

FINAL REPORT

Investigation of a serious incident, occurred on January 26, 2019 at Sofia Airport, Bulgaria, involving the AIRBUS 320-232 aircraft, registration marks G-EUUL, operated by “BRITISH AIRWAYS PLC”



Purpose of Report and Responsibility Level

Under Annex 13 of the Chicago Civil Aviation Convention of 07.12.1944, Regulation 996/20.10.2010 of the European Parliament and the Council on the investigation and prevention of accidents and events in Civil Aviation and Ordinance No. 13/27.01.1999 of MT (last amendment and addition - 22.01.2016), the investigation of an aviation event aims at identifying the reasons that led to the event to eliminate and exclude these in future **without identifying someone's guilt or liability**.

01.List of abbreviations

AAIU	- Aviation Accident Investigation Unit;
ALT	- Altitude;
AMRAIU	- Aircraft, Maritime and Railway Accident Investigation Unit;
AMRAUD	- Aircraft, Maritime and Railway Accident Investigation Unit Directorate
ARP	- Aerodrome reference point;
ATC	- Air traffic control;
ATIS	- Automatic terminal information service;
ATPL(A)	- Airline Transport Pilot Licence
BULATSA	- Bulgarian Air Traffic Services Authority;
CAA	- Civil Aviation Authority;
CPL(A)	- Commercial Pilot Licence;
CVR	- Cockpit Voice Recorder;
DG CAA	- Directorate General Civil Aviation Administration;
EASA	- European Aviation Safety Agency;
EGLL	- London Heathrow Airport;
EGT	- Exhaust Gas Temperature;
FBL	- RA-light rain
FDR	- Flight Data Recorder;
FEW	- Cloud amount - few (1-2 oktas),
FH	- Flight Hour
ft	- Foot;
GSE	- Ground Support Equipment;
ICAO	- International Civil Aviation Organization;
KT	- Knots;
LBSF	- Sofia Airport
MAG	- Magnetic course
METAR	- Aviation routine weather report
MPL(A)	- Multi-pilot licence;
MSN	- Manufacturer Serial Number;
MTITC	- Ministry of transport, information technology and communications;
NOTAM	- Notice to airmen (съобщение за екипажите);
OVC	- Overcast;
p.	- page;
PAPI	- Precision approach path indicator;
PPL(A)	- Private Pilot Licence;

QNH	- Altimeter sub-scale setting to obtain elevation when on the ground;
RWY	- Runway;
SCT	- Cloud amount-scattered (3-4 oktas),
SN	- Snow;
SNOWTAM	- A special series NOTAM notifying the presence or removal of hazardous conditions due to snow, ice, slush or standing water associated with snow, slush and ice on the movement area, by means of specific format;
SRIS	- Safety Recommendations Information System;
TDZ	- Touchdown zone;
TEMPO	- Temporary or temporarily;
TWY	- Taxiway;
UTC	- Universal Coordinated Time;
VC	- Vicinity of the aerodrome;
MTOM	- Maximum Take-Off Mass;

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1. Introduction

Date and time of the aviation event: on January 26, 2019, 12:03 h UTC. All times in the report are given in UTC.

Notified: Aircraft, Maritime and Railway Accident Investigation Unit Directorate (AMRAUD) and Directorate General "Civil Aviation Administration" (DG CAA) of the Republic of Bulgaria, the European Commission, the European Aviation Safety Agency (EASA), The International Civil Aviation Organization (ICAO), the National Bureau of Aviation Occurrences Investigation (BEA) of the Republic of France and the Air Accidents Investigation Branch of the UK.

On the grounds of the provisions of Article 9, para.1 of Ordinance No. 13, dated 27.01.1999, on Investigation of Aviation Accidents; the occurrence was classified as a serious incident by the Aircraft Accident Investigation Unit at the Aircraft, Maritime and Railway Accident Investigation Unit Directorate (AMRAIU) at the Ministry of Transport, Information Technology and Communications. The materials on the aviation occurrence have been filed in case No. 01/26.01.2019 in AAIU archives.

In accordance with the provisions of Article 5, para.1 of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, Article 142. Para. 2 of the Civil Aviation Act of the Republic of Bulgaria, dated 01.12.1972, and Article 10, para. 1 of Ordinance No. 13 of the Ministry of Transport, dated 27.01.1999, on the Investigation of Aviation Occurrences, by Order No. RD-08-52, dated 07.02.2019 of the head of AMRAUD at MTITC, a Commission is appointed for investigation of the serious incident.

Summary:

On January 26, 2019, the Airbus A320-232 aircraft, registration marks G-EUUL, operated by „British Airways PLC“ was prepared for a flight from Sofia (LBSF) to London (EGLL). After completion of pre-flight ground service, the aircraft is pulled with a tug from the stand No3 on partially ice and snow-covered to the taxiway L. During pushback manoeuvre, the aircraft's engines was being started and were brought to ground idle mode. On slippery apron surfaces, the aircraft began to move slowly forward and collided in the pushing tug. The nose gear and the inlet cowl of engine No 2 nacelle of the aircraft have been damaged. The damage to the aircraft did not allow the flight to be performed. There were no consequences for the flight crew, the passengers and the ground handling crew. The flight was cancelled and the passengers were returned to the terminal.

Because of the investigation, the Commission considers that the serious incident is due to the following reason:

1. Lack of coordinated actions between the flight crew and the ramp agent on the order and procedure of engine start-up during the aircraft push on frozen ground areas;
2. Insufficient and poor quality cleaning and removal of icing on aircraft stand No 3.
3. Starting the aircraft engines while pushing the aircraft on the icy slopes of the aircraft stand and taxiway.
4. Loss of control by the driver of the tractor, due to the use of brakes on the icy area.

2. Factual information

The commission received information about the realization of an aviation occurrence from the flight data records, CVR, written explanations from the flight crew, ground crew serving the flights, witnesses of the event, data from the BULATSA and video cameras at Sofia Airport.

2.1.1. Flight number and type, the last point of departure and time, and planned destination point

Flight Number: BAW891.

Type of flight: Commercial Air Transport - Passenger – Airline-Schedule

Last point of departure: Sofia Airport (LBSF), Bulgaria.

Take-off time: planned at 12:05

Planned destination point: London Heathrow Airport (EGLL)

2.1.2. Flight preparation and description of the flight

On January 26, 2019, an Airbus A320-232 aircraft with registration marks G-EUUL, operated by „British Airways PLC“ was located at parking Stand № 3 at Sofia Airport and was prepared for carrying out the scheduled flight from Sofia (LBSF) to London Airport (EGLL). There were 150 passengers and 7 flight crew members on board.

The aircraft was parked with its nose to the southwest. Due to rainfall on the previous day, which turned to snow after midnight, and low temperatures on the apron (below 0°), the parking stand and taxiways have formed blocks of ice covered with snow.

According to the review of the recording by the security cameras, the flight crew performed a pre-flight external check from 11:22:13 UTC to 11:28:13 UTC.

At 12:00 UTC, after the end of pre-flight ground handling, the ground crew of Ground Handling Operator Sofia Airport EAD positioned an aircraft tractor „SHOPF- 110“ No 013 with towbar to push the aircraft from stand No3 to the adjacent taxiway TWY L, for subsequent taxiing to runway and take-off.

After attaching the towbar to the nose landing gear of the aircraft and an indication of the readiness of the flight crew (i.e. released brakes), the aircraft was pushed out of the aircraft stand with instructions from the Ramp Agent to position it with the nose to the 'south'.

While the aircraft was being pushed in a straight axis towards the rear end (red borderline in Fig. 1), the flight crew started the starboard engine No2 on the aircraft stand. After crossing the borderline with TWY L, the main landing gear of the aircraft began to climb up the slope to centreline of the taxiway.

At this point, the driver of the tug began a manoeuvre to turn the nose of the aircraft along the yellow line of the southern arc, to the centreline of the taxiway TWY L, pointing the aircraft's nose to the south. When the tires of the main landing gear of the aircraft were at the highest point of the slope taxiway, the crew started the left engine No1 of the aircraft.

At this time, the tug entered an icy surface pavement area where it began to slip in place, while the aircraft stopped moving backwards. The tug failed to continue pushing and even began to slide backwards, pushed by the force of the forward-moving aircraft.

The tug driver attempted to stop the tractor and the aircraft by pressing the brakes. The tractor stopped, but the aircraft continued to move forward. Since the tug had stopped and the rear end of the towbar was attached to it, the front end rotated the nose landing gear 90° degrees to the direction of movement of the aircraft.

However, the aircraft continued to slide forward along the icy surface, breaking two of the tear bolts (pins) of the towbar, which started diverting backwards. The plane continued its forward movement, passing the tug, which remained on the side of its starboard side until the attacking edge of the inlet cowl of the starboard engine collided into the left side of the tractor. Then the aircraft stopped moving.

At that time, the ramp agent reported the incident to the flight crew and requested from the flight crew to stop the engines, which was carried out at once.

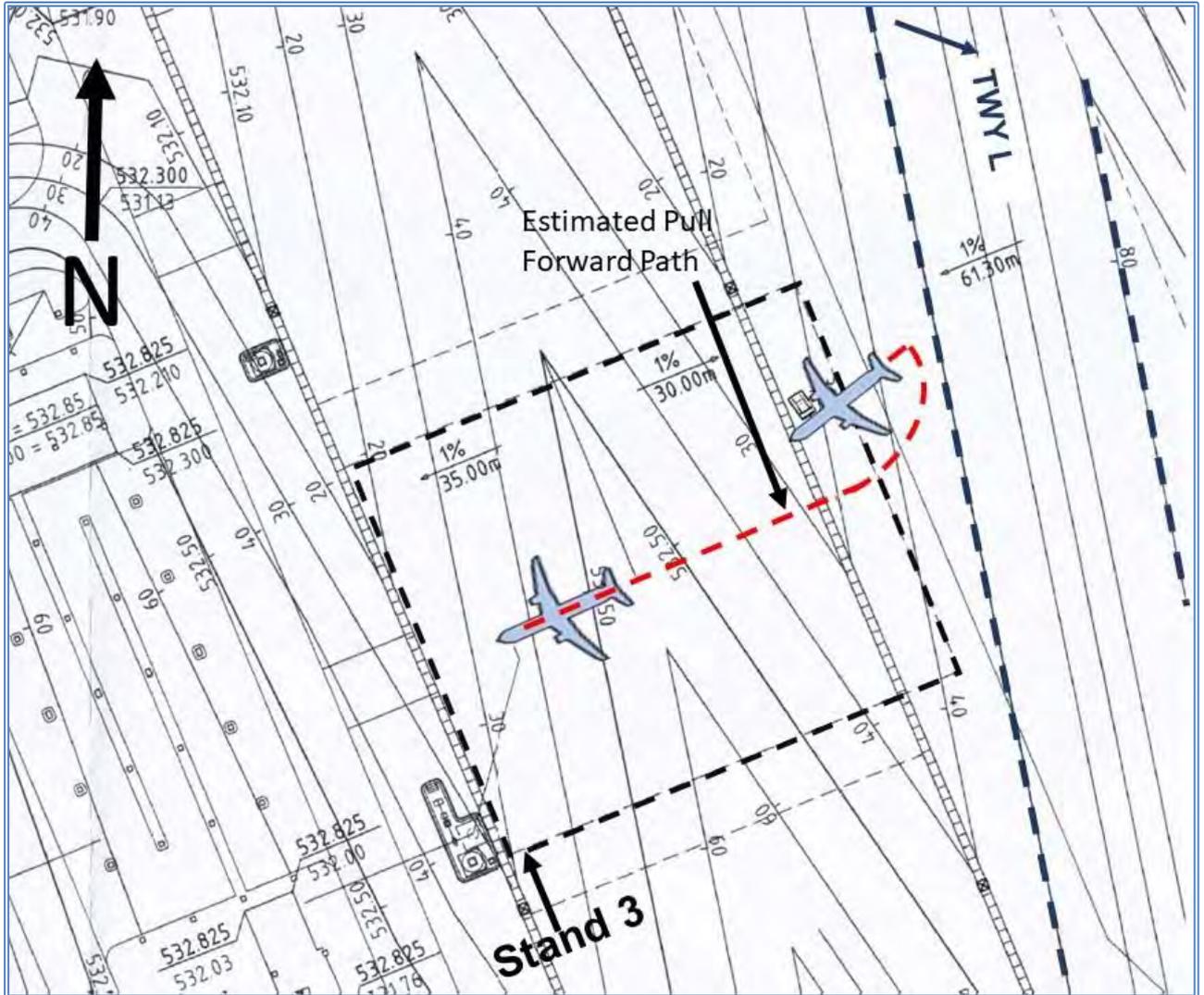


Fig.1 Path of the aircraft during the push from stand No 3 to TWY “L”

2.1.3. Location of aviation occurrence

Location: Sofia Airport (LBSF) Bulgaria, Aircraft stand No 3;
 Date and time: 26 January 2019, 12:02 UTC;
 Lighting conditions: Daylight;
 The control point is with coordinate’s 42°41’28,60”N 023°24’50,86”E.

2.2. Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Total in the aircraft</i>	<i>Others</i>
<i>Fatal</i>	0	0	0	0
<i>Serious</i>	0	0	0	0
<i>Minor</i>	0	0	0	0
<i>None</i>	7	150	157	<i>Not applicable</i>
<i>Total</i>	7	150	157	0

2.3. Damage to aircraft

During the inspection of the aircraft at the aircraft stand No 3 at Sofia airport, the following damage were found:

- The lower part of the nose wheel is rotated at an angle greater than 90° and remains in this position. This can be seen in fig. 9 of Appendix 1.
- Dent on inlet cowl of Engine No 2 nacelle. Fig. 1, fig. 3 and fig. 4 of Appendix 1.

2.4. Other damages

Aircraft towbar tractor „SHOPF- 110“ with towbar performing pushback on an Airbus-320 aircraft type undergoes the following defects as a result of the incident:

- Torn fail-safe tear bolts on the towbar.

2.5. Personnel information:

2.5.1. Commander

Man	40 years old
License:	ATPL (A); CPL (A); PPL (A) Issued on 21.10.2008 by United Kingdom CAA Valid until 30.09.2019
Qualifications:	A320 LR/PBN.
Medical Validity:	Class 1, valid to 25.01.2020
Medical restrictions:	None.
Proficiency in English:	English Level 6.
Flight experience:	
Total Flying Hours:	11 864,55 FH.
Total Flying Hours on Type:	4911:55FH
Information on the working hours and rest:	
For the last 24 hours:	2:55 FH;
For the last 90 days:	42:50 FH.
Rest time prior to duty on 26 Jan 2019:	More than 48 hours as it was his first day back after leave.
Aviation events until present:	No information.

The Commission assumes that the captain possess the required qualification and medical fitness for flights in accordance with existing regulations.

2.5.2. Co-pilot

Man	33 years old
License:	ATPL (A); MPL (A). Issued on 07.05.2015 by United Kingdom CAA Valid until 30.11.2019
Qualifications:	A320 LR/PBN.
Medical Validity:	Class 1, valid to 20.04.2019
Medical restrictions:	None.
Proficiency in English:	English Level 6.
Flight experience:	
Total Flying Hours:	2781:42FH.
Total Flying Hours on Type:	2699:12FH
Information on the working hours and rest:	
For the last 24 hours:	2:55 FH;
For the last 90 days:	161:12 FH.
Rest time prior to duty on 26 Jan 2019:	More than 48 hours as it was his first day back after leave.
Aviation events until present:	No information.

The Commission assumes that the co-pilot possess the required qualification and medical fitness for flights in accordance with existing regulations

2.5.3. Pushback/Towbar tractor operator:

Man – Age: 55

Driver's license obtained categories: „AM, B1, C1, C, D1, D, BE, C1E, CE, D1E, DE, ТКТ*” from 13.12.2016.

Employed by “Sofia Airport” EAD on 17.09.1985;

Employee of “Sofia Airport” on position „GSE/ Ground Support Equipment/ driver“/ sector „GSE“/ Department „Apron services“/division „Ground Handling“/

During 17-19 August 2004 the driver has successfully passed an initial course for operation with a pushback/ towbar tractor and has been granted permission for operation without supervision;

During 2-30 April 2018 – the driver has successfully passed a refresher course for operation with a pushback/towbar tractor

The employee has 34 years of experience as a GSE operator at Sofia Airport.

During the month of January 2019, the driver has been working on a shift based working time.

Before the incident, the employee has had a total of 48 hours of rest time between shifts and has begun the new working shift at 7:00AM local time.

A test has been performed on the employee to determine any alcohol presence in their system, with negative results.

2.5.4. Ramp Agent

Man – age: 27.

Employee of “Sofia Airport” on position „Ramp Agent“/Department „Ramp control“/ division „Ground Handling“

Employed by “Sofia Airport” EAD on 28.06.2018; and left on the 1-st of December in 2019

On 31.08.2018, the ramp agent has successfully passed a course for “Headset and operations during pushback of aircraft on remote and contact stands”;

The employee has 7 months of experience as a Ramp agent at Sofia Airport (until the time of the incident) and previous experience of 3 years 7 months at other ground handling operators.

During the month of January 2019, the driver has been working on a shift based working time.

Before the incident, the employee has had a total of 12 hours, of rest time between shifts and has begun the new working shift at 9:00AM local time.

2.6. Aircraft Information**2.6.1. Airworthiness Information**

Aircraft type:	AIRBUS A320-232
Registration	G-EUUL
Serial number:	1708
Manufacturer	Airbus SAS
Produced:	December, 2002
Operator:	BRITISH AIRWAYS PLC
Total flown hours:	41113 hours
Certificate of Registration:	Certificate Number G-EUUL/R1 issued by United Kingdom Civil Aviation Authority December 2002;
Certificate of Airworthiness:	№ 054200/03 issued on December 05, 2007 by United Kingdom Civil Aviation Authority;
Certificate of Airworthiness validity check:	ARC-G-EUUL/UK.MG.0037/23112017, issued by United Kingdom Civil Aviation Authority, on December 06, 2018 valid until December 19, 2019;
Maximum Takeoff Mass	73500kg.
Landing Mass	64500kg.
Engines:	Model V2527-A5;

According to the information from the Loadsheets the mass of the aircraft during pushback manoeuvre was 70620 kg.

The aircraft AIRBUS A320-232, registration G-EUUL, operated by BRITISH AIRWAYS PLC was airworthy at the time of the realization of the occurrence;

2.7. Meteorological information

2.7.1. Weather conditions at Sofia Airport

On 26.01.2019, Sofia Airport is influenced by a Mediterranean cyclone passing south from Bulgaria. The meteorological conditions at Sofia Airport in the time frame 11:00-12:30 UTC were: westerly winds 13-15kt, visibility 8km, reduced in periods of snowfall to 4600m. During the period of interest, it is snowing with light intensity. The clouds are scattered at 2200-2500ft and overcast at 2400-3000ft. Temperature is between minus 3 and minus 2°C. Pressure (QNH) – 1004hPa. Runway state information is included in METAR messages, which says that the runway is wet and the braking action is good.

Previous day analysis – on 25, at Sofia Airport was raining with positive temperatures, which in the end of the day – at 22:00-24:00 UTC changed to freezing rain, than changed to snow and temperatures dropped below zero. From 00.00 to 19.30UTC on 26 was a period of snowfall with variable intensity and temporal clearings. Considering the rain and the freezing rain event before the snowfall started, there is a high probability, that in the area of Sofia airport there are patches of ice covered by snow.

2.7.2. Aviation routine weather report METAR at Sofia Airport

Interval of issuance from 11:00 to 12:30 UTC on January 26 2019

LBSF 261100Z 27015KT 4600 -SN FEW022 SCT025 OVC030 M03/M05 Q1004 R99/29//95
TEMPO 3000 SN=

LBSF 261130Z 27014KT 5000 -SN SCT025 BKN029 OVC034 M02/M05 Q1004 R99/29//95
TEMPO 3000 SN=

LBSF 261200Z 27013KT 8000 SCT021 OVC024 M02/M05 Q1004 R99/29//95 TEMPO 3000 SN=

LBSF 261230Z 27014KT 8000 -SN OVC022 M02/M05 Q1004 R99/29//95 TEMPO 3000 SN=

2.7.3. ATIS emission

[F] 2019-01-26 11:00:00	[G] 2019-01-26 11:30:01	[H] 2019-01-26 12:00:00
-DTMF 06	-DTMF 07	-DTMF 08
-This is Sofia information F	-This is Sofia information G	-This is Sofia information H
-ATIS Report at 1100Z	-ATIS Report at 1130Z	-ATIS Report at 1200Z
-ILS Z approach.	-ILS Z approach.	-ILS Z approach.
-Runway in use 27	-Runway in use 27	-Runway in use 27
-Braking action is good. The RWY is wet. Flock of birds in VC of the RWY, ALT unknown.	-Braking action is good. The RWY is wet. Flock of birds in VC of the RWY, ALT unknown.	-Braking action is good. The RWY is wet. Flock of birds in VC of the RWY, ALT unknown.
-Transition Level 140	-Transition Level 140	-Transition Level 140
-PAPI RWY 09 out of use	-PAPI RWY 09 out of use	-PAPI RWY 09 out of use
-TDZ 270/15KT	-TDZ 260/15KT	-TDZ 270/11KT
-4600M	-5KM	-8KM
-FBL SN	-FBL SN	
-SCT 2300FT OVC 3000FT	-SCT 2500FT BKN 2900FT OVC 3400FT	-SCT 2100FT OVC 2400FT
-Temperature -3	-Temperature -2	-Temperature -2
-Dewpoint -5	-Dewpoint -5	-Dewpoint -5
-QNH 1004 hPa	-QNH 1004 hPa	-QNH 1004 hPa
-There is MOD ICE ABV 10000ft.	-There is MOD ICE ABV 10000ft.	-There is MOD ICE ABV 10000ft.
-TREND TEMPO VIS 3000M MOD SN	-TREND TEMPO VIS 3000M MOD SN	-TREND TEMPO VIS 3000M MOD SN
Inform Sofia Approach-Info F	Inform Sofia Approach-Info G	Inform Sofia Approach-Info H

2.7.4. SNOWTAM

Due to the presence of hazardous conditions on the movement area of the airport associated with snow, slush and ice and poor braking effect on the aprons of Sofia Airport, the Operations Centre at 07:40 UTC disseminated a SNOWTAM in accordance with ICAO Annex 15, Appendix 2.

LBSFCORD LBSFLZKO
260750 LBSFYNYX
SWL0053 LBSF 01260740
(SNOWTAM 0053)
A) LBSF
B) 01260740
C) 09
F) 2/2/2
H) 5/5/5
N/ 59/POOR
R/ 59/POOR

The meteorological conditions at the time of the realization of the occurrence contributed to the serious incident.

2.8. Aids to navigation

This has no relation to the realized of the occurrence.

2.9. Communications

The air-ground radio communication between the flight crew and ATCO-Tower at LBSF was carried out at the frequency of 118,000 MHz.

After hearing the audio recording downloaded from CVR, the Commission found that during the realization of the event there was a constant radio communication between the flight crew and the ground crew. There was no interruptions and disturbances during the radio exchange.

The records have been attached to the investigative material.

2.10. Aerodrome information

Aerodrome Location Indicator and Name – LBSF/СОФИЯ/SOFIA;
ARP coordinates and site at aerodrome - N42°41'42" E023°24'30", RWY centre;
Elevation - 1742 ft (531m);
Designations / RWY 09/27 - MAG 091°/271°;
Dimensions of RWY (m) - 3600 x 45 m;

The Ground Handling Operator “Sofia Airport” EAD provided Built Drawing. Aircraft stand No 3 / which has a concrete pavement / and in the middle of the stand there is a bilateral slope of 1.00%, directed to the two side drainage grids. The longitudinal slope is about 0.30%, and the direction of fall is to stand No 4. In the middle of the taxiway, TWY L there is a slope of 1.00% directed to the stand No 3.

At the time of realization of the aviation occurrence, the aircraft stands and taxiways are covered with beaten snow and there are the iced areas.

2.10.1. Maximum Slope on Airport Taxiways, Aprons and Stand.

European Aviation Safety Agency (EASA) certification specifications & guidance material for aerodrome design (CS-ADR-DSN) Book 1, states:

1. Chapter D — Taxiways, CS ADR-DSN.D.280 Transverse slopes on taxiways

- (a) The safety objective of taxiway transverse slopes is to promote the most rapid drainage of water from the taxiway.
- (b) The transverse slopes of a taxiway should be sufficient to prevent the accumulation of water on the surface of the taxiway but should not exceed:
 - (1) 1.5 % where the code letter is C, D, E, or F; and
 - (2) 2 % where the code letter is A or B.

2. Chapter E – Aprons, ‘CS ADR-DSN.E.360 Slopes on Aprons’

- (a) Slopes on an apron, including those on an aircraft stand taxilane, should be sufficient to prevent accumulation of water on the surface of the apron but should be kept to the minimum required to facilitate effective drainage.
- (b) On an aircraft stand, the maximum slope should not exceed 1 % in any direction.

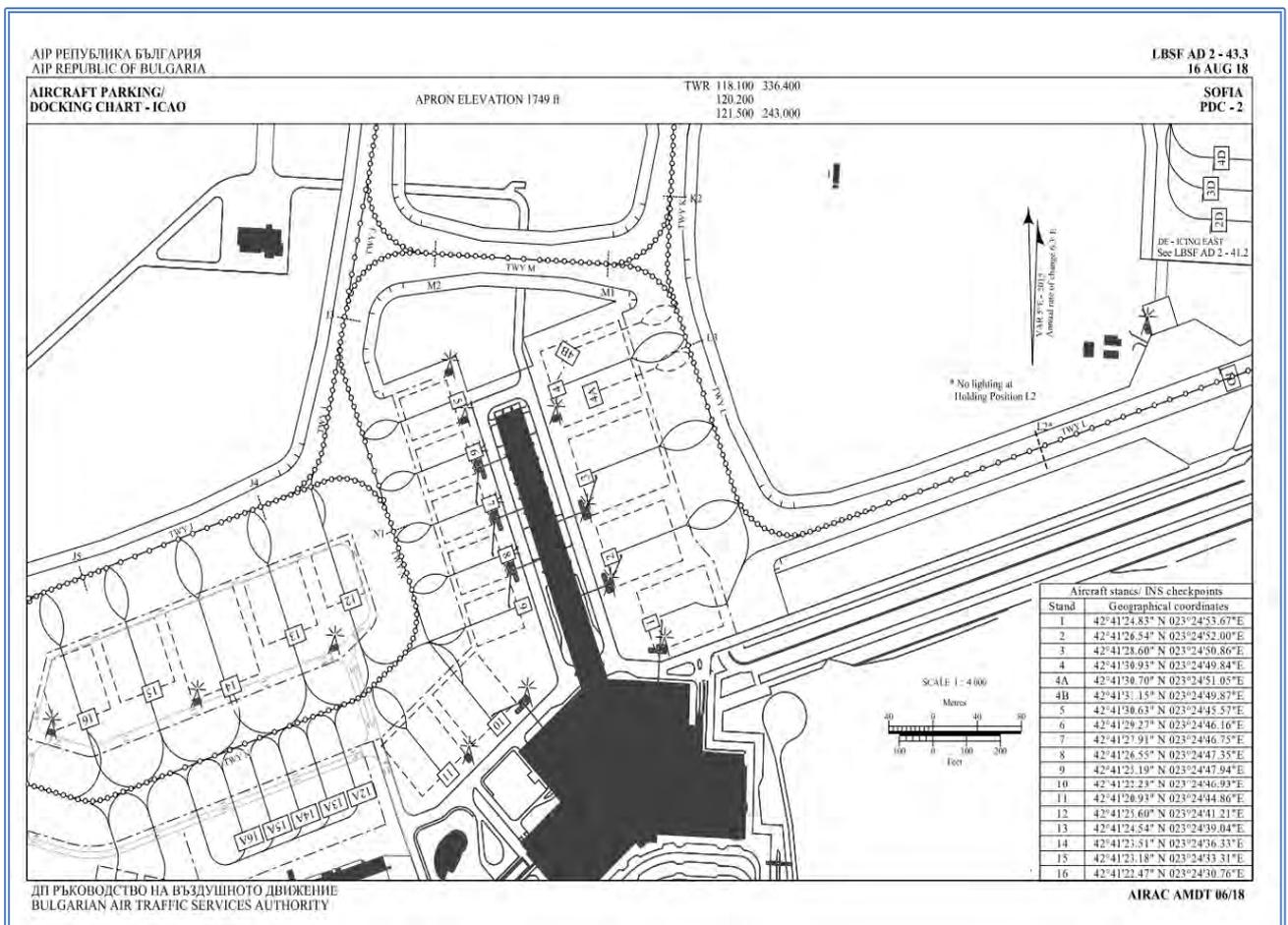


Fig.2 Aircraft Parking Docking chart

2.11. Flight recorders

2.11.1. FDR Trace

A trace provided from AO British Airways on the subject was used for the analysis: Park brake, Magnetic heading, Fuel flow, N1 both engines, N2 both engines and EGT both engines.

This data indicated that the starboard engine was being started during the pull forward manoeuvre.

The maximum engine rotation speeds reached during the start procedure were recorded as 62% N2 and 25% N1. After 1:35 min when the tires of the main landing gear of the aircraft are at the highest point of the slope of the taxiway TWY L, the flight crew was started the engine No 1 of the aircraft, with the maximum rotation speed was reaching approximately 62% N2 and 25% N1.

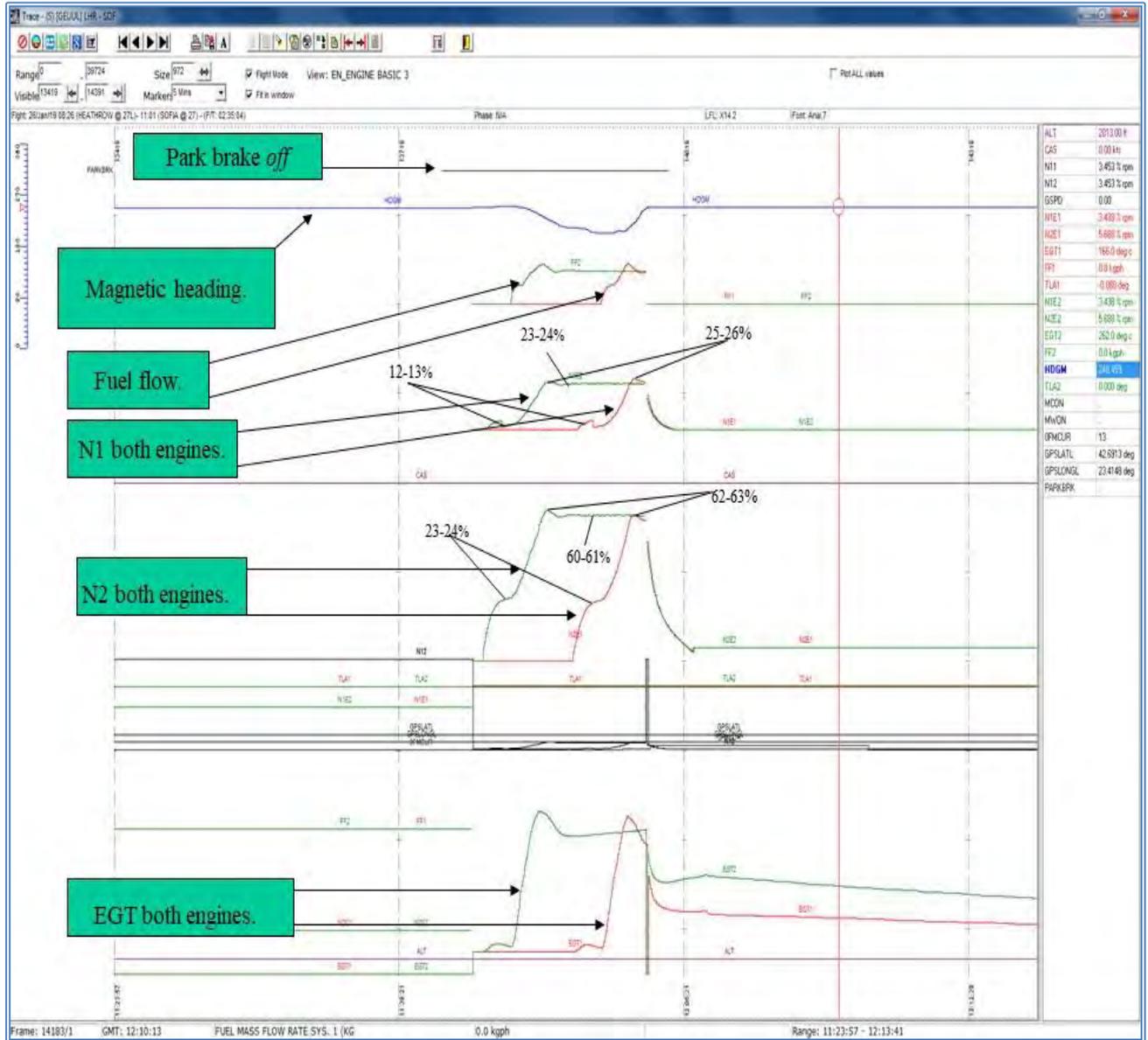


Fig.3

2.11.2. CVR (Cockpit Voice Recorder)

1. Recorder description (CVR):

Recorder Manufacturer/Model: Honeywell 6022, p/n: 980-6022-001

Recorder Serial Number: 15834

This model CVR, the Honeywell 6022, is a solid state CVR that records 120 minutes of digital audio. Specifically, it contains a 2-channel recording of the last 120 minutes of operation and separately contains 3-channel recording of each crew audio panel –captain, first officer, and jump seat – for the last 30 minutes of operation. The 120-minute portion of the recording is comprised of one channel that combines all three audio panel sources, and a second channel that contains the cockpit area microphone (CAM) source.

2. Recorder condition

Provided for transcript only file SSCVR-02052019090147_G-EUUL_CVR.dlu. Data file quality checked with DLU pattern search tool. Check pass. 0 files found with the B6 DB 6D Pattern. 0 files found with the 49 24 92 Pattern

3. Audio recording description each channel’s audio quality is indicated in table.

Channel Number	Content/ Source	Quality	Duration
1	HOT	Excellent	30 min
2	HOT	Excellent	30 min
3	HOT	Excellent	30 min
4	COMPBINED	Good	120 min
5	CAM	Good	120 min

4. Timing and correlation

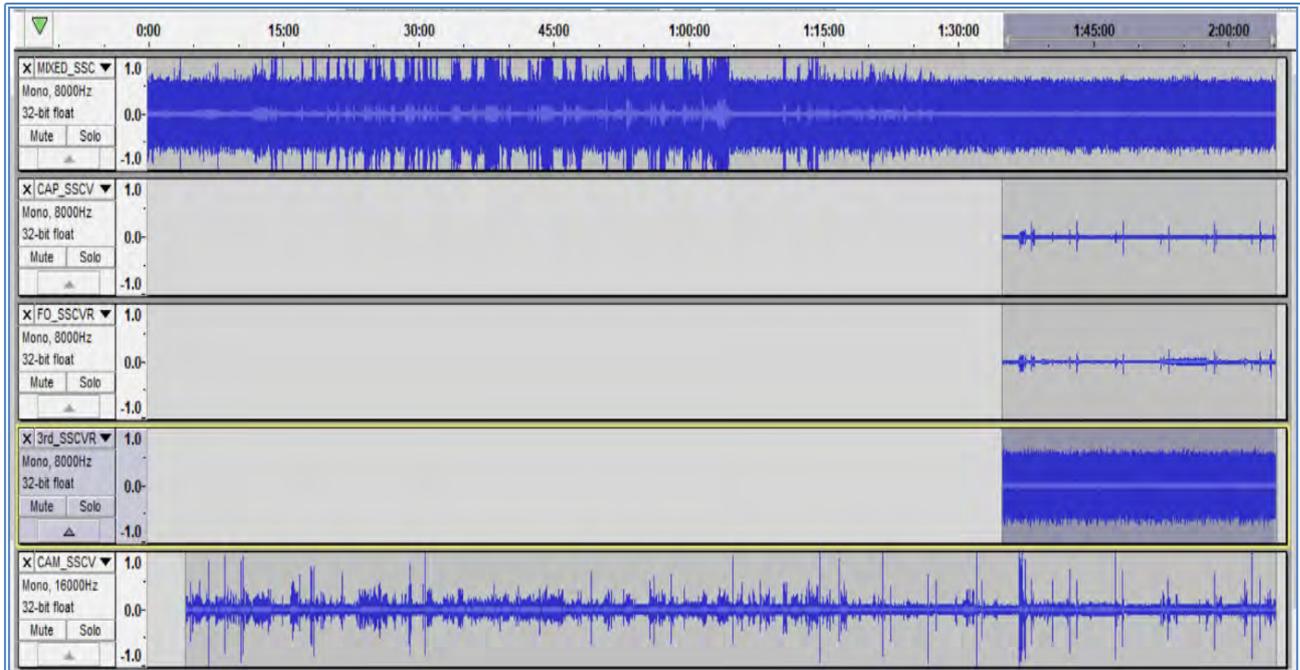


Fig.4

Timing of the transcript established since the beginning of the recording on Mixed channel (end of recordings are all aligned). Further correlation with FDR data or ATC data UTC time could be needed.

5. Description of Audio Events

A transcript covering the period from the initial call of the crew for departure clearance to the power interruption of the CVR (five minutes after last engine shut down)

The time is correlated according to the ATC data provided in UTC.

11:52:44 initial call of Speedbird 891 to Sofia tower requesting clearance to London, Heathrow.

12:02:55 starting engine number two.

12:04:30 starting engine number one.

12:05:31 crew observe tug sliding in proximity to engine number two.

12:06:00 both engines stopped.

12:10:03 Begins announcement to the passengers that the towing is stopped.

12:11:01 recording stops. Next audio is with ground staff speech.

CVR Factual Report has been attached to the case for investigation of the aviation occurrence

2.12. Wreckage and impact information

The impact of the tug is in the starboard of the aircraft. The damages caused by the impact were described in paragraph 2.3.

2.13. Medical and pathological information

There are no injuries and medical consequences for the crew, passengers and ground handling crew as a result of the realized occurrence. Medical and pathological examinations are not performed.

An alcohol test was performed on the tug driver at 14:14 h UTC by alcohol analyst Dreger- Alkotest 7410. The measured level of alcohol in the blood was 0,00 (‰) promille

An alcohol test was performed on the ramp agent at 14:42 h UTC by alcohol analyst Dreger- Alkotest 7410. The measured level of alcohol in the blood was 0,00 (‰) promille

No alcohol tests were performed on the flight crew.

2.14. Fire

No fire arising.

2.15. Factors for Survival

The occurrence was not related to the need to carry out emergency - rescue actions.

2.16. Tests and research

For the safety investigation, the following activities were carried out:

1. Research and analysis of the reports of the written reports, given by the flight crew.
2. Research and analysis of the operational documentation of the aircraft;
3. Decoding and analysis of the FDR and CVR data;
4. Research and analysis of the reports of the written reports, given by the tug driver and the Ramp Agent;
5. Research and analysis of the reports given by witnesses of the event;
6. Research and analysis of documentation relating to the operation and maintenance of the technical condition of the tug.
7. Research of the training by the driver for the period of his work at Sofia airport;
8. Inspect a recording from a security camera at Sofia Airport;
9. Logical-probabilistic analysis of the possible causes for the realization of the aviation event.

For Item 1 research of the written reports, given by the flight crew at Sofia airport for occurrence are reflected in Para 2.1.2.

For Item 2, the results of the study and analysis of the operational documentations of the aircraft are reflected in Para 2.6.

For Item 3 the result of decoding and analysis of the FDR and CVR are reflected Para 2.1.2. and 2.11.

For Item 4 research of the written reports, given by the tug driver and the ramp agent for occurrence are reflected in Para 2.1.2.

For Item 5 research and analysis of the reports given by witnesses are reflected in Para 2.1.2.

For Item 6 research and analysis of documentation relating to the operation and maintenance of the technical condition of the tug are reflected in Para 2.18.

For Item 7 research of the training by the driver for the period of his work at Sofia airport are reflected in Para 2.5.

For Item 8 review of recordings from the security cameras at Sofia Airport are reflected in Para 2.2.1.

Logical and probabilistic analysis of the possible causes for the serious incident is given in Chapter 3 of this Report.

The materials from the interviews and analyses have been attached to the case for investigation of the serious incident.

2.17. Organizational and management information.

The organization and control for movement in the moving area of Sofia airport are described in the “Instruction for towing/pushing of the aircraft” of Ground Handling Operator “Sofia Airport” EAD and “Procedure for carrying out operations during Adverse Weather Conditions on the area of Sofia Airport”, which is provided to the Commission for investigation, for use of the necessary information for the purposes of the investigation.

Instruction for towing/pushing of the aircraft
Principles of operation

...

4.8 Actions Prior before the start of a relocation operation are:

- Checking the stand surface condition - the presence of ice, snow, etc. The purpose is to determine the safety of the manoeuvre:
- Visual check of the aircraft - all doors and service panels are closed and locked;
- Each Ground Support Equipment, with the exception of the one required for the maneuver, must be located outside the boundary line defining the relevant stop and the maneuvering area;
- Verify that only persons involved in the aircraft movement are located in the maneuvering area;
- To verify that each Ground Support Equipment has been removed from the aircraft and there is sufficient distance between the aircraft moved and the surrounding buildings, aircraft or Ground Support Equipment;
- Foreign Object Damage (FOD check);
- Assurance that the ground power cables, Passenger Boarding Bridge, etc. disconnected from the aircraft;
- Visual inspection that the safety chocks have been removed from the landing gear of the aircraft

The Commission found that there was no detailed description of the procedures for towing/pushing aircraft when carrying out of operations during Adverse Weather Conditions and iced pavements.

2.17.1. Ground Operations Manual-British Airways

British Airways has provided procedures for maneuvering during Adverse Weather Conditions
”

4.6.11 Maneuvering During Adverse Weather Conditions

4.6.11.1 General

During adverse weather conditions (fog, rain, etc.) visibility and traction will be affected.

The Tractor Driver must reduce and adapt vehicle speed as required by the present conditions.

4.6.11.2 Icy Conditions

When maneuvering the aircraft on slippery apron surfaces, extreme caution is required to avoid losing control of the tractor due to skidding. Many elements can contribute to the hazards involved such as strong winds, slippery road surfaces, pavement slopes etc.

Observe the following minimum precautions:

- a. Avoid sudden turns, deceleration or acceleration.

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- b. Except when using an Air Start Unit, do not start aircraft engines unless:
 1. The condition of the pavement is such that reasonable traction is ensured.
 2. The aircraft parking brakes are set and the aircraft is disconnected from tow tractor/towbarless tow tractor.

...”

2.18. Additional information

2.18.1. Information about the towbar tractor

The aircraft towbar tractor „SHOPF-110"with inventory No 013 is owned by Sofia Airport” EAD. It is designed for towing/pushback of aircraft types: Airbus 320 Family (A318, A319, A320, A321), etc., specificity - A320, using towbar – J-TOW320. During preparation for the following autumn-winter operations, the towbar/pushback tractor „SHOPF- 110“, Inventory number № 013 has undergone a scheduled technical maintenance on 1.10.2018

The following maintenance has been performed on the GSE: Wheel regulation, parking break system, greasing.

The Bulgarian GD CAA has issued an annual serviceability license for the GSE valid until December 2019.

3. Analysis

To establish the causes for the realized serious incident, the following aspects were reviewed:

1. Actions of the flight and ground crews prior to the commencement of an aircraft relocation operation.

According to the review of the recording of the security cameras at Sofia Airport, the commander of the aircraft performed an External Pre Flight check of the aircraft and the condition of the parking stand. It appears that during those procedures he may not have noticed that the surface of the stand and its approach were partially frozen. After listening to the CVR, it was established that a relocation operation of the aircraft under these conditions was not discussed at the time of the briefing conducted by Pilot Flying (PF). In addition, the flight crew did not discuss when to start the engines - during the push or after the end of the maneuver - with each other or with the ramp agent.

After the end of the pre-flight ground service and the connection of the tow bar to the nose landing gear of the aircraft, the ramp agent established communication with the flight crew. According to the conducted communication and after a completed inspection, the ramp agent notified the flight crew "*Doors are closed, tow bar is connected*". However, the flight crew was not informed about the condition of the surface of the parking stand, which was partially frozen with snow. It should be noted that the flight crew and the ramp agent did not coordinate the execution of the operation to push the aircraft.

In view of the above, the following conclusion can be made:

Lack of coordinated actions between the flight crew and the ramp agent on the order and procedure of engine start-up during the aircraft push on frozen ground areas, which resulted in a violation of the requirements of the Aviation Operator and the Ground Handling Operator specified in the relevant procedures for manoeuvring during adverse weather conditions.

2. The movement of the two rigid connected vehicles - the aircraft and the towing tractor in the presence of the adverse weather conditions, which led to partial icing on the surface.

In view of the above, it could be stated that the aviation occurrence under investigation is characterized by the unrestrained movement of the aircraft and the towing tug (i.e. different direction).

Normally, the aircraft and the tug should move in the same general direction as a result of the force with which the tug pushes the aircraft. This force should overcome the aircraft's force of traction on the surface, which arises from the plane's mass. In the presence of a slope (and depending on its direction), the horizontal composition of the aircraft's force of gravity is added to the mentioned above force.

In the case of this particular aviation occurrence, the horizontal composite is directed in the opposite direction of the force with which the tug affected the nose gear to push the aircraft to the taxiway. This force depends on the torque of the tractor's wheels and the traction of those wheels on the surface.

In order to reveal the complete picture of the interacting forces, it is necessary to take into account the influence of the thrust force of the running engines. At the beginning of the push of the aircraft, the two engines did not work and did not create the thrust. First the right engine, and subsequently the left engine are brought to "ground idle" mode during aircraft push. In this mode, the engines create an idle thrust, which is barely a few percent of the maximum possible. In other words, despite running sustainably, the engine creates minimum thrust in "ground idle" mode.

As a result of the interaction of the above mentioned forces, it might be the case that the joined force of the two engines and the horizontal component of the force of gravity are greater than the force with

which the tug pushes the aircraft. In such a case, the entire pushing operation could be reversed (i.e. movement in the opposite of the desired direction).

Adverse weather conditions associated with complete or partial icing of the surfaces, on which the movement takes place could have a decisive influence on such an operation. Icing leads to a change in the coefficient of traction, which might exert a force and lead to a change in the overall movement and direction of an object.

It should be noted that the abrupt usage of the tractor's brakes might bring the tractor to a sudden halt and lead to the continuation of the aircraft's movement. This could be attributed to the weight difference of the tractor and the aircraft. In addition, the presence of traction between the two moving physical objects and the mutual rigid connection could lead to a change in the direction of movement.

The analysis carried out so far (and further described in paragraph 2.1.2) may be explained by the nature of movement of the two rigid connected vehicles - the aircraft and the towing tractor in the presence of the adverse weather conditions, which led to partial icing on the surface of aircraft stand No 3.

In view of the above analysis, the dominant factors for the realization of the serious incident could be attributed to mainly to:

1. The presence of frozen areas on the surface of aircraft stand № 3;
2. Brought of ground idle mode of the engines when the aircraft is pushed to the taxiway on a slope and frozen area.
3. The use of brakes by the tractor driver in a situation where the tractor is moving in front of the aircraft.

In view of the above, it is concluded that the serious incident under investigation is the result of the aspects related the above, as follows:

1. Lack of coordinated actions between the flight crew and the ramp agent on the order and procedure of engine start-up during the aircraft push on frozen ground areas;
2. Insufficient and poor quality cleaning and removal of icing on aircraft stand No 3.
3. Starting the aircraft engines while pushing the aircraft on the icy slopes of the aircraft stand and taxiway.
4. Loss of control by the driver of the tractor, due to the use of brakes on the icy area.

4. Conclusion

4.1. Findings

As result of the investigation, the Commission made the following conclusions:

2. The Aircraft AIRBUS A320-232, serial number No 1708, registration G-EUUL was manufactured in year 2002, manufacturer Airbus SAS.
3. The aircraft has Registration Certificate No G-EUUL/R1, issued on December 20 2002 by United Kingdom Civil Aviation Authority.

4. The aircraft is owned by “BRITISH AIRWAYS” PLC
5. The aircraft has a Certificate of Airworthiness No 054200/03, issued on December 05, 2007 by United Kingdom Civil Aviation Authority.
6. Airworthiness review certificate of the aircraft No ARC-G-EUUL/UK.MG.0037/23112017 has been issued on December 06 2018 by United Kingdom Civil Aviation Authority and is valid until December 19 2018.
7. The flight crew of aircraft AIRBUS A320-232, registration G-EUUL, Commander and Co-pilot possess the required qualification and medical fitness for flights in accordance with existing regulations.
8. The aviation occurrence is realized in daylight hours, in the presence of hazardous conditions on the movement area of the airport associated with snow, slush and ice.
9. Operations Centre of Sofia Airport at 07:40 UTC disseminated a SNOWTAM in accordance with ICAO Annex 15, Appendix 2.
10. The meteorological conditions at the time of the realization of the occurrence contributed to the serious incident.
11. The data from FDR and CVR recorders for the flight BAW891 were decoding and using during the investigation.
12. There was no emergency evacuation of passengers and crew;
13. The damage of the aircraft did not allow performing the scheduled flight.
14. The tractor driver is qualified to operate with a pushback/ towbar tractor.
15. In the area of pushing of the stand, there is a bilateral slope of 1.00%, directed to the two side drainage grids.
16. In the middle of the taxiway, TWY L there is a transverse slope of 1.00% directed to the stand No 3.
17. Lack of coordinated actions between the flight crew and the ramp agent on the order and procedure of engine start-up during the aircraft push on frozen ground areas.
18. The two engines of the aircraft are started in the process of its pushing in the presence of icing and slope of the stand and taxiway.
19. During pushing, two of the safe tear bolts on the towbar are torn.
20. When entering the area with an icy surface of stand No 3, the tug starts to slip in a place where it cannot control the aircraft.
21. After noticing that the aircraft collided with the tug, the ramp agent reported what had happened to the flight crew and, requested that the engines be stopped which was carried out in a timely.
22. The tractor driver did not use alcohol during of realization of the occurrence.

23. The aircraft towbar tractor „SHOPF-110"with inventory No 013 is owned by Sofia Airport” EAD
24. The aircraft towbar tractor with inventory No 013 has an operational licence issued by the Bulgarian CAA DG, valid until December 2019.

4.2. Causes

Based on the analysis performed, the Commission points out that the serious incident resulted from the following causes:

1. Lack of coordinated actions between the flight crew and the ramp agent on the order and procedure of engine start-up during the aircraft push on frozen ground areas;
2. Insufficient and poor quality cleaning and removal of icing on aircraft stand No 3.
3. Starting the aircraft engines while pushing the aircraft on the icy slopes of the aircraft stand and taxiway.
4. Loss of control by the driver of the tractor, due to the use of brakes on the icy area.

5. Safety Recommendations

Immediately after the realization of the occurrence, the Aircraft, Maritime and Railway Accident Investigation Unit Directorate at MTITC on the basis of Art. 17, para. 1 and para. 2 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 makes the following recommendation in relation to ensuring flight safety to Bulgarian DG CAA:

BG.SIA-2019/01/01. DG CAA is to require from Ground Handling Operators at Sofia, Plovdiv, Varna, Bourgas and Gorna Oryahovitsa airports, in case of unreliable braking effect and snow and/or ice coverage on the apron, stands and taxiways to inform the flight crews of the restriction to start the engines after the towing completion and towbar tractor disconnection from the aircraft

The Sofia Airport” EAD informed the Air, Maritime and Railway Accidents Investigation National Board in writing of 12 February 2019 that from 11 February 2019 safety measures are introduced for servicing aircraft in winter conditions, described in two operating instructions and procedures, as follows:

5. In “Instruction for towing/pushing of the aircraft” “Sofia Airport” EAD, Revision 4/04.02.2019 - of Ground Handling Operator :
 - A supplement in item 4.13, obliging the head of the towing / pushing maneuver to inform the aircraft crew about the restriction in case of icy surfaces of stand, to start the engines after the completion of the maneuver;
 - A new item 7. “Working during adverse weather condition and/or those outside the standards.”

The staff of Ground Handling Operator performing the procedures for towing/pushing the aircraft have received training on the changes.

6. In “Procedure for carrying out operations during Adverse Weather Conditions on the area of Sofia Airport” Revision 2.0/11.02.2019 - of Ground Handling Operator.
 - In item 3.5. 'Winter safety measures', introduced a new text in below point 3.5.8, requiring the flight crew to be notified of the restriction to start the engines after the end of the push operation;
 - In item 4.2. “Responsibilities of the Sofia Airport Operations Centre”, introduced a new text under point 4.2.1. (d) requiring before the start of the operations for the day, the duty officers in the

Operations Centre to inform the ground operators about the condition of the surfaces of the stands and taxiways.

- In item 4.4. “Responsibilities of Ground Handling Operator, new text introduced in sub-item 4.4.1.f), requiring officials to inform the crews about the conditions and restrictions related to them;
 - In item 5.3. “Obligations of operators” information exchange and coordination services, new text introduced in sub-paragraph 5.3.2.d) to inform crews of restrictions and prohibitions, taking into account the specific conditions.
 - The operators of Ground Handling Operator at Sofia, Plovdiv, Varna, Burgas and Gorna Oryahovitsa airports until 20.02.2019 informed the Air, Maritime and Railway Accidents Investigation National Board in writing that safety measures have been introduced for servicing aircraft in winter operation conditions according to the issued recommendation.

On the grounds of Article 18, §5 of Regulation (EU) 996/2010, the safety recommendation issued will be recorded in the centralized European system SRIS (Safety Recommendations Information System).

The Investigation Commission reminds all organizations, to which flight safety recommendations are sent that, on the grounds of Article 18 of Regulation (EU) 996/2010 on Investigation and Prevention of Accidents and Incidents in Civil Aviation and Article 19, paragraph 7 of Ordinance No. 13 on the Investigation of Aviation Accidents are obliged to notify the Air, Maritime and Railway Accidents Investigation National Board in writing of the action taken on the recommendations made.

AIR, MARITIME AND RAILWAY ACCIDENTS INVESTIGATION NATIONAL BOARD

COMMISSION ON INVESTIGATION OF THE SERIOUS INCIDENT

Sofia, 31 March 2021

APPENDIX 1



Fig. 1.

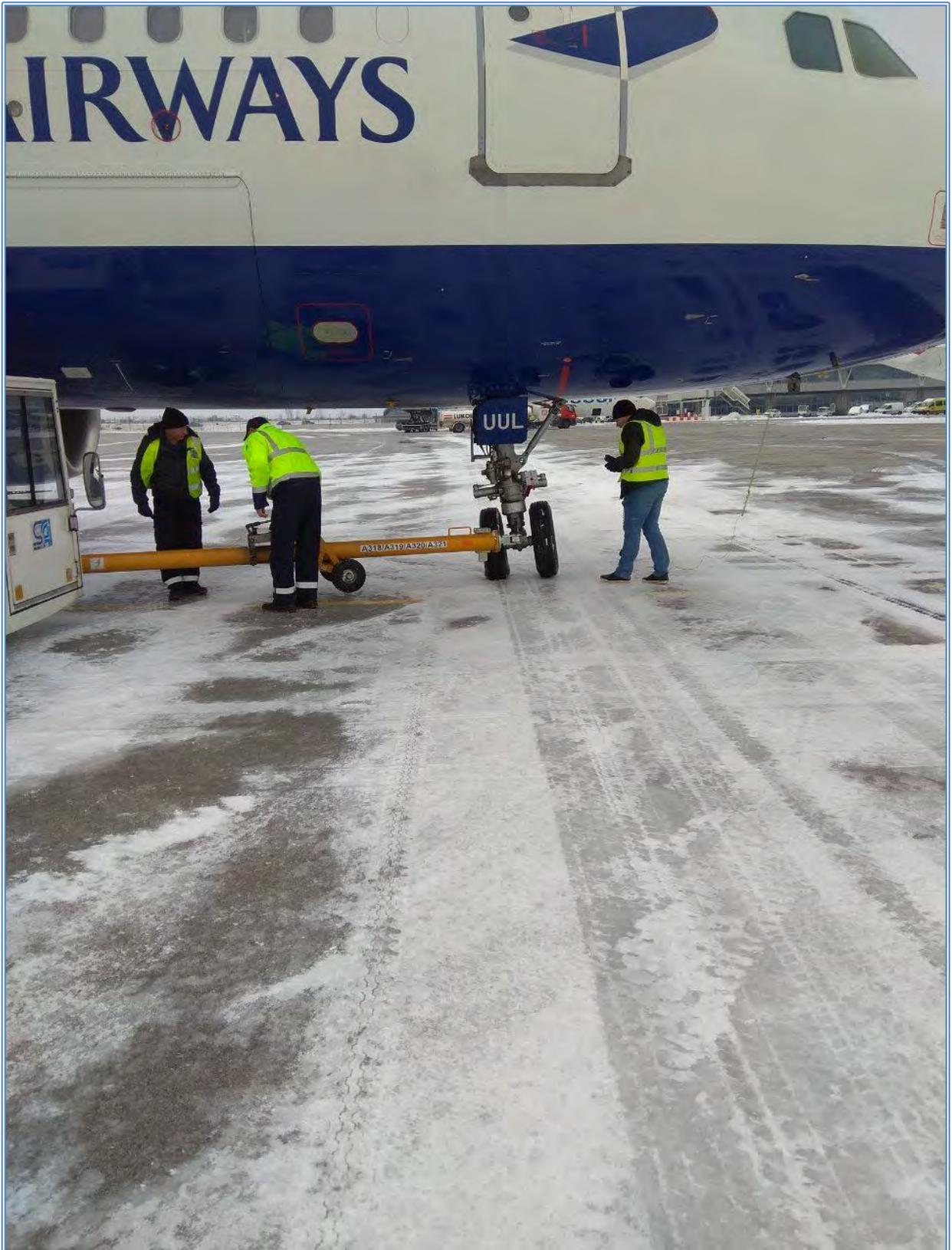


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

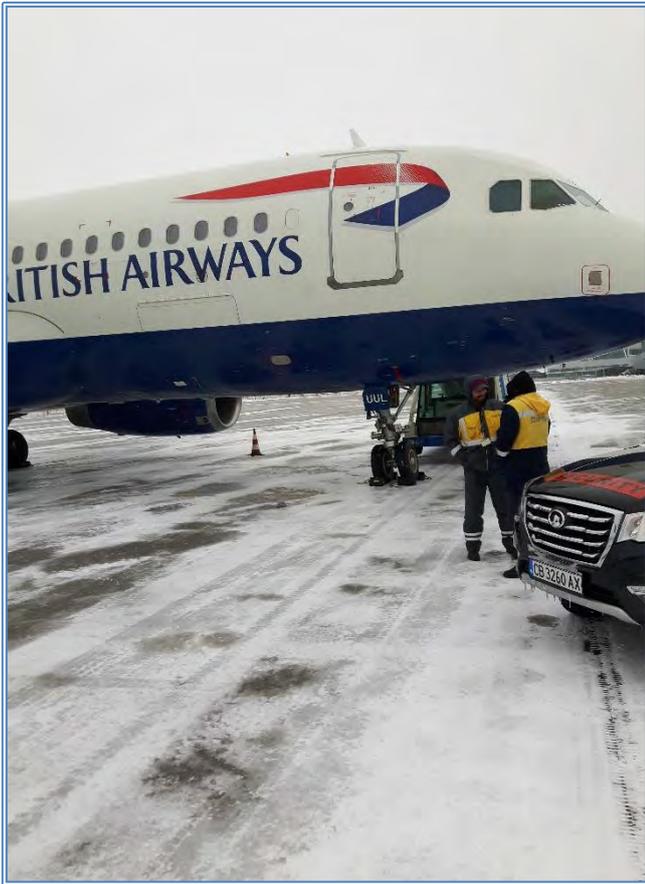


Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9

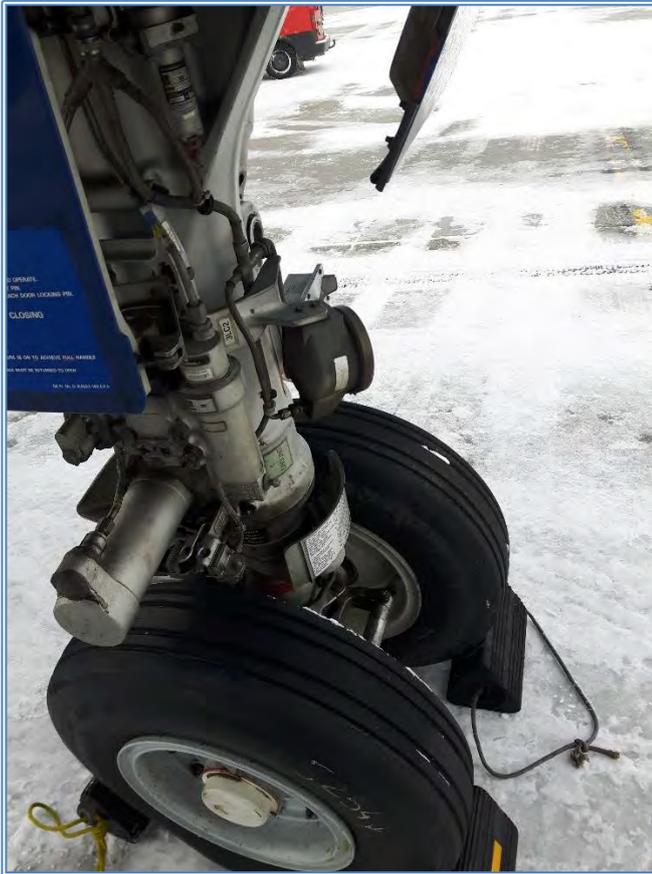


Fig. 10

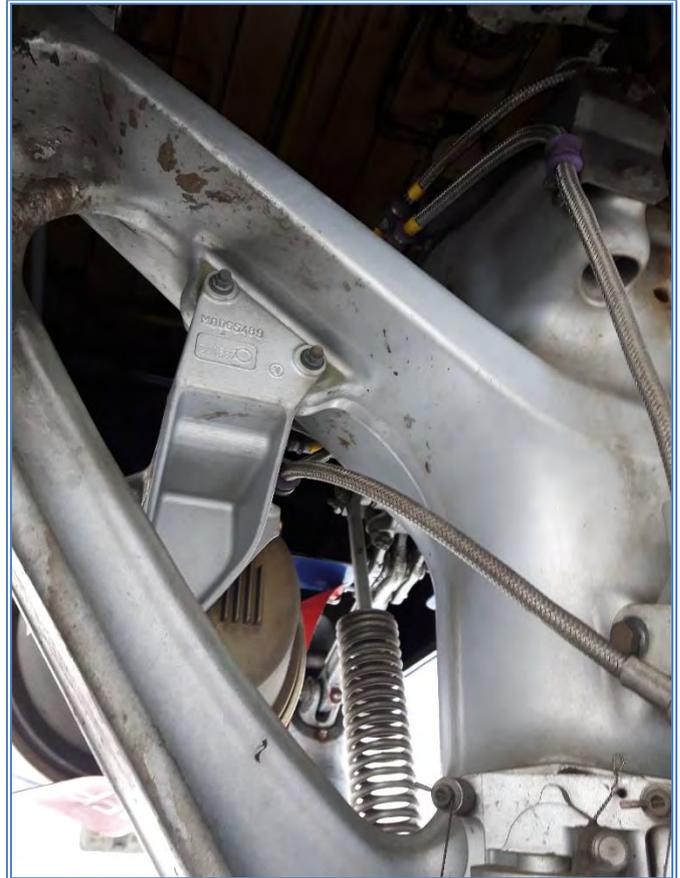


Fig. 11



Fig. 12.

APPENDIX 2

APPENDIX 2. SNOWTAM FORMAT

(See Chapter 5, 5.2.3.)

(COM heading)	(PRIORITY INDICATOR)	(ADDRESSES)										<≡	
	(DATE AND TIME OF FILING)	(ORIGINATOR'S INDICATOR)					<≡						
(Abbreviated heading)	(SWAA* SERIAL NUMBER)					(LOCATION INDICATOR)	DATE-TIME OF OBSERVATION					(OPTIONAL GROUP)	
	S	W	*	*									<<≡(

SNOWTAM	(Serial number)	<≡
(AERODROME LOCATION INDICATOR)	A)	<≡
(DATE-TIME OF OBSERVATION (<i>Time of completion of measurement in UTC</i>))	B)	→
(RUNWAY DESIGNATOR)	C)	→
(CLEARED RUNWAY LENGTH, IF LESS THAN PUBLISHED LENGTH (<i>m</i>))	D)	→
(CLEARED RUNWAY WIDTH, IF LESS THAN PUBLISHED WIDTH (<i>m</i> ; if offset left or right of centre line add "L" or "R"))	E)	→
(DEPOSITS OVER TOTAL RUNWAY LENGTH (<i>Observed on each third of the runway, starting from threshold having the lower runway designation number</i>) NIL — CLEAR AND DRY 1 — DAMP 2 — WET 3 — RIME OR FROST COVERED (<i>depth normally less than 1 mm</i>) 4 — DRY SNOW 5 — WET SNOW 6 — SLUSH 7 — ICE 8 — COMPACTED OR ROLLED SNOW 9 — FROZEN RUTS OR RIDGES)	F) ... <i>d</i> ... <i>d</i> ... <i>d</i> ...	→
(MEAN DEPTH (<i>mm</i>) FOR EACH THIRD OF TOTAL RUNWAY LENGTH)	G) ... <i>d</i> ... <i>d</i> ... <i>d</i> ...	→
(ESTIMATED SURFACE FRICTION ON EACH THIRD OF RUNWAY) ESTIMATED SURFACE FRICTION GOOD — 5 MEDIUM/GOOD — 4 MEDIUM — 3 MEDIUM/POOR — 2 POOR — 1 (<i>The intermediate values of "MEDIUM/GOOD" and "MEDIUM/POOR" provide for more precise information in the estimate when conditions are found to be between medium and either good or poor.</i>)	H) ... <i>d</i> ... <i>d</i> ... <i>d</i> ...	→
(CRITICAL SNOWBANKS (<i>If present, insert height (cm)/distance from the edge of runway (m) followed by "L", "R" or "LR" if applicable</i>))	J)	→
(RUNWAY LIGHTS (<i>If obscured, insert "YES" followed by "L", "R" or both "LR" if applicable</i>))	K)	→
(FURTHER CLEARANCE (<i>If planned, insert length (m)/width (m) to be cleared or if to full dimensions, insert "TOTAL"</i>))	L)	→
(FURTHER CLEARANCE EXPECTED TO BE COMPLETED BY ... (<i>UTC</i>))	M)	→
(TAXIWAY (<i>If no appropriate taxiway is available, insert "NO"</i>))	N)	→
(TAXIWAY SNOWBANKS (<i>If higher than 60 cm, insert "YES" followed by the lateral distance apart, m</i>))	P)	<≡
(APRON (<i>If unusable insert "NO"</i>))	R)	→
(NEXT PLANNED OBSERVATION/MEASUREMENT IS FOR) (<i>month/day/hour in UTC</i>)	S)	→
(PLAIN-LANGUAGE REMARKS (<i>Including contaminant coverage and other operationally significant information, e.g. sanding, de-icing, chemicals</i>))	T))<≡
NOTES: 1. *Enter ICAO nationality letters as given in ICAO Doc 7910, Part 2. 2. Information on other runways, repeat from B to P. 3. Words in brackets () not to be transmitted.		

SIGNATURE OF ORIGINATOR (*not for transmission*)