. General requirements», approved and implemented by the Federal Technical Regulation and Calibration Agency order of 23.12.2010г. No. 1070-ст. However, by the time of the accident this standard had not been put in force yet (it is in force since 01.07.2012).

## 2.2. The analysis of the SMS implementation in UTAir

According to the documents presented, the safety management system implementation was started by the company in 2008. At the time of the accident the third edition of the document was in force (CT-003-03 standard), agreed with Tyumen IAO AT of the Federal Air Transport Agency, approved by the head of Flight Safety Inspection Department of the FATA and by the Airline's general manager. The document was put in force in March 2011. The content analysis of the Standard CT-003-03 showed, that the included theoretical provisions, in general, comply with the same statements of the type documents. The style of the presentation caters for the flight

safety management specialists and is not adapted for average flight and maintenance personnel perception; although the document itself stipulates that it must be used for all specialists training irrespective of their rank in the company.

The CT-003-03 standard does not contain the practical issues of the flight safety management with regard to the A/C fleet, operated by the airline, and to the flight geography. An attempt to specify the mentioned aspects was made in the other airline documents (Hazard Identification and In-Flight Risks Management, the CT-097-01 standard, May 2009 and the Flight Safety Management Program of UTAir, JSC 2011-2012). These documents are referred to in CT-003-03. It should be pointed out, that both documents are approved by the Airline General Manager only and were not approved by the FATA or its regional offices.

The definition of the operational hazards and threats, together with their means of control can be found in the CT-097-01 standard. The analysis revealed that this document contains mainly general provisions. The process of the flight safety threats definition and of the evaluation of the respective risks is not fully covered. The range of hazardous factors, that influence the flight safety condition, including in-flight icing, ground de-icing/anti-icing and quality control of the latter are not covered.

For example there is a definition of the hazardous situation (HE15AF) in the document, related to the dispatch of a “non-airworthy A/C”. Through the description of this situation it is noted, that this is “such situation that leads to the unconscious or deliberate dispatch of the aircraft which is not airworthy”. There is no further specification of this hazardous situation, for example with reference to the de-icing/anti-icing, aircraft type, base or transit airport. Furthermore, the given document does not contain any quantitative risk assessment of this very hazardous situation at all, that is its relation to any one or another cell of the Risk Assessment Matrix or any measures of the risk mitigation (elimination). That is generally true for all others hazardous situations, considered in the document. The airline informs that the work on the specific risk levels and the mitigation measures has not been completed yet.

It should also be noted that the criteria for risk evaluation in the given documents in terms of the probability and the severity are different in CT-003-03 and CT-097-01. In CT-003-03 the probability calculation and the evaluation of the situation severity (catastrophic, hazardous) is carried out per one flight hour and in compliance with the criteria, stated in the Aviation Regulations AP-25. In the CT-097-01 the calculation is carried out per 100000 flight hours, while the risk severity is given as a relative number scale. The risk acceptability areas (acceptable, acceptable based on risk mitigation and unacceptable) depending on their position in the Risk Assessment Matrix are different in the mentioned documents.

It is also worth mentioning that in the CT-003-03 the airline uses the following safety indices:

- the quantity of fatal accidents per 1 mln of flights;
- the quantity of non-fatal accidents per 1 mln of flights;
- the quantity of the accidents caused by human factors.

The present indices are calculated by the method of the moving average for the last 5 years separately for airplanes and helicopters. The same safety indices can be found in Flight Safety Management Program of UTAir for 2010 – 2011. It should be pointed out that most of the world airlines have been operating without accidents for 5 and more years. With the use of the given safety indices in a period of 5 years the airline will be able to reach the flight safety index of 100% (in accordance with the criterion chosen) which may lead to self-complacence and flight safety control jeopardizing. Methodologically it seems more justified to introduce the additional complex flight safety indices which will take into account the number of serious incidents, incidents and/or potentially hazardous conditions (for example, runway excursions or unstabilized approaches).

It is to be mentioned, that in 2010 the airline aircraft performed 63000 flights, in 2009 the flights number was about 58500. Even with the unchanged growth dynamic of the flights number the airline will not be able to perform 1 million flights within 5 years. Thus the actual values for the given flight safety indices can be calculated only by extrapolation.

As the target level of the flight safety the airline indicated the absence of accidents, calculated by the mentioned formula for 2012 (that is the absence of the mentioned occurrence within 5 years)[16]. Considering the ATR 72-201 VP-BYZ accident, the aim of the flight safety management has not been reached by the airline.

Based on the above, the Commission makes general conclusion that in the airline SMS implementation is on the initial level. SMS has been developed, agreed and approved, however in the airline there are no obvious results of the current activity on the flight safety management, which could be available for the airline departments staff. SMS in the airline is inefficient and as far as the average staff is concerned cannot be considered the guidance. This fact together with the absence of the systematic control on behalf of the senior management on the airline internal rules and standards implementation resulted in the irresponsibility of certain employees.

Some of airline documents that determined SMS require follow-up revision and mutual agreement. The absence in RF of a procedure for SMS development and implementation by

[16] In the UTAir Flight Safety Management Program the accident with the B-737 VQ-BAC aircraft on 16.01.2010 at the Vnukovo airport, is unreasonably determined as an incident.

operators as well as the absence of procedure of data capture and analysis for risks that form the flight safety hazards both contributed to the abovementioned shortcomings formation[17]. The modified documents shall be reviewed and approved by Federal Air Transport Agency.

## 2.3. Aircraft Pre-Flight Preparation

On 02.04.2012 the UTAir Air Division 1 crew consisting of pilot-in-command and F/O performed the scheduled passenger flight UTA-120 en route Tyumen - Surgut on the ATR 72-201 VP-BYZ, scheduled departure time was 01:30.

After the landing at the Tyumen airport (the aircraft arrived from Surgut the previous day at 17:41) the aircraft was met and taxied to stand 3, heading to terminal (heading 30°-31°). The UTAir-Technic personnel, having the only admission for carrying out ground handling procedures, performed the following procedures: after-arrival check, taxi to stand, power supply, cabins heating hook up and the cabin and toilets cleaning.

UTAir Technic foreign-manufactured aircraft maintenance workshop personnel carried out the aircraft maintenance under «Oil check + engine visual inspection» (job card No. T-1964 from 01.04.2012, maintenance beginning at 18:00, maintenance end at 20:00). The works were performed by the foreign-manufactured aircraft maintenance workshop shift engineer and by the foreign-manufactured aircraft maintenance workshop interim shift head.

According to the record in the aircraft logbook, there were no findings by the crew on the previous flight UTA-119 en route Surgut – Tyumen[18]. There were no findings during the maintenance either. With that the aircraft pre-flight preparation by the certified maintenance personnel was completed.

Immediately prior to the flight no ATR 72-201 VP-BYZ maintenance was carried out, because there had been no complaints from the crew. Before the flight the aircraft was fully serviceable. The post-accident analysis of the recorders and the aircraft and engines wreckage revealed that there had been no fire, in-flight aircraft destruction or any in-flight failure up to the aircraft collision with ground.

From 20:00 till 00:25 no handling was performed on the aircraft.

From the arrival till 21:00 the aircraft was on stand under the influence of the wind with the direction 90–120°, 9-10 m/sec gusts up to 13-14 m/sec in the severe rain and snow shower.

[17] On December 25, 2012 the Federal Law No.260-ФЗ "Concerning the Introduction of Changes into the Air Code of Russian Federation" was signed (coming into force on September 23, 2013). The abovementioned changes stated that State Safety Management System of civil aviation aircraft of RF is exercised in accordance with ICAO international standards. The Government of Russian Federation sets the procedure for SMS developing and application. In accordance with the procedures stipulated by the Government of RF the civil aviation authority should gather and analyze data on hazard and risk factors which constitute a threat to the flight safety

[18] The flight was performed by the crew in question.

The outside air temperature was changing between +0°C and -0°C. At 21:05, after the atmospheric front passage, the wind direction changed to 240°-260° with the gradual increase of the wind velocity up to 7 m/sec with gusts up to 10 m/sec. Meanwhile the precipitation was going on in a form of light snow shower with rain, the air temperature passed from the positive values to the negative ones. The precipitation ceased at 01:00. At the moment of the aircraft departure the air temperature was -1°C, no precipitation.

Thus the analysis of the aerodrome actual weather within the time of the aircraft stand showed that all conditions for the ground icing accumulation existed. The right side of the aircraft, being windward at the moment of the most intense precipitations, must have been subject to the more severe ground icing.

***Note:*** *Within the period from 00:10 till 01:44, except ATR 72 VP-BYZ, there were 9 more aircraft that took off from the Tyumen airport (A-319, B-737, ATR 42 and ATR 72), 4 of them operated by UTAir. Excluding the transit (turn-back) flights (Sibir airline, Aeroflot airline), all the departing aircraft underwent the de-icing/anti-icing. The de-icing/anti-icing of the transit aircraft was not carried out after the mutual decision of the aircraft crews and the maintenance personnel because no contamination had been found on the wing surface at visual inspection.*

*At the same time three Yamal airline B 737s were preparing for takeoff (two of them were on stand at the aerodrome at night). All were de-iced/anti-iced. According to the statements of the Yamal airline shift engineer and two PICs of B 737 as well as statements of two UTAir B 737 PICs the wing and stabilizer surfaces were covered with snow with ice under it.*

*There is also a statement of the UTAir ATR72 VQ-BLI PIC (the aircraft was standing on the aerodrome at night, actual time of departure 00:15): «during the external check I detected a layer of snow, about 3 cm thick, on the surface of the fuselage, elevator and wing … I decided to conduct de-icing/anti-icing….» and further «…The last time I saw the ATR 72 VP-BYZ on 02.04.2012 at about 06:00[19]… it was on Stand 3, there were wet snow deposits on its wings and fuselage similar to the wet snow deposits on my aircraft and on the airfield surface».*

[19] Local time

Because of the adverse weather situation, the meteorologist shift on duty of the Roschino (Tyumen) meteorological center on 01.04.2012 made the timely notices for the Roschino aerodrome concerning the conditions of the ground icing accumulation. In compliance with the order of the meteorological information transfer on the aerodrome, the notices were transferred to the concerned services, including the UTAir-Technic operation and dispatch department and the UTAir office.

On the analysis of the aviation engineering service summary list (it is filled in by the UTAir-Technic LLC PPCD) it was established that it contains the following note: "Storm 17:00 – 23.00, supercooled rain. An engineer from the ground handling staff and foreign-manufactured aircraft maintenance certified engineer were informed".

During the interview, the personnel that were in charge of the ATR 72-201 VP-BYZ ground pre-flight preparation confirmed that they had been set the task of carrying out the aircraft pre-flight de-icing/anti-icing.

The peculiarity of the UTAir foreign-manufactured aircraft ground handling procedures organization in the Tyumen airport is that it is not under the airport ground handling service responsibility. In particular, for de-icing/anti-icing the airport provides the special vehicles and fluid, the operator's functions are performed by the UTAir-Technic personnel. The majority of UTAir-Technic staff has the aviation technical education, but the rest of the personnel are employed from the other organizations.

Foreign-manufactured aircraft ground handling, including ATR aircraft, was to be conducted by the shift No. 4. With that the following personnel were taking immediate part in the VP-BYZ aircraft ground handling (the information of the personnel mentioned was given above in Item 1.5.2 of the present Report):

- shift head, an engineer;
- airframe and engines technician;
- avionics technician;
- airframe and engines mechanic (he does not have the aviation professional background, did not undergo training in a certified training center, has undergone training within UTAir-Technic).

The shift head (shift engineer) and the aircraft mechanic were authorized for the ground handling procedures carry-out (including the aircraft de-icing/anti-icing as operator) in compliance with the orders and ATR 42/72 Ground Handling Instructions that were valid at the time of the accident, but the aircraft mechanic, according to the position description, was admitted for work under the shift engineer supervision only.

In compliance with the UTAir Ground Handling Management Manual that is obligatory for use in UTAir-Technic, being the organization in charge of the UTAir aircraft servicing, all the ground handling specialists were to undergo training in a certified training center on the curriculum, that implies, among all, that the personnel shall know the danger of the ground icing and its influence on the aircraft in-flight performance. Still none of the specialists underwent such training in a certified training center.

The admission for ground handling was granted upon the completion of the theoretical lectures within UTAir-Technic and Tyumen airport special vehicles service with the following practical training. Neither UTAir-Technic, nor the Tyumen airport has the training certificate or license. The training conducted within UTAir-Technic, according to the explanations of the personnel that were in charge of the aircraft servicing on 02.04.12, was limited to the documentation study. It was not more than 30 minutes for the study of all the aspects related to icing. Meanwhile, UTAir has a certified training center in Tyumen, within which the training of the UTAir destination airports ground handling specialists was organized regularly. Within 2009-2011 639 specialists underwent training to carry out the airline aircraft ground handling. None of the UTAir-Technic personnel at the base Tyumen aerodrome has undergone training in the adjacent personnel training center.

In the ATR 72 AFM Limitations Item 2.06.01 it is stated that takeoff is prohibited when frost, snow or ice is adhering to the wings, control surfaces or propellers (Clean Aircraft Concept).

Taking into account the existing international practice, the aircraft pre-flight ground servicing, including de-icing/anti-icing and its quality control, is not related to maintenance and may be not the responsibility of the certified engineering and technical personnel. At the same time, the evaluation of the need to de-ice/anti-ice and the quality control of the procedures in question, that are crucial phases of the aircraft pre-flight preparation, are placed on the personnel, that are in charge of the aircraft release to flight because the de-icing/anti-icing is immediately related to the aircraft continued airworthiness (fitness to fly)) and the flight safety (Ground Handling Management Manual, Program and Company Standard СТП 310-06).

Considering the above-stated together with the flight safety management provisions, stated in the ICAO Flight Safety Management Manual, the investigation team considers the de-icing/anti-icing attribution to the ground handling (not maintenance), without specifying special requirements to personnel that is non-certified and non-qualified, significantly increases the risk of the dispatch of an aircraft which does not comply with the clean aircraft concept.

It is worth noting, that the UTAir Ground Handling Management Manual determines the

aircraft de-icing/anti-icing is an integral part of the actions involving the ground handling, maintenance personnel and the crews, that are aimed at the flight safety assurance. The sentence cannot provide an accurate understanding of whether the de-icing/anti-icing is related to the ground handling or maintenance. The investigation team concluded that the UTAir-Technic personnel, that were authorized for the foreign-manufactured aircraft maintenance had not taken part in evaluation of the need to de-ice/anti-ice the aircraft although meteorological overnight conditions were contributing to contaminants accretion..

Upon the activities distribution within the shift (schedule task No. 184 from 01/02.04.2012) the aircraft mechanic was assigned to the ATR 72 VP-BYZ ground handling. Besides, the aircraft mechanic was to carry out the works on the servicing of the departure of ATR 42 VP-BLN (departure time at 21:00 01.04.2012), ATR 72 VQ-BLI (actual departure time at 00:15) and ATR 72 VQ-BLK (actual departure time at 01:44).

In Chapter 1.18.6 the special de-icing/anti-icing vehicles traffic schedule is given, those vehicles were operated by the UTAir-Technic aviation engineering service shift No. 4. This schedule is the evidence, that 4 out of 6 aircraft to-be-de-iced/anti-iced were treated by the shift head.

Performing the functions of the average staff as far as the de-icing/anti-icing is concerned, the shift head deprived himself of the possibility of the quality control of the pre-flight preparation procedures that were carried out by the personnel that was not authorized for the solo aircraft de-icing/anti-icing.

The aircraft mechanic completed the ATR72-500 VQ-BLI de-icing/anti-icing at 00:00, after that started the ground servicing of the ATR72-201 VP-BYZ aircraft on the stand No. 3. The next aircraft, that was to be serviced by the schedule (in fact this aircraft was serviced by the shift head), was ATR 72 VQ-BLK (stand No. 2, the planned departure time at 01:35, actual departure time at 01:44).

As the aircraft mechanic came to ATR 72-201 VP-BYZ the avionics technician had already been there and uncovered the engines. After removing of the covers and blanks, by the avionics technician's statement, he together with the aircraft mechanic carried out the aircraft external inspection. According to the aircraft mechanic's statement, on visual inspection of the aircraft from the ground the wing surfaces and the stabilizer were clean at the lower part, no traces of icing were seen. According to the avionics technician and the aircraft mechanic's statements the upper surfaces of the wing and stabilizer were not inspected.

In the course of the investigation the investigation team came to the conclusion, that it is impossible to fully evaluate the wing and stabilizer upper surfaces condition visually from the

ground without the use of a step-ladder. The experiment conducted with the aircraft mechanic on the stand, was another proof of the conclusion.

The crew came to the aircraft at about 00:30. As it can be concluded from the outdoor surveillance video cameras record, the PIC carried out the aircraft pre-flight inspection in a superficial way. Within several seconds the PIC slowed close to the right engine, and then went along the fuselage sides, stopped near the left main gear[20], after that passed to the cockpit.

As it follows from the avionics technician's statement, after the aircraft inspection the aircraft mechanic entered the cockpit, then returned with the information that the crew had refused from de-icing/anti-icing. This information has been transferred to all the services that were in charge of the aircraft departure.

By the aircraft mechanic's statement, having entered the cockpit he said to the PIC *«that the aircraft is clean»*. The PIC answered: *"We are not going to be treated, will take-off as it is"*. Neither the aircraft mechanic's words, nor the PIC's decision were recorded by the CVR[21]. The fact that the wing and stabilizer upper surfaces had not been inspected by mechanic was not reported to the PIC.

***Note:*** *Doc. РД-В6.022-02 "De-Icing/Anti-Icing Program of UTAir Aircraft"*

***Chapter 8. De-icing/anti-icing procedures. Personnel duties and responsibility.***

*Para 8.1 When the crew arrives in order to perform a flight on the AC the personnel in charge of the AC pre-flight preparation shall report to the PIC about the result of the AC surface inspection and the fitness of the AC for flight.*

*Para 8.2 After accomplishing preflight inspection the PIC and the Engineering and technical personnel take a coordinated decision on the necessity of deicing procedures or its rejection.*

*Para 8.3 AC deicing necessarily takes place if the PIC and the Engineering and technical personnel do not take a coordinated decision on deicing rejection.*

*Para 8.7 The personnel in charge of AC releasing to flight is responsible for:*

- *the control of AC surface cleanness after accomplishing anti-icing procedures;*
- *the reliability of the information for the PIC on the condition of AC surfaces;*

[20] Most probably, the PIC checked pressure within parking brake, which indicator is located at this place.
[21] The CVR functioned in an automatic start mode and was switched on at the engine startup.

- *timely and correct documentation drawing.*

*The PIC is responsible for the final decision of the aircraft departure after the aircraft was de-iced/anti-iced.*

In the ground servicing job card of 01.04.2012 No. T-3193 there are the signatures of the PIC and aircraft mechanic. The decision that there was no need of the aircraft to be de-iced/anti-iced, as it is prescribed by the UTAir Ground Handling Management Manual, was not drawn up neither in the job card Supplement, nor in the aircraft logbook (FTLB) (Figure 52).

***Note:*** ***UTAir de-icing/anti-icing policy***

***Item 15.***

*Point 15.1 Documentation*

*If no icing on aircraft surfaces and no weather conditions contributing to ice formation are observed, the PIC and engineering and technical personnel shall make a coordinated decision not to perform de-icing/anti-icing. This decision shall be recorded as a supplement to the job card.*

*The data to be entered: «De-icing/anti-icing not required»,*

*«Date»*

*«UTC time»*

*«Last name and identity number of the engineer»*

*«Last name and identity number of the PIC»*

*As for foreign-manufactured aircraft the data shall be entered in the aircraft FTLB Anti-Ice section.*

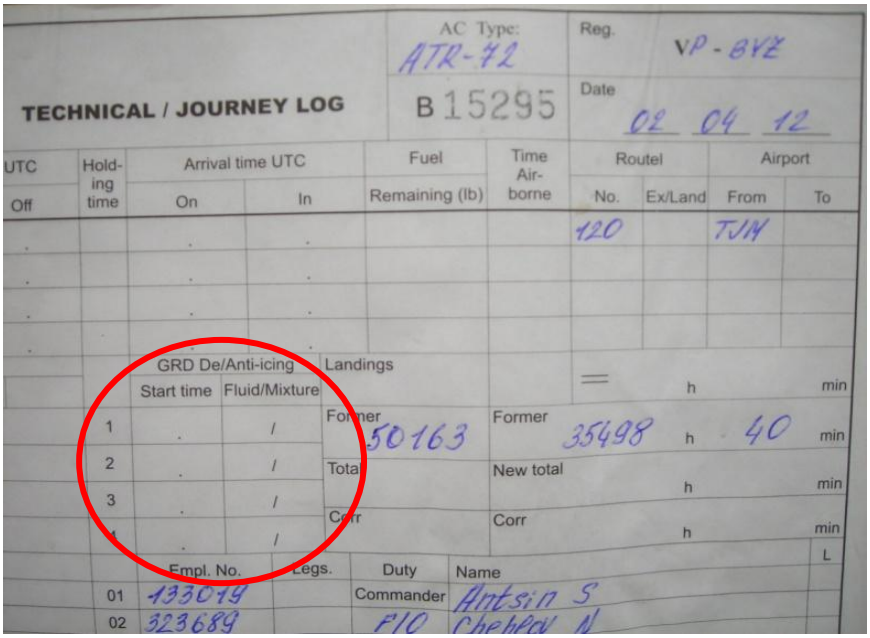



**Figure 52. The aircraft FTLB page with blank de-icing/anti-icing columns**

In violation of the Ground Handling Management Manual provisions, the engineers and technicians, authorized for the foreign-manufactured aircraft maintenance, were not present at the aircraft departure. None of the certified engineers has evaluated the aircraft airworthiness for flight. The quality assurance and risks prevention system in UTAir-Technic during one of the important phases of the aircraft servicing completion and departure does not function.

After that, as it follows from the avionics technician and the aircraft mechanic's statements they went away to the stand No. 2 for the ATR 72 VQ-BLK aircraft pre-flight preparation, leaving the aircraft to the other shift staff, that had not taken part in the aircraft preparation.

The works on the completion of the ATR 72 VP-BYZ ground servicing (detaching from the aerodrome power unit, the start-up and taxi from the stand) were carried out by the airframe and engines technician and by the avionics engineer.

According to the airframe and engines technician's statement at about 01:00 he got the shift head's instruction to come to the stand No. 2 to render assistance to the aircraft mechanic involved in ATR 72 VQ-BLK aircraft servicing. After coming to the stand No. 2, the aircraft mechanic that had already been there told him to go to the stand No. 3 to service the engines start-up of the ATR 72-201 VP-BYZ aircraft.

During the carry-out of the above-mentioned works on the servicing of the ATR 72 aircraft on the stands No. 2 and 3, the shift head was occupied with the B 737 VQ-BID departure service. The aircraft was on the stand No. 11 (scheduled departure time at 01:15, actual departure time at 01:22).

According to the shift head's statement, on coming to the stand No. 2 for de-icing/anti-icing of ATR 72 VQ-BLK, there was the aircraft mechanic there, who reported that the ATR72-201 VP-BYZ crew had refused from de-icing/anti-icing.

On the analysis of the video surveillance cameras record (camera No. 6) it was established that at about 01:06 – 01:07, the special vehicle Tempest with the shift head came to stand No. 2 to carry out the de-icing/anti-icing of ATR 72 VQ-BLK. At that moment the Mercedes vehicle had been already standing on the stand No. 3 to carry out the de-icing/anti-icing of ATR 72-201 VP-BYZ, the aircraft doors at that very moment were still open.

Being reported by the aircraft mechanic that the ATR 72 VP-BYZ crew had refused of de-icing/anti-icing, the shift head, aware of the aircraft condition (he had already treated some), did not demand the execution of his previously given instruction that all aircraft shall be de-iced/anti-iced and launched no actions to prohibit the departure of the non-airworthy aircraft.

The shift head must have appealed to his rights and report to the PPCD staff that the

ATR72-201 VP-BYZ departure without prior de-icing/anti-icing shall be prohibited. In the UTAir Flight Operations Manual (item 16) it is stated: *CAUTION. If there is evidence of ground icing on the aircraft surfaces the PIC refuses the aircraft de-icing/anti-icing, the aircraft maintenance head or the ground handling staff, carrying out the aircraft dispatch procedures, shall stop the works in question and report immediately to the Production and dispatcher service staff the date, aircraft identification number, the precise description (parameters) of the ground icing.* There was no report to the PPCD, consequently there was no feedback following.

Mercedes de-icing/anti-icing special vehicle left stand No. 3 at 01:09:30.

In violation of his operating procedures the aircraft mechanic signed the job card instead of the engineer that confirmed the ATR 72 VP-BYZ aircraft readiness to take off. Moreover, he signed for the works that in fact had not been carried out by him (the aircraft departure with the engines start-up support and taxi-out from the stand).

The aircraft ground handling job cards analysis of the aircraft that were de-iced/anti-iced by the shift head showed, that under the function of the supervising engineer the only ground handling and de-icing/anti-icing card he signed was the card of ATR 42 VP-BPK, flight UTA-299. As far as the other job cards are concerned, in violation of the current documents provisions, the signatures were put in by the aircraft technicians. The documentation completed does not meet the provisions of the UTAir-Technic current documents and is the evidence of the over-simplification at the important phase of the aircraft pre-flight preparation.

Thus, the departure of the aircraft with non-removed ground icing had become possible. The clean aircraft concept was violated. The decision of the aircraft departure without de-icing/anti-icing was taken jointly by the aircraft mechanic who had not undergone special training, did not have appropriate qualification and was not authorized for solo decision of the aircraft dispatch and by the PIC that failed to conduct the complete pre-flight aircraft inspection and make sure himself that the aircraft condition complied with the clean aircraft concept. The shift head, whose functions were to control the aircraft pre-flight preparation neglected this function and did not appeal to his right to stop the dispatch of the aircraft that did not meet the Clean Aircraft Concept. There was no corresponding report from him either to the airport or the airline services. Consequently, representatives of the airport inspections, airport and regional Federal Agency for Air Transport office, located at Roschino airport did not evaluate the aircraft condition and did not cancel the decision of the departure of the aircraft whose condition did not meet the clean aircraft concept. The fact that the pre-flight aircraft preparation was carried out by the untrained aircraft mechanic was the consequence of the shortcomings in the UTAir-Technic and UTAir quality system, revealed in non-execution of the Ground Handling Management

Manual provisions by the UTAir-Technic management as far as the staff training and the absence of the proper control by the UTAir on its subcontractor activity are concerned. The commission considers, that in view of the existing practice, when the airworthiness significant operations such as de-icing/anti-icing are carried out by the ground handling personnel (not by the maintenance staff), its quality control must be ensured by the operator, subcontractor or the departure aerodrome corresponding services, that will allow to a great extent to prevent the risk of dispatching an aircraft, whose condition does not meet the clean aircraft concept.

## 2.4. The flight description and the analysis of the aircraft motion

According to the data of the video camera, the aircraft entrance door was closed at 01:13.

At 01:18 the crew went ahead with the engines startup, first right then left.

At 01:19:08, after the right engine startup, the PIC gave the instruction to the F/O about the de-icing/anti-icing system activation procedure: *«Anti-icing and De-icing, after we taxi-out»*.

At 01:22:53 the pre-taxi checklist was started. While the checklist was followed the F/O reported: «Anti-Icing – level 1, Flaps – 15» (the level 1 of the aircraft de-icing/anti-icing system is activated[22], flaps 15°).

At 01:23:16 the crew requested the ATC clearance for holding position, and was said to stand by. The standby was related to the other aircraft taxiing for takeoff.

At 01:24:02 PIC confirmed again: *«Anti-Icing on»* and a little bit later, *«De-Icing later»*.

At 01:24:54, after they were cleared to holding position, the crew started taxi-out backward from the stand No. 3.

At 01:26 the PIC called out: *«…continuous relight on, de-icing on»*, F/O confirmed: *«De-icing-level on»*. The de-icing system activation (the rubber boots) is also confirmed by the recording of the binary signal on FDR.

At 01:27:13, after taxi checklist completion, the PIC said: *«It does not want to inflate on the ground for some reason»*, the F/O answered: *«Yes»*. After that, at 01:27:26, the PIC said: *«Na-ah, it is peeled off normally, it is inflating»*. Most probably, this dialogue is related to the pneumatic de-icing system function (the rubber boots inflation) and snow and ice contamination removal.

While taxiing the brakes were run up, the deflection of the control surfaces and spoilers was checked. The control lock was switched off. There were no complaints concerning the controls of the aircraft.

Before ATR72-201 VP-BYZ the taxi for holding point was performed by the Yamal

[22] The aircraft anti-icing system description is given in Section 1.6.1.

B 737.

At 01:31:28 the B 737 crew was cleared for takeoff and reported: *«Yamal 1-0 taking off, take care, good bye».*

At 01:32:08 the crew of ATR 72 VP-BYZ, after they were cleared to line up, reported: «Line up».

At 01:32:33, in accordance with the FDR data, the pneumatic de-icing system was switched off. The system time activation on ground was about 6.5 minutes.

Before takeoff the TWR transmitted to the ATR72-201 VP-BYZ crew the weather data: wind 230° 6 m/sec, gusts 9м/с, temperature -1°C. There was no precipitation.

**ATIS information at 01:30:**

*...Apron and taxiways slippery.*

*Wind 230 degrees 6 meters per second gusts 9, at the height of 100 m: wind 270 degrees 18 meters per second, at the circuit height wind 280 degrees 25 meters per second. Visibility 10 km. Broken cumulonimbus 400 meters. Temperature -1, dew point -1. QFE 742 mm, 989 hPA.*

Weather conditions did not hazard the flight safety.

At 01:32:54, after the crew report that they were ready for takeoff, the ATC cleared takeoff.

At 01:32:58 the crew went ahead with takeoff. The takeoff was performed with the flaps in a takeoff position at 15°. The PIC was the pilot flying; the F/O functioned as pilot non-flying.

According to the FDR data, the actual elevator trim position (≈ -1.65°, nose up) was not equal to the estimated position for CG 30.72 % of MAC (≈ -0.7°, nose up).

The takeoff engine parameters corresponded to the normal takeoff mode: propellers RPM 100%, engine torque (N1) 90%.

The time interval between the previous Yamal B-737 aircraft takeoff (MTOW 59000 kg) and the ATR 72-201 VP-BYZ aircraft takeoff (MTOW 21500 kg) was 1 min 30 sec, that is in compliance with FAP-128 Para 9.17.3 which determines that the minimum interval for such aircraft types shall be not less than 1 minute.

At 01:33:25, at 118 knots speed, the PIC started the rotation and in 3 seconds at 127 knots speed the aircraft lifted off.

After the Co-pilot reported of the positive climb, at 01:33:31, at the altitude ≈30 ft and at the speed of 130 knots the PIC commanded the flaps retraction and yaw damper activation. F/O confirmed the command.

In 5-6 seconds after liftoff the PIC started to move the elevator trim to nose down position. All in all, up to the autopilot engaging (at 01:33:56), 4 impulses of the trim position change were launched, with that the trim moved on ≈2.55° (from the position ≈-1.65° nose up in the position ≈0.9° nose down). The trim deflection in a manual mode if more than 1 sec duration was accompanied by the corresponding sound signal.

At 01:33:44 there was the F/O report of the 400 ft acceleration altitude (the altitude of flaps retraction). At the same time the F/O gave the notice of the need to monitor as the speed reached the white bug (F/O: *«note white bug*[23]*"*).

At 01:33:47 there was the PIC report of the setting on the ADU (Advisory Display Unit) the speed of 170 knots that would be maintained by the autopilot during further climb. F/O confirmed the action execution.

At 01:33:53, at the altitude of 570 ft, there was the PIC command for autopilot engage[24], that was performed by the F/O with confirmation. The autopilot engage is also confirmed by the binary signal recorded on the FDR.

After autopilot engage there was the flight speed acceleration as in the compliance with the control law the autopilot functioned in speed mode (until reaching 170 knots[25]).

At 01:33:58, at a speed of 138 knots, the PIC gave the command for flaps retraction. F/O confirmed the command, checked the current flight speed and performed the flaps retraction. According to the FDR record the flaps retraction was started at the altitude of 640 ft and at a speed of 139 knots.

During the flaps retraction the autopilot continued the trim of forces on control column. The elevator trim changed from 0.9 nose down to 1.4 nose down.

At 01:34:00 the PIC gave the command to perform climb sequence procedures and then reported (PIC: «CLIMB SEQUENCE and report»). F/O confirmed the command, although the corresponding actions were not completed due to the fact that emergency situation started.

| | |
|---|---|
| ***Note:*** | *It is worth noting, that from the liftoff moment the aircraft flight was performed with a bank of an average value of 2.5° to the right.* |

At 01:34:06, by the moment of the flaps retraction end, the CVR recorded the conversation between the crew that there was the buffeting. In two more seconds, at the altitude

[23] White bug – the index on the speed indicator, that is set by the crew and determines the minimum speed of the flight with flaps retracted depending on actual weight in normal conditions, unlike the red bug, which determines the mentioned speed in potential or actual icing conditions.
[24] The minimum allowed height of the autopilot engaging at takeoff is 100 ft.
[25] In the course of the autopilot engaging this speed was not reached. The maximum reached speed with the autopilot engaged amounted to 152 kt.

of 700 ft the self-induced bank started to develop with the rate of up to 15°/sec. The bank started at the true angle of attack value 8.2° at the speed of 150 knots, with the autopilot engaged, before the activation of stall warning system. With slaps and gears retracted the aircraft angle of attack value, when the stall warning system is activated is equal to 11.6º in normal conditions.

| | |
|---|---|
| ***Note:*** | *According to the ATR 72 AFM the stall speed under normal conditions (without icing) with flaps and gear retracted is equal to 110 knots (for the weight of 18700 kg)* |

The crew conversation from this very moment up to aircraft impact with the ground is given in full in the table below:

| | | | |
|---|---|---|---|
| 01:34:06.0 | 01:34:06.7 | F/O | Wo…ooow. |
| 01:34:08.0 | 01:34:08.8 | PIC | Wut's this? |
| 01:34:09.4 | 01:34:10.1 | F/O | Wut's a buffeting? |
| 01:34:10.4 | 01:34:11.3 | PIC | Autopilot disengage. |
| 01:34:10.9 | 01:34:11.1 | | ***Autopilot disengage sound signal (cavalry charge).*** |
| 01:34:11.3 | 01:34:13.9 | | ***Sound signal F ≈1600Hz (cricket) stall signal*** |
| 01:34:14.4 | 01:34:14.5 | | ***Sound signal F ≈1600Hz (cricket) stall signal*** |
| 01:34:15.3 | 01:34:17.6 | | ***Sound signal F ≈1600Hz (cricket) stall signal*** |
| 01:34:16.9 | 01:34:17.6 | F/O | Wait, wut's this |
| 01:34:17.9 | 01:34:18.9 | PIC | Report him. |
| 01:34:18.7 | 01:34:29.7 | | ***Sound signal F ≈1600Hz (cricket) stall signal*** |
| 01:34:19.3 | 01:34:19.9 | **EGPWS** | ***Don't sink.*** |
| 01:34:19.8 | 01:34:20.9 | F/O | Report wut, shit? |
| 01:34:22.6 | 01:34:23.4 | F/O | Wut's the failure? |
| 01:34:24.0 | 01:34:24.9 | PIC | I didn't get it. |
| 01:34:30.5 | 01:34:35.4 | | ***Sound signal F ≈1600Hz (cricket) stall signal*** |
| 01:34:30.6 | 01:34:31.4 | F/O | You mother fucker |
| 01:34:31.7 | 01:34:33.6 | PIC | UTAir 120, we are falling!! |
| 01:34:34.7 | 01:34:35.4 | Crew | A-ah!! |
| 01:34:35.3 | 01:34:35.3 | | ***The end of the record.*** |

At 01:34:10 the autopilot disengage was registered. The analysis revealed that, most probably, the autopilot was disengaged by the crew. Practically at the same time with the autopilot disengage sound signal the stall warning system was activated. The activation of the stall warning was accompanied by the stick shaker. The warning activation, with short intervals, continued up to the end of the flight. The analysis showed that the stall warning system activated as per design on the angle of attack values for normal conditions.

The right bank maximum value of ≈40° was reached, after that the right bank started to decrease due to the control wheel full left deflection and the rudder left deflection.

The further motion of the aircraft can be determined as deep stall with the left bank developed up to 60°, which could not be compensated by the full deflection of the ailerons to the right. The crew hardly used the rudder. As the elevator was not deflected to nose down, the angle of attack increased to >25°. The aircraft was descending with a great vertical speed.

According to the analysis, while the emergency developed, the conditions for stick pusher activation were met several times (Fig. 53)[26]. At the same time, it is necessary to note that the activation of the pusher is inhibited at the radio altitude less than 500 ft (after the time instant 01:34:16.5 of the accident flight), at that the inhibition in question is armed during the climb of the radio altitude more than 500 ft after takeoff (in the accident flight the maximum registered radio altitude was 701 ft at 01:34:06.5). The analysis of the record, given on Figure 53 shows that the first pusher activation occurred at 01:34:11 (в 01:33:22 by the time on Figure 53), at that the crew resisted the pusher operation (the elevator deflection to nose down). The force that is necessary to apply on the control column to "overpower" the pusher is equal to 30-50 daN (depending on the elevator position). After the force from the control column is released and if activation conditions are still met the pusher will continue to deflect control column to pitch-down.

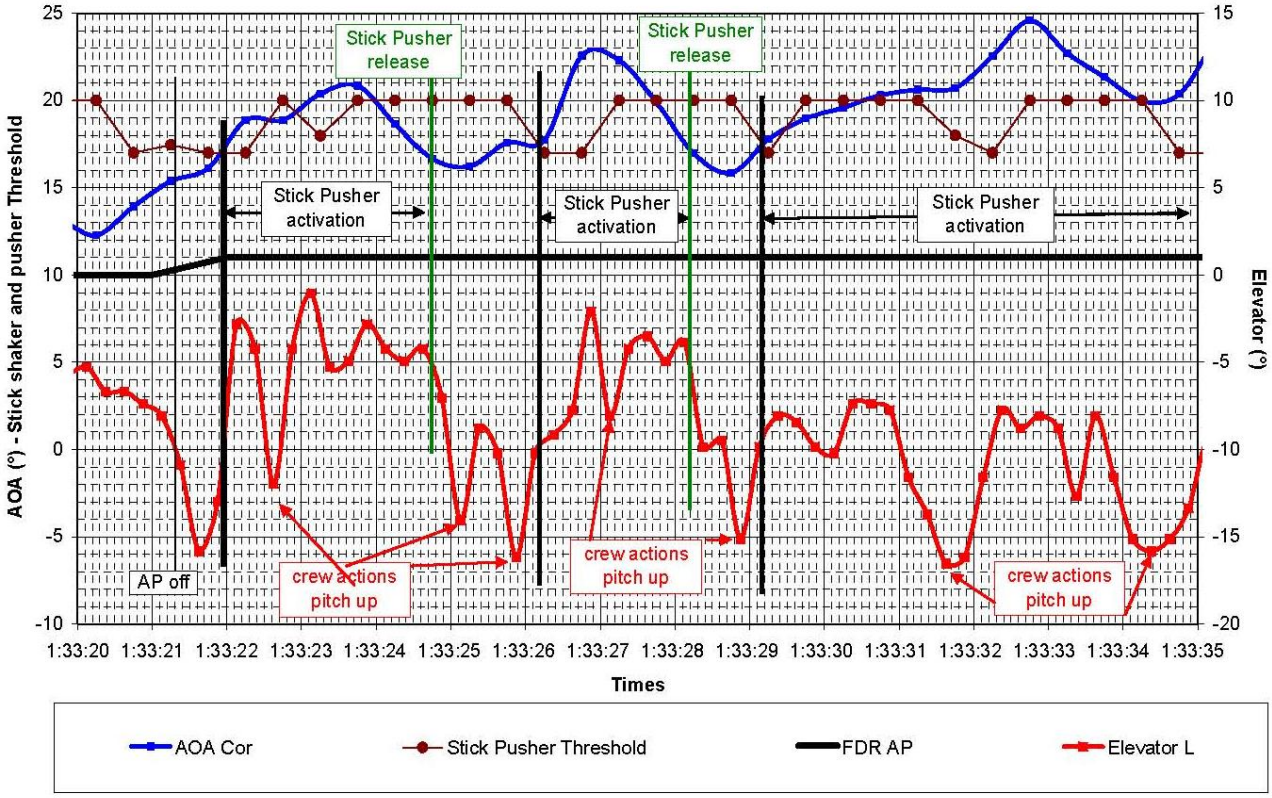



**Figure 53. The estimated times of the stick pusher activation**

[26] Parameters are shown as a function of FDR time that is ~49 sec behind the time used in the Report.

The aircraft impact with the ground occurred at 01:34:35 with pitch angle ≈11° nose down, with the roll ≈55° to the left and vertical speed more than 20 m/sec.

As the engineering simulation showed (section 1.16.1), in the course of the entire flight (including takeoff run and liftoff) the lift coefficient deficiency, compared to the data basis, was equal to ~0.23 with significant increase of drag.

The comparison of the climb envelopes after takeoff (Figure 54) for the accident and the previous flight (TOW ~19350 kg, OAT +6°) shows, that in the previous flight with greater TOW, with the same engine operating mode, a significantly smaller angle of attack value was necessary to climb with a greater vertical speed, meanwhile the speed in the previous flight also increased faster.

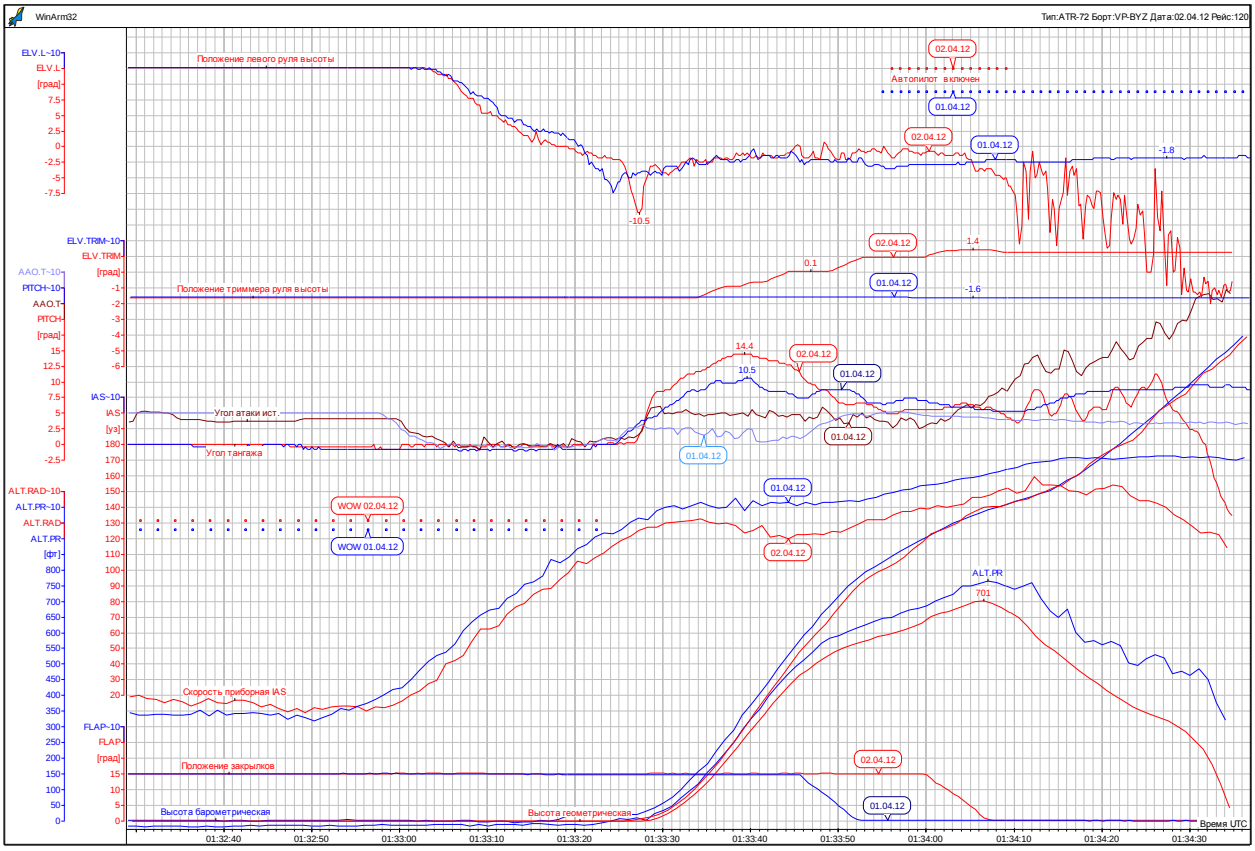



**Figure 54. The comparison of the climb envelopes in a previous and accident flight**

Figure 55 shows the changes in the elevator position in some flights with the elevator trim ≈-1.65° nose up. As it can be concluded from the graph, at the initial phase of the takeoff run (up to the speed of 70-80 knots, when pilots hardly apply any forces on control column in pitch, that is the elevator is deflected under the effect of hinge moment) the way the elevator position was changing in the accident flight with the speed (hinge moment) increase is significantly different from the other flights, which confirms the difference in the air flow over the stabilizer and the elevator.

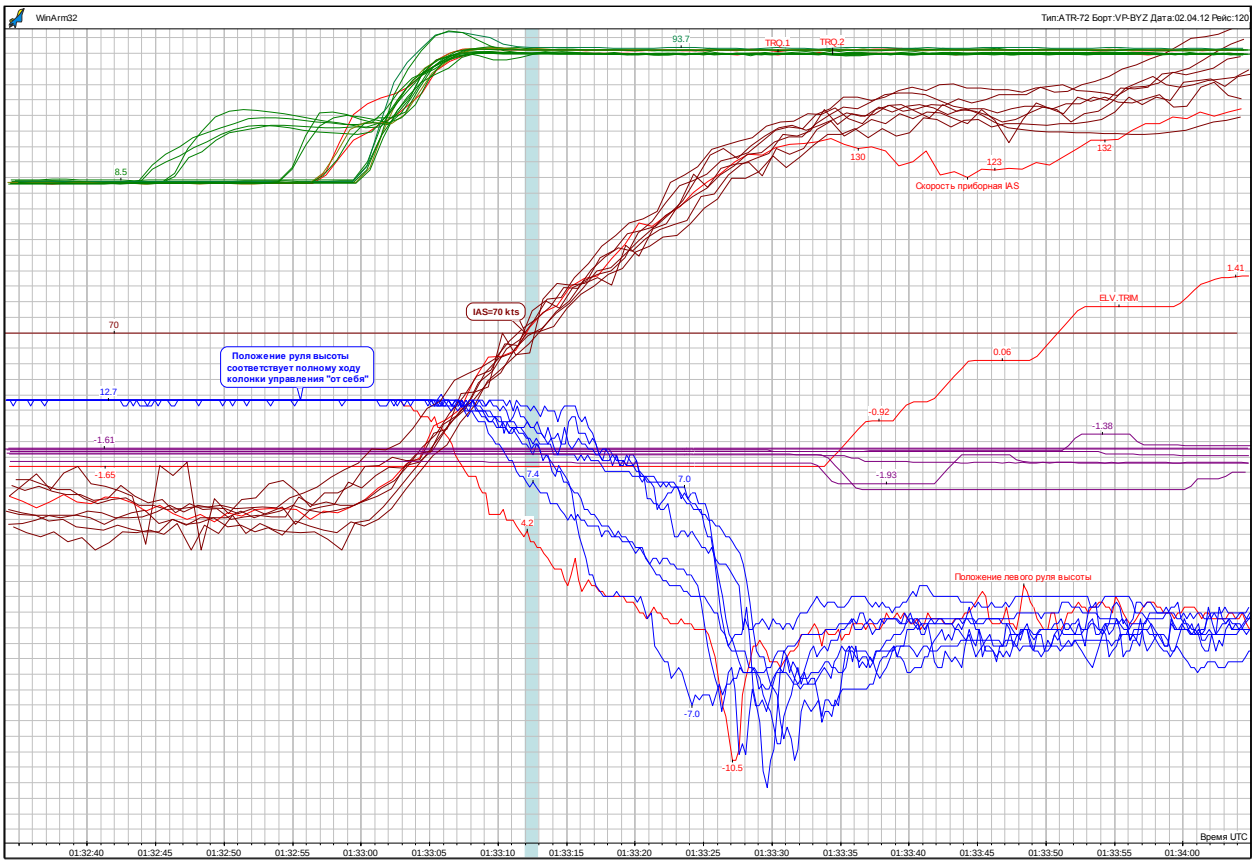



**Figure 55. The comparison of the elevator deflection at the takeoff run with the elevator trim position ≈-1.65°**

It has been noted above, that after the aircraft liftoff it was necessary to trim the forces on the elevator intensively in the nose down direction up to full stop that did not occur in the previous flight and cannot be explained by the only fact of initial aircraft mistrimming to nose up. According to the data of the aircraft manufacturer, that were collected from the previous accidents investigation, this fact is explained by the significant change of air flow over the upper stabilizer and elevator surface because of the effect of the snow and ice contamination.

Thus, the facts established by the investigation team in the course of the investigation:

- the significant aerodynamic degradation of aircraft performance (the lift decrease and the increase of the drag);
- significant increase of the angle of attack value during climb-out;
- the unusual change of the character and value of the hinge moment on the elevator (forces on the control column) with the speed increase;
- the self-induced aircraft bank at operating angles of attack before the stall warning system activation;
- the failure to perform de-icing/anti-icing after a long period of the aircraft location on the stand under the conditions of the icing contamination accumulation;

- comments of the crew about the presence of the ice contamination on the aircraft surfaces;
- the initial aircraft bank to the right under the conditions when the right side of the aircraft must have been subject to the most intensive icing;

allow to assume that after the flaps retraction the stall on the operating angles of attack occurred due to the significant aerodynamic degradation due to ground icing. Meanwhile, the engineering simulation (Chapter 1.16.1) revealed, that the recovery of the aircraft to normal flight without flaps extension was impossible. The crew did not extend flaps after the start of the stall.

## 2.5. Analysis of the crew work and rest balance

After the arrival of the Flight 119 to the Tyumen airport, in compliance with the flight shift schedule, the flight crew went for rest to the Liner Hotel of the Roschino airport, where it was staying till 23:30[27]. The rest period was 4 hrs 30 minutes.

According to the conclusion of the medical group, the crew members before the flights of 01-02.04.2012 had sufficient pre-flight rest. At the same time, the investigation team notes that both pilots had great working load. Thus, in 2011, in fact both pilots accumulated flying hours within the extended sanitary standard[28] (PIC – 895 hrs, F/O – 896 hrs). In March 2012 both pilots continued working intensely. The PIC accumulated flying hours were equal to the extended sanitary standard (89 hrs. 20 min), the fist officer accumulated flying hours were within the average sanitary standard (80 hrs). The investigation team revealed, that as far as the pilots are concerned, in March 2012 the provisions of the regulatory documents that determine the order of the split shifts, were violated[29]. In March the pilots had 5 split shifts (there shall be not more than two). Taking into account the above stated together with a great number of unused days-off from the moment of the employment of the crew by the airline (PIC had 111 unused days-off, the F/O - 123 unused days-off) the investigation team concludes that, most probably, both pilots performed the flight with background accumulated fatigue. The fatigue accumulation provokes the demonstrated increased fatigability, lack of attention, distraction and as a consequence increases the possibility of committing errors in piloting and decision taking.

The fact of the PIC's possible accumulated fatigue is also confirmed by the results of his

[27] The other cabin crew was assigned to UTA-120 flight.
[28] According to the requirements in force, the in-flight time cannot exceed 80 hrs within a calendar month and 800 hrs within a calendar year. The in-flight time can be increased up to 90 hrs within a calendar month and 900 hrs within a calendar year.
[29] On the crew member agreement the flight shift may be split in two parts. The interval between two parts of the flight shift is not considered working time.

psychological tests that were conducted by qualified psychologists. The testing was organized in October 2011. According to the psychologists conclusion, the general level of the PIC cognitive functions retained, in terms of the Manual on civil aviation flight and ATC staff selection, training and professional activity with psychological support in Russian Federation of 01.01.2001 (hereafter referred to as the Manual), shows the "high" level (19 points), but with relatively decreased performance indicators of the short term memory and visual reaction.

Those psyche protection mechanisms may be activated as the reaction to the workload increase and duration (on different levels including behavioral, psychological, physiological) and may be related to the fatigability development with background accumulated fatigue. Under the state of the fatigue development, as any information comes into mind, the psyche does not percept the entire information current but turns on the data entry verification, selection, analysis and classification on the areas of mind that are responsible for information storage (reproduction, forgetting) mechanism. The first element to react to the fatigue is the memory and the sensor systems activity.

To prevent the organism's energetic resources exhaustion (that occurs in the state of fatigue), the protection mechanisms of suppression are activated in central nervous system and that allows inhibiting their complete exhaustion and activate the recovery mechanism.

***Note:*** *The symptoms of* ***fatigue*** *are the subjective sensations that accompany the state of fatigability, and are revealed in a feeling of weakness, physiological discomfort, realization of the inadequate condition of the psyche processes, the domination of motivation to cease the activity, negative emotional reactions.*

***Fatigability*** *is a temporary decrease of workability under the continued influence of the workload. It appears due to internal resources exhaustion and discrepancy in activity support systems.*

*The fatigue is revealed on different levels :*

*-behavioral – labor capacity decrease in terms of quality and the speed of work in progress;*

*-physiological – difficulty in building of the conditioning connections, the increase of nervous processes delay;*

*-psychological – the sensibility degradation, cognitive and mental deterioration, emotional and motivational area shifts.*

*Under the fatigue vegetative de-compensation occurs, the nervous processes*

*delay increases, the negative emotions appear (tiredness affection).*
*The feature of the fatigue symptoms depends on the kind of workload, its time and localization together with time that is necessary for workability recovery. («The dictionary of the practitioner psychologist», S. Golovin, Moscow, 2001).*

Thus, the investigation comes to general conclusion, that with great degree of probability both pilots performed the flight under background accumulated fatigue.

## 2.6. The analysis of the requirements on pre-flight air crews meteorological support

The civil aviation regulatory documents in force (FAP-128, Civil aviation Regulations on Meteorological support, issued 1995) determine that the air crews shall be aware of meteorological data under pre-flight preparation. However this obligatory information implies only the actual and forecast weather reports for the departure, destination and alternate aerodromes (if applicable) together with the data for en route. The different special weather reports and notices of the presence or forecast dangerous weather phenomena are also transferred to the crews. In regulatory documents there are no requirements that a crew must necessarily acquire the weather conditions on the aerodrome within aircraft stand period.

Under hands-on experience that is stated in the airline flight operations manual the decision for de-icing/anti-icing is generally taken jointly: by the ground personnel that is in charge of aircraft pre-flight preparation and by the PIC. With that the preliminary decision of need to de-ice/anti-ice is taken by the ground personnel with the following information transfer to the crew. If the qualification of the ground personnel is insufficient, the crew may be transferred wrong information that there is no need of de-icing/anti-icing. This, with the other adverse factors presence (night-time, hurry, crew tiredness), may lead to significant risk increase of departure of the aircraft with non-removed ground icing.

Thus, the information transfer (under signed receipt) to the crew before flight of the weather conditions presence within the aircraft stand period that are contributory to the icing accumulation, will allow considerable decreasing of the mentioned risks. It is more than logical, taking into account that the final responsibility for compliance with clean aircraft concept rests on PIC.

## 2.7. The analysis of the crew qualification and actions

Because the causes of the accident are related to the departure of the aircraft with non-

removed ground icing and the following stall, so the analysis of the qualification and actions was made with the accent to these two aspects.

According to the given documents, the PIC and F/O were trained and admitted to solo flights in complete compliance with the training curriculums in force, had the valid pilot license and medical certificates. All the obligatory procedures[30], that authorize the solo flights (including regular simulator flights with approaching to stall including under in-flight icing conditions), were undergone by both PIC and F/O. The crew also underwent autumn-winter period training.

At the same time, as it will be noted further, the actions of the crew during pre-flight preparation and the rise and development of the emergency is the evidence of serious gaps in training for cold weather operations and possible icing, the ground one included, as well as in the recognition of approaching to stall and recovery procedures.

After it came to the aerodrome, the crew started pre-flight preparation with Aircraft Meteorological Center, where at 00:15 they underwent the weather briefing and got the documentation. During the weather briefing the crew got all obligatory information concerning weather at departure aerodrome Roschino (Tyumen), en route information, at the destination aerodrome Surgut and at the alternate aerodrome Nizhnevartovsk. On the completion of the weather briefing the PIC was handed the form АВ-11 №1, which he confirmed with his signature on «Registration of the weather briefing recipients in Roschino aircraft meteorological center» list with the indication of the flight number and aircraft registration number. Actual weather did not affect the decision-making for departure.

At 00:20 the crew underwent the medical examination in the airport start up medical station, the state of health confirmed they were fit for flight.

On the completion of the medical examination the F/O received the navigator case and the flight plan in the Aeronautical Information Service that is confirmed by the corresponding notes in the register. Then the crew pre-flight preparation went on in the briefing room.

The aircraft TOW was 18730 kg, CG - 30,72% MAC, which did not exceed the limitations.

According to the explication of the avionics technician, who was standing near the aircraft, the crew came to the aircraft at about 00:30.

[30] The detailed information on the crew training is given in Section 1.5.1.

The analysis of the outdoor surveillance camera No.6 data showed that PIC carried out the aircraft pre-flight inspection[31] with only partial compliance to the inspection order prescribed by FCOM and UTAir Flight Operations Manual, in a superficial way, along the fuselage sides only. It is worth noting, that the major part of the wing and stabilizer surfaces is not available for inspection if the crew is on ground without high step-ladders or a platform. Thus, PIC did not evaluate the condition of the aircraft aerodynamic surfaces and was not able to make the justified decision if there was need of the aircraft to be de-iced/anti-iced.

***Note:*** *UTAir Flight Operations Manual Part A-16 Item 16.5 (4):*

***Responsibility and de-icing/anti-icing quality control***

*The crew is prohibited to take off, if the aircraft surfaces are covered with ice and snow.*

*The PIC should not perform the flight**, if he has not ensured**, that the aircraft surfaces have no contamination on them which can influence the performance and controllability of the aircraft…*

At the same time, there were all reasons for PIC to suppose the presence of ground icing. The descent for approach at the Roschino aerodrome was performed in multi-layer clouds with icing. According to the FDR record, the crew activated the ice protection system in De-Icing mode. During the landing and taxi to stand there was moderate shower rain with the temperature near 0°. Although by the moment of departure the precipitation stopped, the actual temperature was below zero. On the apron, including the aircraft stand area there was snow and ice contamination, which follows from the analysis of the outdoor surveillance video camera and from the ground personnel statements.

Also within pre-flight preparation the aircraft on the adjacent stands were de-iced/anti-iced, which should have attracted PIC's attention.

Based on the results of the aircraft external inspection PIC wrote in FTLB: «LC PERFORMED BY CDR» (the external inspection was performed by PIC), indicated the time of inspection at 00:40 and the fuelling of 2000 kg.

[31] According to Flight operations manual and FCOM the preflight inspection is carried out by the PIC only, First officer does not carry out the preflight inspection. Non-participation of the first officer in preflight inspection does not allow him to acquire necessary skill and get ready to put into operation as PIC.

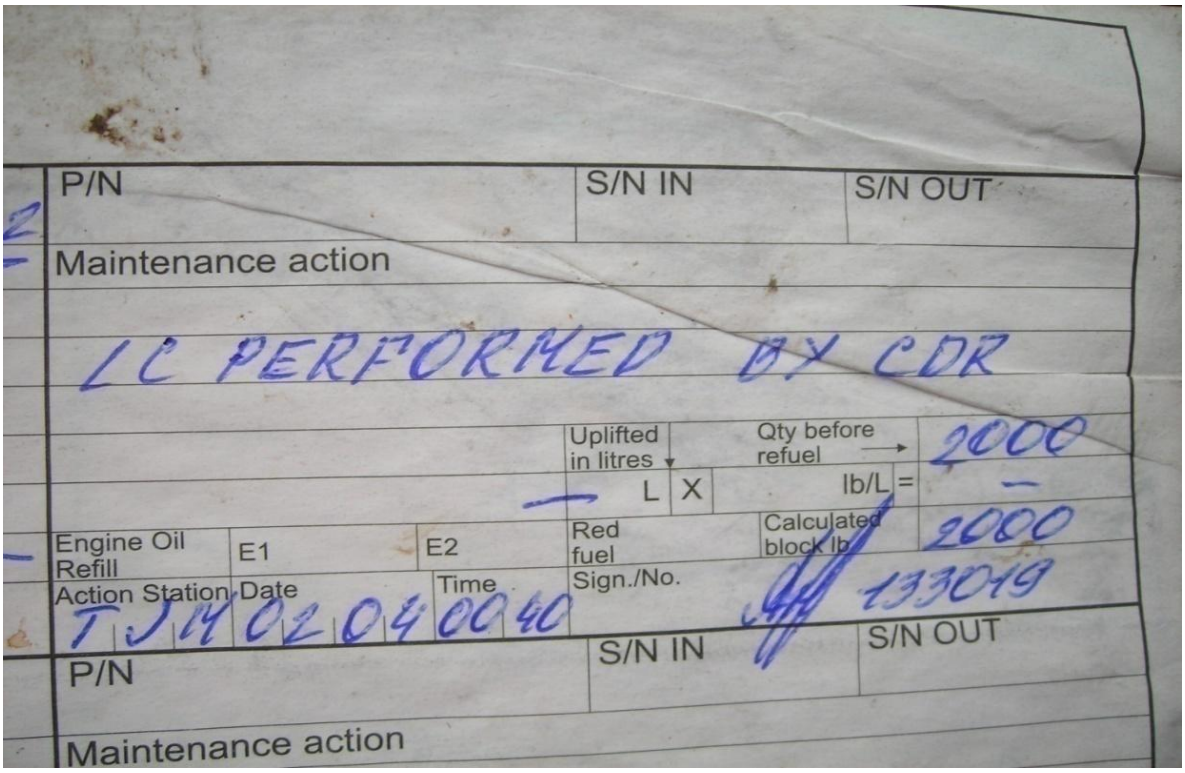



**Figure 56. FTLB page**

The aircraft mechanic who entered the cockpit reported (by his words) that the aircraft is clean, the PIC's answer was: «We are not going to be treated, will take off as it is». The precise words of the dialogue cannot be ascertained. The conversation was not recorded by the CVR.

The aircraft mechanic gave the job card that was signed by him. PIC put his signature. Shortcomings in aircraft mechanic training and the evaluation of the aircraft condition have been analyzed above. It should be noted, that the crew members normally do not know, whether the ground specialists have the permission for solo work or whether they have aviation education and aviation specialist license. For the crew such specialists are the representatives of the engineering and technical personnel that are in charge of the aircraft preparation and departure.

During the interview the aircraft mechanic said, that he did not inspect the upper surfaces of the wing and stabilizer with the use of high step-ladder or platform, but did not report this fact to the PIC. Considering the fact that the PIC performed the aircraft pre-flight inspection in a superficial way the investigation team notes that the joint decision prescribed by the Airline's Flight Operations Manual, made by the ground personnel and the PIC for de-icing/anti-icing or the refusal of the procedure under the existed conditions in general could not have been made reasonably. Although the ground personnel report, for certain degree, provoked the PIC to make the thoughtless decision, the investigation team notes that PIC relied on the aircraft mechanic's opinion, however both of them had performed their duties in a deficient way.

Analyzing the possible psychological aspects of the PIC's faulty actions, it is worth noting, that the psychological and nervous tension can be relieved within a greater period of time than the physical tiredness. Under great flying workloads (the pilots often accumulated more than 80 flight hrs a month), it is necessary to focus proper attention on the timeliness and the duration of rest, including the adequate post-flight rest periods and the timely and complete vacations granting. In fact, the crew members had a lot of unused days-off. As the accident flight was the final one (and right before the PIC's birthday on 03.04) and the night rest in a hotel was also insufficient (its duration was 4:30), so, most probably, the rise of the «unconscious (non-recognized) motivation» for the fastest work completion might have become background for the PIC's following decisions. Having been reported by the ground personnel that the aircraft is clean it might be assumed that the internal «readiness and desire» of the PIC to hear this information were so great that no piece of received information was cast doubt on. In such a way, the aircraft general "readiness image" for flight might have risen that was constructed of the background fatigue, the absence of the proper situation analysis as well as distinct knowledge of the regulatory documents and, what is most important, the PIC had no exact knowledge of the possible consequences.

After making such decision, PIC, possibly, began to doubt its correctness, because during taxiing he gave the command to the F/O to activate aircraft ice protection system in De-Icing mode. It is possible, that PIC observed the snow and ice accretion on the wing from his seat in the cockpit.

The analysis of the other airline crews' flights revealed that ground activation of the ice protection system in De-Icing mode occurred earlier; in particular it was the practice of the flight instructor who was in charge of the killed PIC's commissioning. It was impossible for the investigation team to determine exactly what the aircraft condition in these cases were. According to the explications, the crews that activated the aircraft ice protection system in De-Icing mode on ground before flight justify their actions by the need to check the workability of the system in question, because under the expected flight conditions the icing in cloud could not be excluded.

The AFM does not prescribe the pre-flight system check. At the same time, there is no prohibition to use the system (De-Icing) on ground either.

By the airline representatives' words, as early as the beginning of the A/C type operations the check procedure was recommended by Finnish specialists, who assisted the Airline's staff at the initial stage of operation. On the request to the SIA of Finland the answer was received, that

for this very moment it seemed to be impossible to restore the training documentation that was in use for the time period discussed.

According to the aircraft manufacturer information, there were failures on the first aircraft, related to the freezing of the distribution valve, which provided the air feed to rubber boots. The fault was corrected by installation of the heated valve. All UTAir ATR aircraft have the heated valves, that is there is no need to check the system before flight.

Whatever the PIC motivation was for the system activation, the CVR has the evidence that in the course of the system function on ground the crew observed the snow and ice contamination fall from the wing leading edge at taxi.

The system of de-icing of wing and stabilizer is designed only for in-flight icing conditions, because it protects only the leading edge of the corresponding surfaces as deep as 14 % MAC, where ice is accumulated in flight. As the result of ground icing accumulation the entire wing and stabilizer upper surfaces are contaminated. In fact, the above-described crew actions on the ice removal might have led to the formation of the ice barrier on the entire wing and stabilizer span and make the situation even worse. In this case the only way to completely remove the snow and ice contamination and comply with clean aircraft concept was to de-ice/anti-ice the aircraft by the corresponding fluids.

The crew did not make the decision to stop taxiing and return for de-icing/anti-icing. This possibility was not even discussed by the crew. The investigation team was not able to determine the exact reason for such decision. There is no evidence of hurry or takeoff “by all means”. The motives of the economical nature are not confirmed either, because initially the de-icing/anti-icing was ordered for all airline aircraft, the special purpose vehicle came at the aircraft stand on time and left only after the decision of the refusal of de-icing/anti-icing. So, the most probable reason for such decision, according to the investigation team's opinion, is deficiency in crew members qualification, foremost as far as the PIC is concerned.

The peculiarity of the transition training programs for the flight staff to the foreign-manufactured aircraft (for all aircraft types, including the transition courses at other countries' certified training centers) is that, as a rule, they do not stipulate a deep study of aerodynamic features of the aircraft and its behavior in case of aerodynamic characteristics degradation at different phases of flight, including the icing effect. The danger of the ground icing and the aircraft behavior in flights with non-removed snow and ice contamination is not paid special attention to within training.

The aircraft manufacturers, as a rule, do not issue recommendations on aircraft behavior at takeoff with non-removed snow and ice contamination. The corresponding get-to-know

manuals on the flight performance peculiarities during Cold Weather Operations are issued[32]. However the use of these materials is not obligatory, each operator determines their applicability on their own account.

According to the information given, the airline had Cold Weather Operations manual available for its staff and it was used for flight crews training. At the same time, it should be noted, that these documents are issued in the English language, while the real PIC and F/O language proficiency level did not allow them to completely understand the training guides content (for details see Item 1.18.9). The actual crew actions during pre-flight preparation and the flight performance show that the crew did not possess necessary knowledge of general aerodynamics, of the ground icing effect on the aerodynamic characteristics at takeoff and was not prepared to the actions in such a situation.

Most probably, the crew, watching the snow and ice contamination fall from the wing leading edge had considered the measures on show-and-ice deposits removal by means of the ice protection system activation sufficient.

The feature of both crew members is the fact that after graduating from higher school for civil aviation, where the training was organized on the domestic-manufactured and Ukraine manufactured aircraft, the PIC and the F/O were directly trained to fly the foreign-manufactured aircraft. The analysis of the UTAir transition training course for the flight staff to the ATR 42/72 aircraft showed that it implies, mainly, the self-learning of the aircraft systems and their function principles, including anti-icing system (2 hrs). It provides for the briefings with the qualified flight-instructor who is authorized for initial training as well as for supplementary study, if necessary, of the aviation terminology in English. The personnel training center equipment, its possibilities and conditions allow the students to study aircraft.

Based on the results of the first phase of training a computer test or written exam is organized, however no check of the material acquisition within each subject is conducted. It cannot be excluded, that the exam test procedure does not reveal problems concerning the knowledge of some particular aspects.

The second part of the curriculum stipulates the study under instructor's supervision of the operation procedures (SOP). There is about an hour devoted to Subject No. 4 “Flight under icing conditions” in this part of curriculum, where the following aspects are considered:

- the impact of the snow and ice contamination on aircraft performance;
- the actions under the condition of severe icing;

[32] ATR Aircraft has these guidelines issued.

- the procedures under icing conditions on different phases of flight.

All the aspects concern in-flight icing conditions; no attention is paid to the clean aircraft concept before flight and the danger of the ground icing. No attention is attracted to the possibility of the contaminated aircraft stall right after takeoff.

It is supposed, that within the period of flying as the F/O the PIC should get the experience and the procedure of the aircraft pre-flight preparation with ground icing conditions. When commissioning a PIC, the flight instructor was not only to train the piloting of the aircraft but to cultivate the consideration of the documents provisions, including the obligatory compliance with the clean aircraft concept, to teach making intelligent decisions with the paramount accent on flight safety.

It is worth noting that while performing solo flights as a PIC (the pilot was authorized for them in November 2011), with the consideration of the weather phenomena within winter period of 2011-2012 on the territory of the Western Siberia, evidently, the PIC had not run into the weather conditions that occurred at the Roschino aerodrome on 02.04.2012. The analysis of the available documentation concerning PIC's flights from Surgut and Tyumen (the majority of flights was performed from these cities) showed that de-icing/anti-icing had never been ordered by the PIC.

All the crew further actions also confirm that they were not aware of the danger of aircraft takeoff with non-removed ground icing. The value of takeoff safety speed ($V_2$) was set on the airspeed indicator for normal conditions but not for flight under the conditions of possible icing. During the inspection of the PIC's and F/O's instrument panels it was revealed that the $V_2$ bugs were set at 111 kt. According to FCOM this speed value corresponds to takeoff normal conditions for the actual weight. For takeoff under possible icing conditions this value would be equal to 115 kt.


**Figure 57. PIC instrument panel**


**Figure 58. F/O instrument panel**

After the takeoff the crew performed flaps retraction, being guided by the white bug (minimum flight speed with retracted flaps for normal conditions, 132 kt, TOW 18730 kg), but not to the red bug of minimum flight speed with retracted flaps under possible icing conditions (160 kt for TOW 18730 kg).

***Note:***

*The information provided in two previous paragraphs is given only for crew actions analysis purposes and must not be considered as an alternative means of compliance with clean aircraft concept.*

When taxiing the crew observed ice on the wing leading edge and its fall after ice protection system activation, so they must have understood, that in fact there was snow and ice contamination on the entire surface of the wing and stabilizer, not only on the leading edges that are protected by ice protection system. So, it should be noted that both PIC and the F/O were absolutely unaware of the danger of takeoff with non-removed ground icing and did not realize its effect on the aerodynamic performance of the aircraft that may be referred to the gaps in their education at the flight school as well as during the transition course to ATR 42/72 aircraft and during the commissioning.

Altogether, from the moment of the engines start-up and till the rise of the emergency the SOPs were fulfilled. It should be pointed as a shortcoming that before the flight the elevator trim was set by the crew incorrectly. The actual trim position (-1.65°, nose up) did not comply with the estimated one for CG 30.72% MAC (≈ -0.7°, nose up), however the trim position was in a green zone permitted for takeoff (Figure 59).


**Figure 59. The instrument panel with the indication of the elevator trim position**

The aircraft takeoff run and liftoff occurred without particularities. After aircraft liftoff, due to significant degradation of the lift, to provide the "normal" climb speed (the angle of climb) a greater angle of attack was required (+ ≈4°) (Figure 54). As there is no angle-of-attack indicator on the aircraft, this fact could not assist the crew to identify the change in the aircraft aerodynamic performance.

The only sign of the "unusual" aircraft behavior at this stage of flight was the unusual change of forces on the control column, which demanded the forces trimming in a forward direction almost to the mechanical limit. The fact of significant change of the aircraft balance as far as the forces are concerned is characteristic of a contaminated stabilizer upper surface that leads to the change of the air flow along the elevator and consequently to the change of the hinge moment. According to the aircraft manufacturer data, such incidents had occurred earlier. To make the crew familiar with the situation the manufacturer worked out the special simulator exercise. The Finnair simulator, on which the crew members were trained, has such exercise. The Airlines didn't present the data on the actual undergoing of the exercise of takeoff with contaminated stabilizer by the crew members to the Investigation team.

It is worth noting that in AFM and FCOM there is no information on the change of the aircraft behavior with ground icing. This is true not only for the ATR aircraft, but almost for all

types of A/C. The available documentation in force concerning flight operations does not consider the cases of non-compliance with the Clean Aircraft Concept and, correspondingly, does not contain the recommendations on crew actions in these cases. At the same time, the cases of takeoff with non-removed ground icing recur from time to time in international civil aviation. In spite of the obvious (without any exceptions) necessity of the compliance with the clean aircraft concept, the Investigation Team notes, that the implementation of the corresponding supplements in pilots' training programs as well as in Flight Crew Training Manual will help to significantly improve the pilots' situational awareness, to identify the rise of the emergency and take corresponding measures.

The development of the emergency started at the moment of flaps retraction end from the aircraft buffeting with following non-commanded bank to the right, which was generated by the start of the stall. Such aircraft behavior was not anticipated by the crew at all. The crew performed the correct action on autopilot disengagement, although neither at that very moment, nor a little bit later, at the activation of the stall warning system (cricket and stick shaker), did the crew identify the start of the stall. Correspondingly, the actions prescribed by the AFM such as: push of the control column and flaps extension on 15°, were not performed. The engineering simulation and simulator experiment showed that with the actual aerodynamic performance the aircraft stall recovery with only control column deflection (in pitch and roll) without flaps extension on 15° was impossible.

Thus, the main contributing factor to the situation turning into the catastrophic one was failure of the crew to identify the stall start. The investigation team notes that nowadays all the crew training concerning the critical modes recovery, including stall is performed on the simulators in a calm, "room" atmosphere. The aerodrome training under real conditions nowadays is not performed.

According to the given documents, the simulator training aimed to train actions in flight with high angles of attack close to the stall ones till the moment of stick shaker activation, including under icing conditions, was organized with the crew. However it should be noted that these exercises are performed in level flight at altitude of 2 400 – 3 00 ft in compliance with pre-defined procedure (engine on idle, the flight speed decrease by means of pitch increase till cricket and stick shaker activation and the recovery with acceleration). At takeoff, when the psychological factor of the ground proximity interferes with the control column pitch down movement, these exercises are not trained.

Note: By the information of the aircraft manufacturer the existing flight simulators software does not allow “to introduce” the stall mode abruptly.

The international and domestic practice of the accident investigation (for example the A-330 accident operated by Air France, flight AF 447, occurred on 01.07.2009), shows that such training is often insufficient. The existing simulator training programs do not guarantee that the crew will identify the aircraft approach to the critical conditions (or flying under them) and take corrective measures on time.

In such a manner, the crew members turned out to be in a situation, when visual, aural and tactile signs of the critical mode came out all of a sudden just in several seconds, which did not correspond to situation that was trained. This situation has not been encountered before in their flight practice.

Based on the analysis of possible psychological factors of the crew's failure to identify the emergency it is necessary to understand that each pilot has his own “image of flight” depending on its phases. The formation of the image of takeoff with all operations and sensations takes place within the process of accumulation of the flight skills and habitual in-flight sensations. Up to the end of flaps retraction during takeoff the crew performed habitual actions in compliance with the image of takeoff that always occurred under normal flying conditions.

What happened with the aircraft after flaps retraction was not anticipated by the crew at all and provoked their astonished reaction: F/O: «Wooow» (01:34:06) and PIC: «Wut’s this?» (01:34:08), F/O: «Wut’s buffeting?» (01:34:09). The crew was not ready for such a rapid situation rise and development in flight, so the mental “search” activity was completely directed to the identification of a failure, but not to the action on the aircraft recovery from uncontrolled flight on the basis of aircraft stall warning system.

Probably, there was certain influence of the crew members’ personal traits of character that under psychoemotional tension revealed themselves as follows: irrational, that is immediate (emotionally overwhelming), reaction of the PIC without critical evaluation of the current situation and, as stress was increasing, with certain impulsiveness. The PIC impulsive and instinctual actions to pull the control column to prevent aircraft collision with the ground did not allow the pusher to decrease the angle of attack and to recover the normal air flow along the aircraft.

The evidence of the rapidly increasing psychoemotional tension of the F/O also revealed itself by irrational reaction with moderately explicit counteraction to the external pressure (after PIC words “Report to him” F/O answered “Report wut? Wut’s the failure?”) with harsh statement afterwards (“You mother fucker”).

It should be noted, that tired brain needs more time to concentrate the cognitive (mental) functions with the aim of recognition of the current situation and correct decision-making together and to reveal the motor reactions for rapid actions to eliminate the emergency.

Up to the aircraft collision with the ground the elevator was mainly nose-up, the flaps were not extended. The crew attempts to counteract the bank by the deflection of the ailerons only did not lead to any positive effect. The engineering simulation and the simulator session showed that, most probably the recovery was possible in this situation. On condition of the timely performance of the actions prescribed by the AFM, the altitude loss at the stall recovery might have amounted to 300-400 ft.

# 3. Conclusion

## 3.1. Findings

On the basis of the analysis of the found out facts and the circumstances of the flight, the results of the field investigation, including the wreckage plot of the accident site made with the use of unmanned aerial vehicle, the data of the ground and flight recorders, engineering simulation of the flight performed by the ATR Aircraft Manufacturer, the analysis of the air navigation and meteorological support of the flight, the results of the special MFC examination; the given data on the crew qualification and the organization of the flight operation within the airline; the medical data; the information of aircraft ground handling and maintenance; the results of the simulator session;, the assessment of the crew actions; the results of the forensic expertise **it has been established that**:

3.1.1 The ATR72-201 VP-BYZ aircraft had valid registration and airworthiness certificates. Before takeoff from Tyumen airport the aircraft was serviceable, its components and engines had sufficient life times and time limits to perform the flight.

3.1.2 The aircraft was fuelled with a sufficient quantity of fuel for the planned flight route, taking into account the chosen alternate airdromes. According to the results of the performed examinations there are no remarks as to the physicochemical quality indexes of the fuel.

3.1.3 The TOW (18730 kg) and CG (30.72% MAC) of the aircraft did not exceed the limitations, set by AFM.

3.1.4 The investigation team did not find any failures of the airframe, engines and systems functions till the collision with ground. There was no in-flight aircraft fire or destruction.

3.1.5 The meteorological support of the flight was in compliance with the regulatory documents provisions. Actual weather conditions at takeoff: *wind 240 06 m/sec gusts 9 m/sec, visibility 10 km, broken clouds (5-7 oct.) cumulonimbus, cloud base 390 m, temperature -1°C, dew point -1°C, QNH 1002 hPa* did not obstruct the flight dispatch.

3.1.6 The day before the accident the descent to approach for landing at the Roschino aerodrome was performed in multi-layer clouds under icing conditions, which does not exclude the residual in-flight icing accretion. During the aircraft stand (more than 7 hrs), under the atmosphere front passage, at the Roschino aerodrome there was precipitation with the near zero temperature and strong wind contributing to the ground icing accretion The right side of the

aircraft (RH wing and RH horizontal stabilizer) must have been subject to more intensive ground icing as the situated windward during the period of most intensive fallout of precipitation.

3.1.7 Due to a presence of non-removed ground icing on wing, fuselage and horizontal stabilizer surfaces the aircraft aerodynamic performance at accident takeoff did not meet the aircraft type characteristics. The actual value of the lift coefficient as compared to the type values decreased by ≈25%, with drag coefficient practically doubled.

3.1.8 There were timely transferred alerts of the presence of the ground icing conditions at the aerodrome. The alerts were transferred to all relevant services, including the PPCD dispatcher of UTAir-Technic, whose personnel was in charge of the aircraft maintenance and ground handling, and UTAir office. There was no mandatory procedure in the current regulations to inform a flight crew about the abovementioned alerts during a pre-flight weather briefing however the abovementioned documents were available and, if interested, flight crew members might have studied these documents.

3.1.9 Federal aviation regulations «The preparation and conducting of flights in civil aviation in the Russian Federation» (FAP-128, item 2.14) prohibit flight crews (pilots) from starting a flight, if there is frost, slush or ice on the wings, fuselage, control surfaces, tailplane, propellers, powerplants surfaces, windshields or ports of the pressure instruments – that is the requirement of the clean aircraft concept is introduced. The same requirements can be also found in the ATR 72 AFM.

3.1.10 At the time of the accident there was no basic regulatory document in force in the Russian Federation as far as the aircraft ground icing protection is concerned. The operators worked out the aircraft ground icing protection programs autonomously.

3.1.11 The provisions of UTAir documents (Flight Operations Manual, Ground Handling Management Manual, Anti-icing policy), that determine anti-icing procedures, in general met the provisions of the ICAO Manual of Ground De-Icing/Anti-Icing Operations, and also the provisions of the domestic and international guidelines. The abovementioned documents were available for UTAir-Technic who in accordance with the contract provided maintenance and ground handling to UTAir A/Cs.

3.1.12 According to the existing international practice, the aircraft de-icing/anti-icing is not considered a part of maintenance that can be carried out by certified aviation specialists only. This kind of works is related to ground handling. As de-/anti-icing treatment works are part of A/C operations and affect the airworthiness so these works must be done by trained, qualified and licensed personnel that has been trained in the certified training center. An operator shall provide the Quality Assurance.

3.1.13 The separation of the conceptions of ground handling and maintenance within the aircraft operation is not fully reflected in the regulatory documents for civil aviation in the Russian Federation. The de/anti-icing activities are not sorted out as far as the aircraft condition evaluation, decision-making on aircraft need to be de-iced/anti-iced, and its quality control and responsibility are concerned. This issue is not cleared even within major airports. The PIC who makes decision on departure and is, finally, responsible for Clean Aircraft Concept compliance does not usually have the physical possibility to inspect highly located aircraft construction elements (wing, stabilizer), moreover he cannot adequately evaluate the quality of de-icing/anti-icing treatment staying in a cockpit. From the point of view of the regulatory documents it is necessary to clearly separate the functions and responsibility of the maintenance, ground handling and flight personnel as far as the compliance with clean aircraft concept is concerned.

3.1.14 The pre-flight ground handling of the ATR 72 VP-BYZ aircraft was carried out by the UTAir-Technic personnel that is authorized for the ATR 72 aircraft ground handling only. In violation of the provisions of UTAir anti-icing policy and UTAir-Technic ATR 42/72 de-icing/anti-icing procedures the certified maintenance staff did not assist and did not monitor the quality of the ground personnel work.

3.1.15 The training of the UTAir-Technic ground handling personnel in terms of de-icing/anti-icing procedures was carried out in accordance with the Personnel training program on the conduct of ATR 42/72 aircraft after-arrival, on-stand and before-departure service (for the airports where there are no certified personnel), approved by ROSTRANSNADZOR Civil Aircraft Continued Airworthiness Department and agreed with UTAir. Only 30 minutes of lectures are dedicated to study de-icing/anti-icing issues. The content of the Program does not allow training the specialists in a proper manner, especially if they do not have aviation background.

3.1.16 The UTAir-Technic personnel training was performed by UTAir-Technic itself and by the Tyumen airport, which both are not certified training organizations and that violates the UTAir Ground Handling Management Manual. UTAir didn’t provide oversight (audit) of the UTAir-Technic (as a subcontractor) activities and on personnel training.

3.1.17 Practically the implementation of the safety management system in UTAir is at the initial phase. Airline SMS approved by FATA Flight Safety Inspection Head and Airline Director General and agreed by Tyumen FATA ITO AT specialists contains general issues mainly and is not adopted for the implementation of Airline activities in particular areas. Different airline documents that determine the safety management system need to be reviewed

and mutually coordinated. At the time of the accident the safety management system was inefficient and had not become the guideline for the ordinary staff.

3.1.18 The crew members had valid aviation specialist's licenses.

3.1.19 The crew members had valid medical certificates. The accident has no attitude to the crew members' state of health.

3.1.20 Under the maximum possible flight crew workload in 2011-2012 the Airline permitted violations of their work and rest balance, in particular there were 5 split flight shifts in March 2012 when only 2 split flight shifts are allowed by regulations. The PIC had 111 unused days-off, and the F/O had 123 unused days-off. Following the results of psychological team analysis the conclusion was made that with great degree of probability the crew performed the flight with background accumulated fatigue. The fatigue accumulation provokes the symptoms of increased fatigability, inattention, distraction and, as a consequence, committing errors in piloting and decision-making.

3.1.21 According to the given documents, the crew members underwent all the ATR 72 training, prescribed by regulatory documents, including the training on aircraft stall prevention including under the conditions of possible in-flight icing. PIC transition and classroom training was performed by Tyumen Personnel Training Center, NPP. FO transition training was performed in Tyumen Personnel Training Center, NPP in accordance with Sabenavita (Lithuania) Training Center program; his further classroom training was performed by Tyumen Personnel Training Center, NPP. The flight crew members' simulator training was performed in Toulouse (France) and Helsinki (Finland).

3.1.22 The manufacturer guidelines on Cold Weather Operations are issued in English only. In the Russian Federation there are no qualification requirements concerning the English language proficiency for pilots that fly aircraft with operation documentation in English only. According to expert conclusion based on tests analysis that were passed by pilots in Tyumen Personnel Training Center, NPP the PIC and F/O language proficiency did not allow them to understand to the full extent the content of the methodological technical documentation.

3.1.23 The ATR72 VP-BYZ aircraft ground handling was assigned to the aircraft mechanic who does not have aviation background. The aircraft mechanic was authorized to his duties only under the shift engineer (head) supervising. He didn't obtain the authorization to release the A/C to flight.

3.1.24 Before the servicing of ATR72 VP-BYZ the aircraft mechanic performed the servicing of another A/C - ATR72-500 VQ-BLI, including de-icing/anti-icing treatment as well as job-card drawing and signing.

3.1.25 The evaluation of the ATR72 VP-BYZ aircraft condition was performed visually by the aircraft mechanic, from the ground, the upper wing and stabilizer surfaces were not inspected. From the ground, without the use of step-ladders it is impossible to check the conditions of upper surfaces of wing and stabilizer to full extent. However based on the results of the inspection the aircraft mechanic reported to the PIC that the aircraft was clean. The PIC was not informed that the upper wing and stabilizer surfaces had not been inspected.

3.1.26 Regardless of the de-/anti-icing treatment that was being performed for the next stands aircraft the PIC performed the pre-flight inspection in a pro forma manner without paying adequate attention to the presence of snow-and-ice deposits on critical surfaces of A/C (wing and horizontal stabilizer), possibly hoping that the ground staff report on the aircraft condition would be objective.

3.1.27 In the presence of show-and-ice deposits on the ground and environment objects, in violation of FAP-128 (item 2.14) and ATR 72 AFM requirements that prohibit the flight in presence of show, ice or frost on A/C critical surfaces, as well as of UTAir Program for De-/Anti-icing A/C treatment providing that stipulates the mandatory de-/anti-icing treatment to an A/C in such conditions, the PIC and the aircraft mechanic had made a groundless but agreed decision that there is no need for the A/C to be de-iced/anti-iced.

3.1.28 As the reason of release the A/C to flight without de-/anti-icing the aircraft mechanic reported to the shift head the following: the PIC’s refusal of the A/C de-/anti-icing treatment. The shift head though being aware of the aircraft conditions after a long-term stand (as he had already treated several aircraft), did not demand the execution of his earlier given instruction on the de-/anti-icing treatment of each aircraft, didn’t reported to the Production and Dispatcher Service and didn’t stop the flight of the accident A/C. In fact, the shift engineer kept himself aloof of the aircraft mechanic activities monitoring.

3.1.29 To provide aircraft de-/anti-icing treatment in the AP three special purpose vehicles were engaged, there was anti-icing fluid in a sufficient quantity. De-icing/anti-icing vehicle had come at the ATR 72 VP-BYZ aircraft stand on time and left no earlier than after the aircraft mechanic signal and the information about the PIC’s refusal from the de-/anti-icing treatment.

3.1.30 Within one and a half hour before and after the accident except ATR 72 VP-BYZ there were nine more aircraft taking off from the Tyumen airport (A319, B737, ATR42 and ATR72), 4 of them operated by UTAir. Excluding transit flights (Sibir and Aeroflot airline), all aircraft underwent de-/anti-icing.

3.1.31 In the course of taxi and takeoff, up to onset of the emergency, the crew, all in all, performed the SOP correctly. As a shortcoming it should be noted that the elevator trim was set by the crew in position -1.65° (nose up), which was not equal to the estimated value of -0.7° (nose up) for the actual CG.

3.1.32 In the course of taxiing the PIC gave the command to the F/O to activate aircraft anti-icing system in de-icing mode, after that the crew observed the ice and snow contamination fall. The de-icing activation of aircraft anti-icing system continued for 6 min 30 sec, after that the system was switched off by the crew.

3.1.33 The crew did not consider the decision to stop taxi and return for de-/anti-icing. The crew, the PIC in particular, manifested the unawareness of the ground icing danger that, on the investigation team's opinion, is connected to shortcomings in both initial training programs (within higher school for civil aviation) and the transition course and recurrent training for ATR 72 type as far as the ground icing influence is concerned.

3.1.34 Takeoff was performed with flaps extended at 15°. The first level of the anti-icing system (the heating of sensors and windshield) was activated.

3.1.35 The aeronautical service of the flight complied with the regulatory documents in force. The actions of the ATC, the flights radio technical service and aeronautical telecommunications have no relation to the causes of the accident. The aircraft departure was performed by schedule. The runway was completely vacant; there were no time constraints for the crew for pre-flight and departure preparation. The time interval after the previous aircraft takeoff (B 737) amounted to 1min 30 sec that is in compliance of the regulatory documents requirements. The causes of the accident are not related to the wake turbulence.

3.1.36 The climb after takeoff was performed at significantly higher angles of attack that was caused by the significant decrease of the wing lift effectiveness. There is no angle of attack indicator aboard so the crew didn’t have a possibility to monitor this parameter.

3.1.37 During the climb-out the crew had to trim the aircraft intensively in nose down direction almost to the structural limit. The need to trim is explained by the redistribution of the aerodynamic forces (the change of the hinge moment) along the elevator surface due to the contamination of the stabilizer upper surface. The aircraft documents (AFM, FCOM) do not contain this effect description and the crew recommended actions. At the same time this exercise can be performed on the simulator. The Airline didn’t provide the Investigation Team with the data of the crew simulator training on takeoff with contaminated stabilizer.

3.1.38 Till the moment of the flaps retraction, there were no other obvious signs that could be the evidence of the "unusual" aircraft behavior, except increased angle of attack values and the redistribution of forces on the elevator.

3.1.39 At the altitude of 640 ft the autopilot was engaged.

3.1.40 During takeoff the crew performed all the actions at speeds that are recommended for the normal flight on "clean" aircraft.

3.1.41 The flaps retraction was initiated at the attitude of 640 ft at speed of 139 kt (the reference speed under normal conditions is 132 kt, under possible (in-flight) icing conditions it is 160 kt).

3.1.42 At the moment of the flaps retraction end the aircraft self-induced bank occurred due to the start of the stall. The bank appeared at the operational angles of attack, with engaged autopilot, before the activation of stall warning system. Before that moment the crew noted the buffeting.

3.1.43 Neither this time, nor later, after the activation of stall warning system[33] (cricket and stick shaker), and even after the pusher activation the crew did not recognize the stall of the aircraft, and, consequently, did not take measures on stall recovery (to push the control column and to extend flaps); the stick pusher was overpowered by the crew.

3.1.44 The analysis of several accidents circumstances, connected to the aircraft stall, occurred in domestic and foreign civil aviation showed, that the existing methods of the simulator training on stall recognition are not effective enough. In majority of cases, in real flights, the crews that underwent simulator training failed to identify the stall and did not take corrective measures on stall recovery, and again this prove the importance of all necessary measures to prevent the A/C to run into the such flight conditions.

3.1.45 Actual actions of the crew after aircraft stall consisted in an attempt to counteract the bank (the right initially, then the left one) by the control wheel deflection. The control column was deflected to nose up.

3.1.46 The simulator session showed that without applying the recommended procedure on stall recovery (to push the control column and to extend flaps) the recovery to normal flight was impossible. If the crew had complied with the recommended procedure the altitude loss for recovery, most likely, would have been within 300-400 ft.

3.1.47 The aircraft collision with the ground occurred at the pitch angle ~11° nose down, left bank of about 55° and vertical speed of descent more than 20 m/sec, which predetermined

[33] The stall warning system activated at the angles of attack stipulated by system function logic

severe destruction of the aircraft and the death of most people aboard. After the collision with ground the post-impact fire rose on certain elements.

3.1.48 Search and rescue works, all in all, were performed effectively, that allowed to evacuate surviving people on time and ensure the accident site guard.

3.1.49 There were no aircraft construction features revealed that might have had negative influence on the crew and passengers survival.

## 3.2. Causes

**The immediate cause** of the ATR 72-201 VP-BYZ aircraft accident was the PIC's decision to takeoff[34] without de/anti-icing treatment despite the fact that snow and ice deposits were present on aircraft surface and were discovered by the crew members during taxi which resulted in degradation of aircraft aerodynamic performance and stall during climbing after takeoff as well as inability of the crew to recognize stall and, consequently, failure to undertake recovery procedure.

The aircraft stall occurred at the operational angles of attack right after flaps retraction with engaged autopilot before stall warning system activation[35] and was caused by the loss of the wing lift effectiveness due to takeoff with non-removed ground icing.

**The system cause** of the accident were shortcomings in ground handling activities and staff training in UTAir-Technik that became possible because of absence of due monitoring by the Technical and Operation Supervising Directorates of UTAir airline for compliance with airline requirements regarding ground handling and aircraft ground icing protection which resulted in erroneous evaluation of aircraft conditions by the PIC and aircraft mechanic (the shift head kept himself aloof from monitoring mechanic's activities) after the aircraft has been on ground in icing conditions for a long time and in release the aircraft to fly without de/anti-icing treatment.

non-execution of measures on de-icing was the consequence of the erroneous coordinated decision of the PIC and the aircraft mechanic who was in charge of the aircraft pre-flight servicing after long aircraft stand under conditions, contributing to the ground icing accumulation of the aircraft. There was no control of the aircraft mechanic work on behalf of the shift engineer.

The departure of the aircraft with non-removed ground icing became possible due to system shortcomings in the aircraft ground icing protection organization in the Russian Federation, that at the time of the accident was revealed in the absence of the valid basic

[34] In violation of requirements of Para. 2.14 FAP-128 and ATR72 AFM.
[35] The stall warning system was activated as per design.

document, that would determine the regulatory requirements as to aircraft ground de/anti-icing, including the requirements for organizations licensing and training of the personnel that is responsible for the works in question.

The contributing factors were:

- The shortcomings in the UTAir safety management system which contains, all in all, general issues only and is not adopted for the implementation of Airline activities in particular areas, which did not allow to reveal and correct existing safety risks in a timely manner.
- The shortcomings in the UTAir-Technic quality management system, resulted in neglecting of certain requirements of the UTAir ground handling management manual regarding staff training and monitoring for aircraft de/anti-icing treatment which led to the situation when not sufficiently-qualified staff performed the evaluation of the aircraft surface conditions and made the decision on need for the aircraft to be de-iced/anti-iced.
- The absence at the time of the accident of regulations36 that establish state requirements for ground handling (de/anti-icing treatment in particular) including staff training and organization licensing.
- The shortcomings in crew members initial and recurrent training as far as the danger of ground icing, its influence on the aircraft aerodynamic performance together with aircraft anti-icing system operation features and design are concerned that did not allow the crew to make the only appropriate decision to return for de-icing/anti-icing treatment after the observation of the snow and ice contamination on the wing after anti-icing system activation in de-icing mode while taxiing for takeoff.
- The methodological imperfection of the crew computer based and simulator training programs concerning the prevention of aircraft stall, identification of approach to stall and taking timely actions for recovery.
- The increasing need for number of flight crews to perform highly growing flights schedule which, with ineffective SMS, resulted in flight instructor work deficiencies during PIC training and absence of PIC skills to take correct decisions and to strictly comply with the regulations in force.
- The possible fatigue of the crew members due to the violation of the work and rest balance while performing split flight shifts together with a large number of unused days-off.

[36] As a result of Investigation Team's recommendations given during the investigation on February 5, 2013 the FATA issued general provisions on "Aircraft ground icing protection" which were recommended to be used by operators. In addition since July,1st 2012 the State Standard (ГОСТ) P 54264-2010 «Methods and Procedures of aircraft de-icing/anti-icing» was put in force.

## 4. Other shortcomings revealed by the investigation

The shortcomings, stated in this chapter did not influence the outcome of the flight and are given to justify the investigation team recommendations:

1. Within the briefing of the ATC shift that entered on duty there was no flights responsibility distribution performed.

2. The radio exchange of the ATC personnel was carried out with slight derogations from the requirements of the FAP "The conduct of the radio exchange in the Russian Federation airspace".

3. The information on the activation of the COSPAS-SARSAT emergency beacon was received by the International Mission Control Center (Moscow) not earlier than 1:20 after the accident.

4. In presence of the heads of different organizations of the different range, the general management of the search and rescue works on the accident site was conducted inaccurately to some extent (Para 2.3.1 of the Aviation regulations on aircraft accident/incident investigation, issued 1998).

5. Within the operation on search and evacuation of killed people, the displacement and cut of the aircraft wreckage was not documented and photographed, that significantly complicated the investigation activity as to the definition of the aircraft condition and the aircraft elements location after the accident. The documentation of the killed and injured people location in relation to the aircraft wreckage was not carried out either.

## 5. Flight Safety recommendations

In the course of investigation the IIC has sent to the FATA Director a letter (ref. 05-11-484 dated 01.11.2012) with the safety recommendations issued by Investigation team relative among other issues to the improvement of quality of A/C de-/anti-icing treatment. In February 2013 the deputy Director of FATA Airworthiness Department issued general provisions on "Aircraft ground icing protection" which were sent to FATA regional offices as well as to airlines, aircraft design companies and repair plants.

### 5.1. To Russian aviation authorities[37]

5.1.1 To consider the reasonability of development of Federal Aviation Regulations for A/C maintenance, overhaul and repairs, as well as for ground handling taking into account domestic and international experience.

5.1.2 To consider the reasonability of reviewing FAP "Airport Certification. Procedures" in terms of including into the AP activities the A/C ground handling operations particularly the de-/anti-icing treatment.

5.1.3 With the consideration of the ICAO Safety Oversight manual requirements to develop and implement the guidance on the conformance evaluation methods to the current requirements for civil aviation organizations.

5.1.4 To consider the possibility of establishing dedicated control stations for pre-flight A/C surfaces inspection for ground ice accretion (near holding point).

5.1.5 To consider the reasonability of use of the dedicated de-/anti-icing simulators for personnel training.

5.1.6 To include the study of ground icing influence on A/C aerodynamic performance and flight safety in training programs for personnel responsible for A/C de-/anti-icing treatment.

5.1.7 In frame of Federal Law No.260-ФЗ dated December 25, 2012 to continue SMS implementation into airlines, APs, maintenance A/C centers, involving into this activity all departments of airlines, APs, maintenance A/C centers.

[37] Aviation authorities of other States of Agreement to consider the applicability of these Recommendations with consideration of a State actual situation.

5.1.8 To review the initial training programs in aviation schools in terms of providing additional training hours (classroom and practice) for issues related to A/C operation (e.g., "Clean A/C Concept", ground icing influence on A/C aerodynamic behavior, as well as decision-making conditions and de/anti-icing treatment procedures and coordination with ground personnel). To use for training purposes reports and other data on investigation of accidents that have occurred because of the said reasons, including accidents involving foreign operators.

5.1.9 To develop and implement English language proficiency requirements for flight crew members that perform flights on A/C with documentation in English only, as well as for personnel that provide maintenance and ground handling for those A/C.

5.1.10 Because of repeal of Federal Aviation Regulation (FAP) "Requirements to Flight Crew Members for international flights" to develop and implement the procedures for training and authorization to international flights for RF CA A/C flight crew members including GA crews.

5.1.11 To implement recommendations related to the content of flight data analysis procedures stipulated by FAP "Flight Preparation and Operations in RF Civil Aviation" Para 5.7 for the purpose of rendering methodological support to airlines in establishing of flight data analysis systems.

5.1.12 In cooperation with ROSGIDROMET to update the scope of mandatory meteorological information to be provided to a crew before flight for the period of the A/C aerodrome parking in case there were ground icing conditions observed within this period.

5.1.13 To consider the reasonability of reviewing Procedures of COSPAS-SARSAT ELT Registry in terms of mandatory registration of emergency locator transmitters by the International coordination and computing COSPAS-SARSAT center (Moscow, RF) for A/C registered in a third countries but operated by Russian operators.

5.1.14 To come forward with the initiative of the speed-up of the COSPAS-SARSAT low-orbit satellites launch under the liabilities of the Russian Federation of the support of the mentioned system.

5.1.15 To consider the practicability of reviewing the "Manual for RF CA flight and ATC personnel selection, training and professional activity based on psychological aspects"

issued on 01.01.2001, taking into account new requirements that are laid to flight and ATC personnel by operation of new A/C types.

### 5.2. To airlines' management

5.2.1 To get acquainted with Recommendations to UTAir and to analyze the situation with flight operation procedures, flight personnel training, flight operation quality monitoring and risk prevention as well as the Airline SMS efficiency, and if necessary to take the corrective measures designated to improve the abovementioned processes.

5.2.2 To draw the flight crews' attention to the fact that in-depth awareness of A/C aerodynamic performance is needed, and that it is very unsafe to simplify or violate stipulated flight rules and AFM requirements during the flight preparation as well as during the flight.

5.2.3 In cooperation with mangers of organizations providing maintenance and ground handling for A/C to assure the compliance with requirements of the airline documentation for maintenance and ground handling with close attention to A/C de-/anti-icing procedures and to personnel training.

### 5.3. To ATR 42/72 A/C Operators

5.3.1 In cooperation with ATR Company to organize a conference for flight and engineering specialists for the purpose of sharing experience of ATR 42/72 A/C operation.

5.3.2 In coordination with FATA, to introduce into the flight data express-analysis monitoring of A/C anti-icing system usage in de-icing mode while on ground followed by analysis of each individual case.

5.3.3 To prescribe a mandatory completion of "takeoff with non-removed contaminants on horizontal stabilizer" exercise during the transition and recurrent simulator training with explanation of physical aspects of pitch forces changing.

### 5.4. To UTAir Airlines, JSC

5.4.1. To update the Airlines' SMS with consideration of shortcomings highlighted by the investigation.

5.4.2. To review flight personnel transition and recurrent training programs for foreign manufactured A/C as well as for new type of domestic aircraft in terms of

- A/C aerodynamics features;

- A/C behavior when approaching to critical flight modes;
- recognition of warnings triggered when approaching to critical flight modes and pertinent recovery procedures;
- knowledge of A/C anti-icing system philosophy, limitations and efficiency;
- "Clean A/C" concept, ground icing influence on A/C aerodynamic behavior and conditions of de-/anti-icing treatment decision-making and procedures as well as procedures of coordination with ground personnel.

5.4.3. To prescribe a mandatory completion of "takeoff with non-removed contaminants on horizontal stabilizer" exercise during the transition and recurrent simulator training with explanation of physical aspects of pitch forces changing.

5.4.4. To draw attention of flight instructors and crews to the fact that the analysis of the circumstances of certain accidents, related to the stalls, occurred in domestic and international aviation, showed that the current simulator training procedures to recognize and recover from situations in question are not very effective. In most cases the crews that underwent such a training in a real flight failed to identify the approach to stall and take correct actions on aircraft recovery to flight envelope that is yet more proof of the importance of taking all the possible measures to avoid entering into critical flight modes.

5.4.5. To pay attention to the quality of flight instructor's work; to provide recurrent inspections performed by senior command personnel of trainees commissioning; to introduce pilot-instructors' reporting during debriefing with use of training and commissioning flights' data analysis. To draw the pilot-instructors' attention to the importance of practical training on A/C de-/anti-icing procedures when commissioning flight personnel and of keeping pertinent records.

5.4.6. To pay attention to the quality of debriefings and training and ensure they use all available training facilities and documentation; to eliminate formalities during debriefing.

5.4.7. To develop and implement a common format of flight personnel commissioning documentation that will allow to assess the commissioning process (for example, recording type of approach system used as well as approach modes: e.g., A/P, FD etc., as well as meteorological conditions etc.).

5.4.8. To provide keeping records of approaches made by PICs in actual conditions of assigned weather minima.

5.4.9. To use Fatigue Risk Management System (FRMS) Implementation Guide issued in July 2011 by ICAO, IATA and IFALPA in order to monitor flight personnel fatigue risks.

5.4.10. Before flights performing in periods when ground icing is possible to perform inspections (audit) of all destination APs and subcontractors of ground handling for availability of trained personnel and facilities for A/C de-/anti-icing treatment.

5.4.11. To develop procedures to check A/C conditions after anti-icing treatment depending on the AP and the maintenance organization facilities.

5.4.12. To assure the strict compliance with flight personnel work and rest limitations as well as to arrange vacations for crew members in a timely manner.

5.4.13. When appointing crew members for flights to take into account the influence of social factors (such as a birthday, a wedding etc.) on the psychoemotional state of personnel.

5.4.14. Within a framework of Airline SMS to guarantee the quality of work performed by subcontractors and their compliance with procedures established by the Airline paying special attention to de/anti-icing treatment.

5.4.15. To review the quality of operation of Airline Directorates.

5.4.16. To rectify other shortcomings revealed during the investigation.

### 5.5. To Roschino (Tyumen) AP General Director

5.5.1. To consider the possibility of establishing of ground handling organization that will meet the State requirements.

### 5.6. To FATA Regional offices

5.6.1. To provide strict compliance with the requirements of Para 2.3.1 of RF Government Degree No.609 (PRAPI-98) of 18.06.1998 in terms of initial actions and governing of all means and facilities of agencies taking part in the search and rescue operations.

5.6.2. To check APs and Airlines for the emergency response plans.

### 5.7. To State ATM Corporation

5.7.1. To guarantee strict compliance with ATC Procedures for the ATC officers when preparing for duty and during their duty shifts particularly when maintaining radio communications.

### 5.8. To EMERCOM RF

5.8.1 With involvement of IAC, FATA and Investigative Committee of RF, to conduct training for command staff of services that perform search-and-rescue operations at the accident site intended to study the procedures of coordination with the said services especially in terms of documenting the search and rescue operations, A/C fragments displacement and structure cutting operations.

### 5.9. To ATR

5.9.1 To consider the reasonability of introduction into the appropriate documentation (FCOM, FCTM, Cold Weather Operations etc.) the description of detrimental effects of ground icing accretion on different aircraft parts as well as its influence on the A/C performance and handling.

### 5.10. To the certification authorities of States of Design

5.10.1 To review the current procedural approach to checking aircraft surfaces on contaminants accretion before the flight and to monitoring aircraft state after de/anti-icing treatment and to consider the introduction of a requirements to mandatory equip at least those A/C types whose aerodynamic performance is very sensitive to ground icing with an on-board system for automatic detection of ground icing conditions and notifying flight crews.

### 5.11. To EASA and other simulator certification authorities

5.11.1 To consider the possibility to add into the simulator data-package the capability to simulate an unexpected or sudden aircraft stall at any stage of flight[38].

### 5.12. To ICAO

5.12.1 To consider the reasonability of amending Annex 6 to the Convention on International Civil Aviation related to mandatory installation of an AOA indicator in the cockpit.

### 5.13. To the Head of Personnel Training Center, NPP (Tyumen)

5.13.1 Correct the shortcomings contained in the present report.

[38] See also NTSB A-10-022 recommendation given as a result of DHC-8-400 N200WQ accident investigation which happened on February 12, 2009 .