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Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report No. 2256 by the Swiss Transportation Safety Investigation Board STSB

concerning the serious incident involving the A320-214 Airbus aircraft, registration HB-IOP

on 6 October 2014

at EuroAirport Basel Mulhouse Freiburg

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Ursachen

Der schwere Vorfall ist darauf zurückzuführen, dass das Flugzeug die notwendige Flugleistung beim Start nicht erreichte, weil die Flugbesatzung den Start von einer Rollwegabzweigung (*intersection*) mit einer Triebwerkleistung durchführte, die für die gesamte Pistenlänge berechnet worden war.

Folgende Faktoren haben zum schweren Vorfall beigetragen:

- Verfahrensvorgaben, die eine stillschweigende (*silent*) Kontrolle essentieller Punkte verlangen und somit eine gegenseitige Überprüfung im Sinne des *closed loop* ausschliessen.
- Der Entscheid für einen *intersection takeoff* wurde kurzfristig getroffen.
- Eine neu eingeführte zusätzliche Überprüfung der in das Flugführungssystem eingegebenen Daten beim *line up* erwies sich als unwirksam, weil sie der Flugbesatzung nicht bekannt war.

General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, follow the coordinated universal time (UTC) format. At the time of the serious incident, Central European Summer Time (CEST) applied as local time (LT) in Switzerland. The relation between LT, CEST and UTC is:
LT = CEST = UTC + 2 hours.

Contents

Final Report

Synopsis

Owner	GY Aviation Lease 0905 Co. Ltd., George's Dock IFSC 3, 1 Dublin, Ireland
Operator	Belair Airlines AG, Sägereistr. 27, CH-8152 Glattbrugg, Switzerland
Manufacturer	Airbus S.A.S., Toulouse, France
Aircraft type	A320-214
Country of registration	Switzerland
Registration	HB-IOP
Location	EuroAirport Basel Mulhouse Freiburg (LFSB), France
Date and time	6 October 2014, 13:01 UTC

Investigation

The serious incident occurred on 6 October 2014 at 13:01 UTC. The notification was received on 22 October. The former Swiss Accident Investigation Board informed the respective French authorities of the serious incident. They delegated the investigation of the serious incident to Switzerland. The former Swiss Accident Investigation Board opened the investigation on 4 December 2014 at approximately 13:00 UTC. France appointed an authorised representative, who assisted with the investigation.

The present final report is published by the Swiss Transportation Safety Investigation Board (STSB).

Summary

The crew prepared the Airbus A320-214 aircraft, registration HB-IOP, for the flight with the flight plan call sign BHP 2532 from Basel (LFBS) to Djerba (DTTJ), Tunisia. After an initial intention to take off on runway 33, prevailing traffic led the crew to decide on a take-off from runway 15 and calculate the required engine power for take-off using the total available runway length of 3900 m.

While taxiing to the threshold of runway 15, the crew decided to save time by taking off from the taxiway Golf intersection, which gave an available runway length of 2370 m. Without stopping after lining up, they took off with an engine power which had been calculated for the entire length of the runway. This engine power did not meet the requirements for allowing the take-off to be continued or rejected within the remaining runway length in the event of engine failure at decision speed.

During the final stages of the take-off roll, the commander noticed the low engine power, increased it to the maximum possible and initiated aircraft lift-off by rotation. The subsequent climb was uneventful and the flight was able to continue to Djerba. There was no damage.

Causes

The serious incident is attributable to the fact that the aircraft did not achieve the necessary performance on take-off, because the flight crew performed the take-off from a taxiway intersection with an engine power which had been calculated for the entire length of the runway.

The following factors contributed to the serious incident:

- Procedures which require checking essential items in silence, which means that cross-checking cannot take place in the spirit of a closed loop.
- The decision to an intersection take-off was made at short notice.
- Additional cross-checking of the data entered into the flight guidance system during the line up, which had been recently introduced, was ineffective because the flight crew were unaware of it.

Safety recommendations

In the context of the investigation, no safety recommendation was issued.

1 Factual information

1.1 Prehistory and history of the flight

1.1.1 General

For the following description of the prehistory and history of the flight the statements of the flight crew, as well as the recordings of the quick access recorder and the radiocommunication transcript were used. For the entire flight the commander was pilot flying (PF) and the copilot was pilot not flying (PNF).

1.1.2 Prehistory

The crew prepared themselves for the forthcoming flight on the Airbus A320-214 aircraft, registration HB-IOP, with the flight plan call sign BHP 2532. They acted in accordance with the operating procedures of the operator (cf. chapter 1.17). On board the aircraft were 138 passengers, two pilots and four cabin crew members.

Given the prevailing wind conditions, the crew planned to take-off on runway 33 to reduce the taxiing time. The copilot first calculated on his electronic flight bag (EFB) the required engine power for taking off on runway 33 for the anticipated take-off weight according to the operational flight plan (OFP). However, he deliberately did not enter the data into the flight management and guidance system (FMGS). This is the task of the PF, i.e. in this case, the commander.

The FMGS allows two different flight routes to be entered; the crew entered a take-off from runway 15 on the primary flight plan, which was in operation in accordance with ATIS information, and a takeoff from runway 33 on the secondary flight plan, which the crew intended to use.

He also requested departure clearance using ACARS[1] and remarked that they wished to use runway 33. The crew then received departure clearance for a take-off on runway 15, with the remark that they could request runway 33 again from Basel Ground during the pushback.

After receiving the loadsheet, the crew calculated the take-off data for a full-length take-off on runway 15 on their EFBs. After comparing the results, (cf. chapter 1.17.2, Figure 1), the commander entered this data on the primary flight plan using the multi purpose control and display unit (MCDU). The crew did the same for a take-off on runway 33 from the Delta intersection by independently calculating and comparing the corresponding data and entering it into the secondary flight plan. The commander then calculated the take-off data for a take-off from the Golf intersection on runway 15 on his EFB, while the copilot calculated the take-off data for a take-off from the Hotel intersection on runway 15 on his EFB. In this way the crew wanted also to be prepared for an intersection take-off, and therefore prepared four different take-off scenarios.

At the end of the cockpit preparation and before starting the engines, the crew performed the take-off briefing. According to the statement of the copilot, this included a full-length take-off on runway 15 and a take-off on runway 33 from the Delta intersection. Neither of the runway 15 intersections Golf and Hotel were mentioned.

[1] ACARS stands for aircraft communications addressing and reporting system. ACARS is a digital data transmission system for the transmission of simple messages between aircraft and ground stations and vice versa.

1.1.3 History of the flight

At 12:52:28 UTC, the crew reported to the Basel Ground air traffic control officer (ATCO) as follows: *„Belair two five three two, position two zero, requesting push and start, appreciating runway three three."* The ATCO replied as follows: *„Belair two five three two, pushback approved, and eh call you back."* Just a few seconds later the ATCO informed the crew of HB-IOP that they should expect a delay of approximately 20 minutes before taking off on runway 33. The crew decided in favour of a full-length take-off on runway 15 and answered the ATCO as follows at 12:52:50 UTC: *„Then we take runway one five, Air Berlin two Belair two five three two."*

After the pushback and starting the engines, the crew worked in accordance with the operating procedures, which no longer included any checklist items regarding take-off data (cf. chapter 1.17.2).

At 12:56:44 UTC the crew of BHP 2532 requested taxi clearance, which the ATCO issued as follows: *„Belair two five three two taxi one five via BRAVO."* The crew acknowledged this clearance.

A little later, at 12:57:08 UTC, the ATCO requested the crew to give way to an Easyjet aircraft: *„Belair two five three two, you give way to ehm Easyjet aircraft joining BRAVO from the northern apron."* The crew of BHP 2532 replied as follows: *„Copy, as number two, Belair two five three two."* A little later, at 12:59:11 UTC, the crew of the Easyjet reported to the ATCO as follows: *„And eh Easyjet eight five Bravo kilo, ready for departure, holding short Golf."* The ATCO instructed the Easyjet crew to switch to the Basel Tower frequency. A little later, at 12:59:34 UTC, he issued the same instruction to the crew of BHP 2532.

The commander of BHP 2532, which was taxiing behind the Easyjet aircraft, also proposed to take off from the Golf intersection. The copilot was in agreement and after switching to the Basel Tower frequency he reported to the appropriate ATCO as follows at 12:59:46 UTC: *„Bale tower bonjour, Belair two five three two, also able for intersection GOLF, ready."* After the ATCO had immediately questioned whether BHP 2532 actually wished to also take off from the Golf intersection and the crew had confirmed this, the ATCO gave the crew the following information regarding clearance at 13:00:04 UTC: *„Belair two five three two, line up one five GOLF and wait, call you back short, traffic is five miles final, be ready."* The crew of BHP 2532 confirmed this take-off clearance at 13:00:13 UTC as follows: *„Belair two five three two, holding short one five GOLF."* At this time they were still taxiing on the Bravo taxiway at a speed of 14 kt. The ATCO then asked the Easyjet crew whether they were currently starting their take-off roll. Immediately after they had confirmed commencement of the take-off roll at 13:00:22 UTC, the ATCO informed the crew of the approaching aircraft with the call sign „Air France Romeo Yankee" to reduce their speed to minimum approach speed because a second aircraft was going to take off before they landed. At 13:00:34 UTC, he gave BHP 2532, which was at that time taxiing on the Golf taxiway at a speed of 5 kt, clearance to line up at the Golf intersection and wait.

This clearance surprised the crew of BHP 2532 because they were of the opinion that they could only line up after „Air France Romeo Yankee" had landed. For this reason, they asked the ATCO if they really could line up. The ATCO confirmed this as follows at 13:00:41 UTC: *„Affirm Sir, line up one five from GOLF and wait."* The crew confirmed this clearance and at 13:01:08 UTC received the following take-off clearance: *„Belair two five three two, cleared take-off one five GOLF, wind calm, traffic three miles."* At this time the aircraft was lining up. According to the statement of the crew, they performed the take-off check and initiated the take-off roll without stopping at the take-off point (rolling take-off).

The reduced take-off engine power which had been set was based on the entire runway length of 3900 m and the V1[2], VR[3] and V2[4] speeds which had been entered in the FMGS were all 157 kt (cf. chapter 1.18.1, Figure 9).

During the take-off roll, the commander felt that the acceleration in relation to the position on the runway was unusual. He realised that the take-off power that had been set did not correspond to that necessary for an intersection take-off. At 13:01:48 UTC, he therefore set TOGA[5] power at an indicated airspeed (IAS) of 140 kt, 1150 m before the end of the runway. By looking at his EFB, he could see that the aircraft had already reached the speeds for an intersection take-off (V1 and VR 136 kt and V2 138 kt). He then rotated immediately. At this time the aircraft was approximately 790 m from the end of the runway and had an IAS of 150 kt. After a further 250 metres, the aircraft reached a height of 35 ft. The subsequent climb indicated a pitch of up to 19.5 degrees, aircraft nose up (ANU). The onward flight was uneventful.

1.1.4 Location and time of the serious incident

Location	Runway 15 at EuroAirport Basel Mulhouse Freiburg, France
Date and time	6 October 2014, 13:01 UTC
Lighting conditions	Daylight
Altitude	265 m AMSL

1.2 Injuries to persons

None

1.3 Damage to aircraft

None

1.4 Other damage

None

1.5 Personnel information

1.5.1 Flight crew

1.5.1.1 Commander

Person	Swiss citizen, born 1975
Licence	Airline transport pilot licence aeroplane – ATPL(A) according to the European Aviation Safety Agency (EASA)

[2] V1 stands for decision speed. If an engine fails at this speed, the aircraft is able either to continue the take-off with a safe climb or to reject the take-off and come to a standstill on the runway.

[3] VR stands for rotation speed. At this speed, a rotation is initiated to lift off.

[4] V2 stands for take-off safety speed. This speed ensures a safe climb if an engine fails at V1. The fly-by-wire concept of the A320 stipulates a variable take-off safety speed whose minimum is 13% higher than the stall speed.

[5] TOGA stands for take-off and go-around and corresponds to the maximum engine power.

Flying experience	Total	6447 hours
	on the type involved in the incident	3523 hours
	of which as commander	3440 hours
	during the last 90 days	191 hours
	of which on the type involved in the incident	191 hours

All available evidence suggests that the commander started duty well-rested and in good health. There are no indications that fatigue played a role at the time of the serious incident.

1.5.1.2 Copilot

Person	German citizen, born 1984	
Licence	ATPL(A) according to EASA	
Flying experience	Total	3771:48 hours
	on the type involved in the incident	2856:59 hours
	during the last 90 days	195:32 hours
	of which on the type involved in the incident	195:32 hours

All available evidence suggests that the copilot started duty well-rested and in good health. There are no indications that fatigue played a role at the time of the serious incident.

1.6 Aircraft information

1.6.1 General information

Registration	HB-IOP	
Aircraft type	A320-214	
Characteristics	Twin-engine short-haul and medium-haul aircraft with turbofan propulsion	
Manufacturer	Airbus S.A.S., Toulouse, France	
Owner	GY Aviation Lease 0905 Co. Ltd. George's Dock IFSC 3, 1 Dublin, Ireland	
Operator	Belair Airlines AG Sägereistrasse 27, CH-8152 Glattbrugg, Switzerland	
Engines	CFM International CFM56-5B4/3	
Max. permitted masses	Take-off	77 000 kg
	Landing	64 500 kg
Mass and centre of gravity	The mass of the aircraft at the time of departure was 62 967 kg. Both the mass and centre of gravity were within the permitted limits according to the aircraft flight manual (AFM).	

1.7 Meteorological information

1.7.1 General meteorological situation

Switzerland lay on the edge of an Atlantic low centred south of Iceland. A frontal system associated with the low lay over Western France. Basel was sunny with some fair-weather cumulus clouds and gathering cirrus clouds.

Winds at ground level were light. The temperature was 7 °C above the corresponding standard atmosphere value.

1.7.2 Astronomical information

Position of the sun	Azimuth: 211 °	Elevation: 33 °
Lighting conditions	Daylight	

1.7.3 Aerodrome meteorological reports

At the time of the serious incident, the following meteorological aerodrome report (METAR) applied:

METAR LFSB 061300Z VRB02KT 9999 FEW025 20/13 Q1011 NOSIG=

This means: On 6 October 2014, shortly before the 13:00 UTC issue time of the aerodrome meteorological report, the following weather conditions were observed at EuroAirport Basel Mulhouse Freiburg:

Wind	variable at 2 kt
Meteorological visibility	10 km or over
Precipitation	None
Cloud	1/8-2/8 at 2500 ft AAL[6]
Temperature	20 °C
Dewpoint	13 °C
Atmospheric pressure (QNH)	1011 hPa, pressure reduced to sea level, calculated using the values of the ICAO standard atmosphere
Landing weather forecast	No significant changes expected in the two hours following the weather observation.

1.7.4 EuroAirport Basel Mulhouse Freiburg ATIS report

On 6 October 2014 EuroAirport Basel Mulhouse Freiburg (LFSB) broadcast the automatic terminal information service (ATIS) information on the 127.875 MHz frequency with the password LIMA. This was recorded by the commander as follows (emphasis in the original):

"1140 L 15 T80 X 360/3 10 5/016 18/13 1012"

This means:

Time	11:40 UTC
Password	LIMA
Runway in use	15

[6] AAL- above aerodrome level

Transition level	FL 80
Wind	from 360 degrees at 3 kt
Visibility	10 km or over
Cloud	5/8 at 1600 ft AAL
Temperature	18 °C
Dewpoint	13 °C
Atmospheric pressure (QNH)	1012 hPa

1.8 Aids to navigation

Not applicable.

1.9 Communications

Radio communication between the pilots and the Basel Ground and Basel Tower air traffic control units took place correctly and without difficulties in English.

1.10 Aerodrome information

1.10.1 General

EuroAirport Basel Mulhouse Freiburg is located 6 km north-west of the city of Basel (Switzerland) and 22 km south-east of Mulhouse (France) in French sovereign territory. The airport has used the brand name EuroAirport Basel Mulhouse Freiburg since 1987. In 2013 it handled a traffic volume of approximately 87 000 arrivals and departures. The airport is jointly operated by France and Switzerland.

The reference elevation of the airport is 885 ft AMSL and the reference temperature is 27.0 °C.

1.10.2 Runway equipment

The runways at EuroAirport Basel Mulhouse Freiburg have the following dimensions:

Runway	Dimensions	Elevation of runway thresholds
15/33	3900 x 60 m	864/882 ft AMSL
08/26	1820 x 60 m	881/885 ft AMSL

At the time of the serious incident the entire runway length of 3900 m was available for a take-off on runway 15. The take-off distance available (TODA) was 4000 m.

From taxiway Bravo, which runs parallel to runway 15/33, there are a number of intersections with the runway; take-offs are therefore possible from these various intersections with correspondingly shorter runway lengths. For a take-off from the Hotel intersection on runway 15, for example, a runway length of 2990 m is available, while from the Golf intersection, a runway length of 2370 m is available (cf. Annex 1).

1.11 Flight recorders

Because for various reasons the investigation of this serious incident was initiated late, the recordings of the digital flight data recorder (DFDR) and the cockpit voice recorder (CVR) had already been overwritten and were no longer available to the investigation.

The records of the quick access recorder (QAR) were available to the investigation and it was possible to evaluate them.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

There are no indications of the pilots suffering from health problems or fatigue.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

1.17.1 General

The operator had stipulated the operating procedures for the crews in different operations manuals. These include the operating manuals OM A and OM B. Whereas OM A provides general operating procedures, OM B stipulates specific operating procedures for the A320 aircraft type. This OM B primarily references the manufacturer's flight crew operating manual (FCOM). The aircraft manufacturer's flight crew training manual (FCTM), which also contains operating procedures, is also used as a supplement and for training purposes.

Furthermore, the aircraft manufacturer's quick reference handbook (QRH) is used for the crew's daily work. This QRH is the only manual which is available to the crew in paper form. Other operating manuals are only available to the crew in electronic form.

1.17.2 Operating procedures relevant to the serious incident

The FCOM stipulates amongst others that the aircraft manufacturer's published standard operating procedures (SOP) should be applied. It also contains further information from the operator about operation of the aircraft. It stipulates the following: *„Standard operating procedures are divided into flight phases, and are performed by memory."*

It also states the following:

„There is no need to use the QRH-Normal Operation chapters to perform the items. But it is allowed to use the QRH as a guideline, for example during:

- Preliminary Cockpit Preparation

- Cockpit preparation

Ensure that all items are completed in the correct sequence."

The relevant publication in the QRH therefore serves as a basis for the following chronological description of the relevant operating procedures.

The section „Normal Procedures" NP-NP 3/16 of the QRH stipulates the following in relation to power data before pushback and engine start:

<table>
<tr><th colspan="2">BEFORE PUSHBACK OR START</th></tr>
<tr><th>CM1</th><th>CM2</th></tr>
<tr><td>LOADSHEET....CHECK</td><td></td></tr>
<tr><td>FOB....CHECK</td><td>FOB....CHECK</td></tr>
<tr><td colspan="2">FMS TO DATA....CHECK/REVISE AS RQRD (PF)</td></tr>
<tr><td colspan="2">REVISED FMS TO DATA....XCHECK (PNF)</td></tr>
<tr><td>SEATING POSITION....ADJUST</td><td>SEATING POSITION....ADJUST</td></tr>
<tr><td colspan="2">FMS PERF TO page....SELECT (PF)</td></tr>
<tr><td colspan="2">FMS F-PLN page....SELECT (PNF)</td></tr>
<tr><td></td><td>EXT PWR....CHECK AVAIL</td></tr>
<tr><td></td><td>EXT PWR DISCONNECTION....REQUEST</td></tr>
<tr><td>NW STRG DISC....CHECK AS RQRD</td><td>PUSHBACK/START CLEARANCE....OBTAIN</td></tr>
<tr><td>WINDOWS/DOORS....CHECK CLOSED</td><td>WINDOWS/DOORS....CHECK CLOSED</td></tr>
<tr><td>RADIO DISABLED SHOWN ON EFB II....CHECK</td><td>RADIO DISABLED SHOWN ON EFB II....CHECK</td></tr>
<tr><td>EXTERIOR LIGHTS....SET</td><td></td></tr>
<tr><td>THRUST LEVERS....IDLE</td><td></td></tr>
<tr><td>PARK BRK ACCU PRESS....CHECK</td><td></td></tr>
<tr><td>PARKING BRK....AS RQRD</td><td></td></tr>
<tr><td>BEFORE START C/L....REQUEST</td><td></td></tr>
</table>

Figure 1: Procedure from the QRH. CM1 (crew member 1) is the commander and CM2 (crew member 2) is the copilot. PF stands for pilot flying and PNF stands for pilot not flying.

Based on the present serious incident, this means that the commander as PF must enter the take-off data (TO DATA), based on the loadsheet and current weather data, into the FMGS and that the copilot must check this.

According to the statements of the two pilots they performed this with the data for a full-length take-off on runway 15.

Furthermore, the commander must select the PERF TO (performance take-off) page and the copilot must select the F-PLN (flight plan) page on their respective MCDUs.

According to the specifications defined in the FCOM, data insertion by the commander is performed as follows:

TAKEOFF DATA INSERTION (PERF TAKEOFF PAGE):

* V1, VR, V2	INSERT	PF
* FLX TO TEMP	INSERT	PF
* THR RED/ACC altitude	SET or CHECK	PF
* ENG OUT ACC altitude	SET or CHECK	PF
* FLAPS/THS reminder	INSERT	PF
* TO SHIFT	AS RQRD	PF

Enter the takeoff SHIFT distance, if takeoff is to be from an intersection. This is essential for position updating at takeoff and, consequently, for navigation accuracy.

Figure 2: Information on take-off data insertion according to the FCOM.

The insertion of the take-off SHIFT distance, which is the last item mentioned, allows the aircraft position calculated by the FMGS to be updated to the take-off point in the event of insufficient GPS signal quality. If the signal quality is sufficient, the system is in GPS PRIMARY mode and no position update takes place. Since the above procedure does not make this distinction, it would have been necessary in the present case, to insert a value of 1530 m, which corresponds to the distance between the start of runway 15 and the Golf intersection.

The *„Before pushback or start"* procedure is concluded with the commander requesting the *„Before start" checklist*. In the course of this checklist the two pilots once again check whether the take-off data had been entered correctly.

BEFORE START
GEAR PINS and COVERS........................REMOVED
SIGNS...ON/AUTO
FUEL QUANTITY.......................... _____ KG (BOTH)
ALTIMETERS...
.... QNH_____/_____FEET (BOTH)
T/O DATA..
......................INSERTED, V1_____V2_____ (BOTH)
BEACON..ON
PARKING BRAKE......................................AS RQRD

Figure 3: Checklist according to the QRH

The *„After start"* checklist does not address this data anymore.

According to QRH NP-NP 5/16 the following items should be performed while taxiing:

TAXI

CM1	CM2
	TAXI CLEARANCE.......OBTAIN
•Taxi clearance obtained:	
EXTERIOR LIGHTS.......SET	
PARKING BRAKE handle.......OFF	ELAPSED TIME.......AS RQRD
THRUST LEVERS.......AS RQRD	
BRAKES.......CHECK	BRAKES.......CHECK
FLT CTL.......CHECK*(1)*	FLT CTL.......CHECK*(1)*
AFTER START C/L.......COMPLETE*(1)*	AFTER START C/L.......COMPLETE*(1)*
•ATC clearance obtained:	
	ATC CLEARANCE.......CONFIRM
	T.O DATA.......CHECK
	FMS F-PLAN/SPD.......CHECK
	FCU ALT/HDG.......SET
	BOTH FD.......CHECK ON
PFD/ND.......CHECK	PFD/ND.......CHECK
TAKEOFF BRIEFING.......CONFIRM	
	RADAR and PREDICTIVE WINDSHEAR SYSTEM ....AS RQRD
	ATC CODE.......CONFIRM/SET
TERR ON ND.......AS RQRD	TERR ON ND.......AS RQRD
CABIN REPORT.......RECEIVE	CABIN REPORT.......RECEIVE
•Cabin Ready received (and FLT CTL Check completed):	
	AUTO BRK.......MAX

Continued from the previous page

CM1	CM2
	T.O CONFIG pb.......TEST
	T.O MEMO.......CHECK NO BLUE

(1) If FLIGHT CONTROL CHECK and AFTER START C/L is done during taxi, for callouts:
Refer to FCOM/PRO-NOR-SOP-90 Standard Callouts- Summary For Each Phase-Taxi

Figure 4: *„TAXI"* procedure according to the QRH. CM1 is the commander; CM2 is the copilot.

The FCTM stipulates the following under the commander's 'TAKEOFF BRIEFING ..... CONFIRM' item: *„The TAKEOFF BRIEFING CONFIRMATION should only review any changes that may have occurred since the full TAKEOFF BRIEFING done at the parking bay (e.g. change of SID, change in runway conditions, etc.)."*

The information mentioned in footnote (1) *„refer to FCOM/PRO-NOR-SOP-90"* refers to the following supplement to the procedure:

TAXI

EVENT	CM1	CM2
When taxi received obtained	LEFT SIDE CLEAR	RIGHT SIDE CLEAR
Brake transfer check(1)		
F/CTL check if done during taxi.(2)	FLIGHT CONTROL CHECK	

Continued on the following page

Continued from the previous page

EVENT		CM1	CM2
1. Elevators			FULL UP, FULL DOWN, NEUTRAL
2. Ailerons/Spoilers			FULL LEFT, FULL RIGHT, NEUTRAL
3. Rudder(3)		RUDDER	FULL LEFT, FULL RIGHT, NEUTRAL
During taxi		AFTER START C/L (4)	AFTER START C/L COMPLETED(5)
Lining up	Packs on T/O	TAKE OFF CHECK TAKE OFF ALL GREEN	TAKE OFF ALL GREEN
	Packs off T/O (6)	PACKS OFF TAKE OFF CHECK TAKE OFF ALL GREEN PACKS OFF	TAKE OFF ALL GREEN PACKS OFF

(1) *The check is performed silently by CM1 (Refer to PRO-NOR-SOP-10/TAXI-BRAKES).*
(2) *(Refer to PRO-NOR-SOP-10/TAXI-FLIGHT CONTROLS).*
(3) *The PNF should follow pedal movement with his/her feet.*
(4) *Confirmation T/O flaps setting: The PF and PNF check the T/O flaps setting on the MCDU PERF Page and on the ECAM.*
(5) *AFTER START C/L performed and Cabin Ready received (ECAM, CDSS or Voice), CM2 selects:*
AUTO BRK : MAX
T.O. CONFIG : TEST
(6) *Standard configuration is Packs on for T/O. Packs off T/O may be required by operational or performance reasons.*

Figure 5: Detailed procedures for taxiing according to the FCOM

In the Section *'TAXI'*, the FCOM (PRO-NOR-SOP-10[7]) stipulates amongst others the following:

TAKEOFF DATA/CONDITIONS

If takeoff data has changed, or in case of a runway change, prepare updated takeoff data, as appropriate:

F-PLN (Runway)........................REVISE | CM2
FLAPS lever ....AS APPROPRIATE | CM2

Select takeoff position.

V1, VR, V2........................REINSERT | CM2
FLX TO temperature........................REINSERT | CM2

Figure 6: Information on take-off data insertion in the event of a runway change according to the FCOM.

As the crew decided to take-off from the Golf intersection while taxiing, this decision constituted a runway change. The aforementioned items were not performed by the copilot.

[7] PRO-NOR-SOP: procedure – normal – standard operating procedure

Furthermore it should be noted that according to the operator, the relevant pilot (CM 2) works through these items in silence, because great importance is attached to the sterile flight deck procedure. Section 8.3.19.1.1 of the OM A stipulates amongst others the following:

„Sterile Flight Deck procedures dictate that only essential flight deck work be performed during all ground operations involving taxi, takeoff and landing (...) thus allowing the flight deck crew to concentrate on traffic and flying the aeroplane."

Section 8.3.19.2.1 of the OM A stipulates amongst others the following with regard to taxiing:

„The flight crew should be "head-up" and "eyes-out" for a continuous watch during aerodrome surface operations. A sterile cockpit should be maintained. All activities other than normal checklists, shall be kept to a minimum. When crossing a runway, checklist activity shall be stopped."

The commander made the following statement with regard to the 'TAXI' procedure to be performed while taxiing [translated from German]: *„The copilot performs this in silence; I can see whether the 'TAXI' procedure has been carried out on the ECAM* (electronic centralised aircraft monitoring)." The copilot made the following statement [translated from German]: *„No taxi check is performed after starting rolling; we do everything after the engine start, including the flight control check and after start items."*

According to the QRH, the following items should be worked through when lining up on the runway; with the exception of the *„TAKEOFF CHECK"* call by the commander and the *„TAKE OFF ALL GREEN"* call by both pilots, they are to be performed in silence by both pilots.

BEFORE TAKEOFF

CM1	CM2
	BRAKE TEMP (if brake fan running)........................CHECK
	BRAKE FAN pb-sw (if brake fan running)......................OFF
	TAKEOFF/LINE UP CLEARANCE..................................OBTAIN
EXTERIOR LIGHTS..SET	
	TCAS Mode selector..TA or TA/RA
APPROACH PATH................................CLEARED OF TRAFFIC	APPROACH PATH................................CLEARED OF TRAFFIC
"PACKS OFF" (if required)......................................ANNOUNCE	PACKS 1+2 (if required)...OFF
"TAKE-OFF CHECK"..ANNOUNCE	NO SMOKING SIGN....................................CYCLE OFF/ AUTO
	"TAKE-OFF ALL GREEN"..ANNOUNCE
	"PACKS OFF" (if required).......................................ANNOUNCE
"TAKE-OFF ALL GREEN"..ANNOUNCE	
"PACKS OFF" (if required).......................................ANNOUNCE	
	ENG MODE selector..AS RQRD
SLIDING TABLE..STOWED	SLIDING TABLE..STOWED
TAKEOFF RUNWAY..CONFIRM	TAKEOFF RUNWAY..CONFIRM

Figure 7: Procedures from the FCOM NP-NP 5/16

Due to a serious incident on 1 October 2013 (see Final Report No. 2246) the operator added the *„BEFORE TAKEOFF"* procedure with the following caution box on 11 April 2014. The *„TAKEOFF ALL GREEN"* call by both pilots is intended to confirm that they have reviewed the items in this caution box in silence.

CAUTION	With the response "TAKE-OFF ALL GREEN" the crew member confirms that: 1. Packs switching according take off calculation. 2. Altitude in the FCU window. 3. Flex setting on upper ECAM DU. 4. T/O memo »ALL GREEN«. 5. Flaps indication on lower ECAM corresponds to the calculated T/O flaps setting, entered on the MCDU PERF page. 6. RWY entered in the MCDU.

Figure 8: Caution box from FCOM PRO-NOR-SOP-11. Part of the published *„BEFORE TAKEOFF"* procedure

Both pilots stated that they had had no knowledge of this caution box at the time of the serious incident.

1.18 Additional information

1.18.1 Calculating the necessary engine power for take-off

Reducing the take-off power of the engines below the maximum possible value is designed to minimise the temperature in the engine turbines and consequently engine wear. This reduction is achieved by specifying an increased outside air temperature (flex temperature) for the FMGS in order to calculate the engine power.

This take-off engine power matches with the minimum power for allowing the take-off to be continued or rejected within the remaining runway length in the event of engine failure at decision speed V1. In the case of relatively long runways (full-length take-offs), the minimum required angle of climb tends to be the limiting factor, while on shorter runways (intersection take-offs) it is the accelerate stop distance.

Both flight crew members must independently of one another calculate the necessary engine power and speeds for take-off (take-off performance calculation) on an electronic flight bag (EFB). Both pilots have an EFB for this purpose. The corresponding display screens are located in the cockpit below the sliding side windows.

The necessary input for this calculation on the EFB includes amongst others the take-off mass, meteorological data and the take-off runway information including the intended intersection. The results must be read off from the EFB screen (cf. Figure 9) and entered into the aircraft's FMGS using the multi-purpose control and display unit (MCDU) keyboard. Both pilots have an MCDU at their disposal.

During take-off, the relevant computer adjusts the engine power to the value which corresponds to the previous entries of the flight crew on one of the two MCDUs.

In the present serious incident which is the subject of the investigation, both pilots had performed the calculations for a full-length take-off on runway 15 on their EFBs and entered the corresponding speeds in the FMGS (cf. Figure 9).

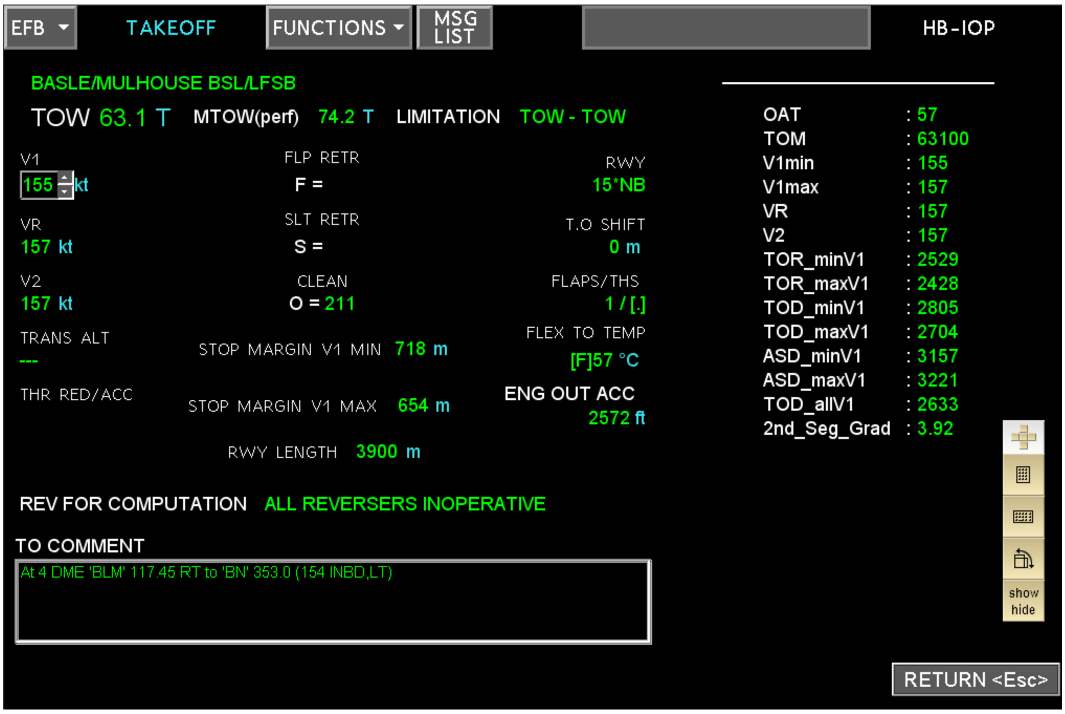

Figure 9: EFB calculations for a full-length take-off on runway 15 with a take-off mass of 63.1 tonnes. Resulting speeds: V1min = 155 kt, V1max = 157 kt, VR and V2 = 157 kt.

The commander had additionally performed a calculation for an intersection take-off from the Golf intersection (cf. Figure 10) and the copilot had performed a calculation for an intersection take-off from the Hotel intersection on their EFBs. The corresponding speeds were not entered into the FMGS.

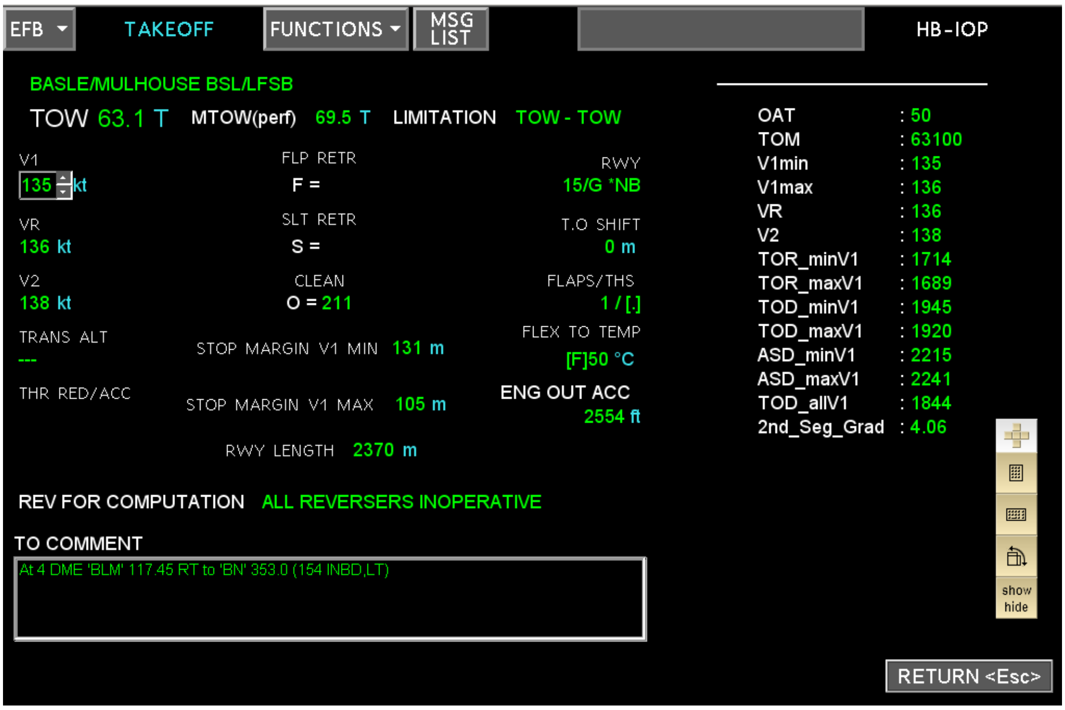

Figure 10: EFB calculation for a take-off on runway 15 from the Golf intersection with a take-off mass of 63.1 tonnes. Resulting speeds: V1min = 135 kt, V1max and VR = 136 kt, V2 = 138 kt.

1.18.2 Take-off distance calculation

Calculating the TOR[8], TOD[9] and ASD[10] distances using the EFB, as shown in Figures 9 and 10, is based on the assumption that the outside air temperature corresponds to the specified flex temperature. Because the effective outside air temperature is lower, this distance information contains inherent safety margins. It was not possible for the crew to quantify these safety margins. Such a quantification is therefore not the subject of the present investigation.

Comparing the results of the calculations for the full-length take-off (cf. Figure 9), it is evident that all three distances are greater than the available runway length from the Golf intersection.

For the serious incident, which is the subject of the investigation, the following picture is shown in summary for the set take-off power for a full length take-off:

Available runway length from the Golf intersection (TORA)	2370 m	
Available take-off distance from the Golf intersection (TODA)	2470 m	
Required runway length	V1min	V1max
TOR (take-off run)	2529 m	2428 m
TOD (take-off distance)	2805 m	2704 m
ASD (accelerate stop distance)	3157 m	3221 m

As the table shows, neither of the following two requirements for a safe take-off were met:

- to allow the aircraft to be stopped within the remaining runway length after a rejected take-off at decision speed;
- to allow the aircraft to continue the take-off within the remaining runway length after an engine failure at decision speed.

The increase of the engine power to the maximum possible value (TOGA) by the commander and the use of the approximately 20 kt lower V speeds, assisted in executing a successful take-off.

1.18.3 Different operators' procedures

1.18.3.1 General

The choice of an intersection take-off was made while taxiing to the threshold of the runway. The question therefore arises of how such a change can be handled using appropriate procedures so that take-off is not attempted with the incorrect engine power in such a case.

By way of comparison, the taxi procedures respectively the 'TAXI CHECK' procedures of other operators, which amongst others also operate the Airbus A320 type are briefly illustrated here.

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[8] TOR stands for take-off run. This is the distance required for the aircraft to accelerate to VR and for it to lift off after an engine failure at decision speed V1. The aircraft manufacturer leaves the crew free to choose between a minimum and maximum decision speed (V1min and V1max).

[9] TOD stands for take-off distance. This is the distance required for the aircraft to accelerate to VR, lift off and for it to reach a height of 35 ft after an engine failure at decision speed V1.

[10] ASD stands for accelerate stop distance. This is the sum of the distance required to accelerate to the speed V1 and the distance required to bring the aircraft to a standstill using the wheel brakes after a rejected take-off at V1.

1.18.3.2 Operator No. 1

This operator operates the Airbus A320, A330 and A340 types. The same checklist applies to all types operated and is completed by the pilots in a closed loop procedure before starting engines and lining up on the runway. This means that both pilots need to confirm to each other and to cross-check that the relevant items have been worked through. These checks include, in particular, the correct configuration for the take-off and the entry of the performance data into the FMGS. After any runway change, which also includes planning an intersection take-off, this involves checking that the critical speeds and flex temperature for the take-off correspond to this change.

1.18.3.3 Operator No. 2

This operator operates the A320 and A330 types. The procedures are the same for the different types.

The procedures in the OM B alert the crew by means of a caution box that when changing runway the take-off data must be adjusted.

Furthermore, OM B stipulates that the pilot flying (on the ground the commander) is to request use of the checklist and that the items are to be worked through by the pilot monitoring (on the ground by the copilot). It emphasises that this should be understood in terms of a question/answer/action, i.e. a dialogue between the two pilots.

1.18.3.4 Operator No. 3

This operator operates the A320 type. At this operator, the procedures to be performed before or while taxiing according to the manufacturer's instructions in accordance with the FCOM are supplemented by two short checklists *„Taxi"* and *„Change of runway/intersection"*, each of which encompasses just three items. The PNF must read the paper version of these checklists.

The *„Taxi"* checklist contains the *„Briefing ... confirmed"* check, which is to be performed by both pilots. For this purpose, the OM B contains a detailed description, according to which this step should include checking the take-off data *(„inserted for appropriate runway / intersection"*).

The *„Change of runway/intersection"* checklist is worked through after a procedure specifically for this case, which is described in detail in the OM B. Initially, this procedure includes instructions to bring the aircraft to a standstill, set the parking brake, inform air traffic control of the time required for the change, and not under any circumstance perform the subsequent steps under time pressure. This is followed by the procedural steps necessary for the change itself. Finally, the *„Change of runway/intersection"* checklist ensures that the desired take-off data has been correctly entered into the FMGS.

1.18.3.5 Operator No. 4

This operator operates the A319 and A320 types according to identical procedures and checklists. The OM B procedures instruct the crew to enter the most likely or the expected variant of the take-off data into the FMGS. The operating procedures make it possible, for example, to determine data for an alternative take-off point (e.g. from an intersection) using the EFB and to record the data clearly on the operational flight plan. The OM B also cites entering this data into the secondary flight plan of the FMGS as an option.

In practice, the operator's crew usually enter the take-off data for the most likely intersection, so that when this option is selected, which usually occurs under time pressure, no new entry into the FMGS is necessary. If during taxiing it emerges that take-off will take place on the entire available runway length, it is possible to enter the relevant data into the FMGS. This does not generally pose a problem, because in this case the increased taxiing time usually means there is more time available. If the crew forget to enter the data, take-off takes place with only a slightly higher engine power than necessary for the entire runway length, which poses no issue in relation to safety.

The OM B stipulates a standardised mnemonic repetition of the most important elements for the imminent take-off and departure during taxiing to the take-off point. This includes the pilot flying addressing the take-off data actually entered and used and this data being cross-checked and verified by the pilot monitoring as part of the closed loop procedure.

1.19 Useful or effective investigation techniques

Not applicable.

2 Analysis

2.1 Technical aspects

There are no indications of any pre-existing technical faults which might have influenced the serious incident.

2.2 Human and operational aspects

2.2.1 Flight crew

The flight crew performed their calculations for take-off in accordance with the procedures stipulated by the operator. By entering the take-off data for a full-length take-off on runway 15 into the FMGS primary flight plan and the take-off data for a take-off from the Delta intersection on runway 33 in the secondary flight plan, they maintained the option of a short-notice change to runway 33, which was also addressed in the take-off briefing. Their actions were therefore proactive and consistent with efficient operation.

The commander then also calculated the take-off data for a take-off from the Golf intersection on runway 15 on his EFB, while the copilot calculated the take-off data for a take-off from the Hotel intersection on his EFB. Although this concept was generally proactive, this created a challenging situation for the flight crew. The flight crew had prepared four take-off variants. A full-length take-off on runway 15 was entered in the primary flight plan; a take-off from the Delta intersection on runway 33 was entered in the secondary flight plan, a take-off from the Golf intersection on runway 15 was entered on the commander's EFB, and a take-off from the Hotel intersection on runway 15 was entered on the copilot's EFB.

In the present case, a decision in favour of an intersection take-off in accordance with the operating procedures would have meant that the commander should have performed another independent calculation on his EFB for a take-off from the Hotel intersection and the copilot perform the same for a Golf intersection take-off and that the two calculated results would then have had to be compared. In a further step, the PF should have entered these results into the FMGS and this should have been cross-checked by the PNF. It is evident that these steps take a certain period of time and should not be performed while taxiing. The crew were therefore probably already aware before leaving the stand that they were not in a position to make a short-notice decision on an intersection take-off while taxiing.

While taxiing, the crew made a short-notice decision to take-off from the Golf intersection on runway 15. The flight crew did not perform the aforementioned steps. It cannot be excluded that the flight crew had not intended to perform a second independent calculation of the intersection take-off data, because they had already calculated the intersection take-off data on their EFBs at the stand and intended only to enter the previously calculated take-off data into the FMGS in the event of an intersection take-off.

The reason the take-off data was not entered into the FMGS may be that the flight crew's decision to use the Golf intersection for the take-off was relatively short-notice and the crew therefore came under time pressure. A possible contributing factor is the fact that the procedure sequence while taxiing stipulates that the copilot must only cross-check the entry of the take-off data in the event of a runway change, and then only in silence. If he had ticked this procedure item before the decision to use the Golf intersection, this check would have been ineffective. In this case, the commander was not able to identify this, as no verbal communication takes place regarding this point. Furthermore, it is obvious that in the case of the *„TAKEOFF BRIEFING ... CONFIRM”* item the commander did not address the planned intersection take-off, although this is stipulated in the relevant procedure sequence (cf. Figure 4).

The time pressure undoubtedly increased when the flight crew received an unexpectedly early line-up clearance; at this time they were still under the impression that the approaching aircraft would land before they took off. The line-up on taxiway Golf took place without the aircraft stopping. The take-off roll was also initiated without stopping at the take-off point (rolling take-off). Doubt remains as to whether the *„BEFORE TAKEOFF"* checklist items, which according to operating procedures should have been worked through, were worked through in their entirety under this time pressure. The pilots could have realised that they had not entered the intersection take-off data for the take-off no later than the last item in the *„TAKEOFF RUNWAY ... CONFIRM"* procedure.

In the case of the *„TAKEOFF ALL GREEN"* item too, the two pilots would have been able to notice that their power selection was incorrect, because the caution box introduced to the *„BEFORE TAKEOFF"* procedure after the last serious incident (cf. Figure 8) again explicitly mentions that cross-checking both the *„Flex setting on upper ECAM DU"* and the selected runway in the MCDU is necessary. However, neither pilot was aware of this caution box.

Because of his experience from numerous take-offs at EuroAirport Basel Mulhouse Freiburg, the commander realised during the take-off roll that the relationship between the acceleration and the position on the runway was unusual. He then set TOGA power, which was appropriate to the situation and created a better basis for the subsequent climb. The commander looked at the speeds he had displayed on his EFB and realised that the aircraft had already reached the speeds calculated for a take-off from the Golf intersection (V1, VR, V2). For this reason, he immediately initiated lift-off by rotating the aircraft. The subsequent climb was performed with significant pitch. This exceeded the maximum pitch specified by the flight director (17.5 °) by up to 2 °, which is probably due to the reaction to the situation. However, this high pitch had no negative effect on the climb.

It is worth noting in this context that the commander initiated the rotation for lift-off before the speed entered in the FMGS (157 kt) had been reached. According to his statement, after looking at the take-off data for the intersection take-off on his EFB he had determined that the corresponding speeds were 20 kt lower, so that the aircraft could already lift-off at the current speed (approximately 140 kt).

The actions and reactions of the flight crew to realising the incorrect engine power setting facilitated the successful take-off. According to the present calculations, it would however not have been possible to bring the aircraft to a standstill on the runway in the event of a rejected take-off that had bee initiated at high speed.

2.2.2 Operator

The procedures published by the operator are stipulated in different manuals. This makes it difficult for the crews to have a simple overview of the complete procedure sequences and it is therefore difficult to implement them in practice. It is without doubt appropriate that the main procedures are listed for the crews in the quick reference handbook (QRH), which is the only document in paper form. However, the two instructions *„There is no need to use the QRH normal operation chapters to perform the items. But it is allowed to use the QRH as a guideline, for example during (...)"* (cf. chapter 1.17.2) and *„Ensure that all items are completed in the correct sequence"* are not appropriate in the case of important processes and make it possible for individual and even repeated errors to go undetected.

Checklists and essential procedures should be worked through in the form of a closed loop procedure („address, execute, control") with the necessary verbal communication. The serious incident, which is the subject of the investigation, demonstrates that silent checks can lead to unsatisfactory cross-checking. The commander, for example, did not notice that the take-off data check requested by the copilot, which should be performed in the event of a runway change in particular, did not take place. Conversely, the copilot did not notice that the commander did not perform a revision of the take-off briefing. It is highly likely that mutual verbal communication regarding these issues would have prevented these omissions (cf. Figures 4 and 6).

The operator reacted to a similar serious incident by introducing a caution box (cf. Figure 8). The points mentioned in the caution box are intended to prevent pilots from setting the incorrect power. Although attempting to solve the problem by providing crews with a new regulation which promises success in the case of error-free execution may seem satisfactory from a legal perspective, this approach is less convincing from the perspective of flight safety. It is doubtful whether the six additional points to be worked through in silence represent constructive problem solving. They represent an additional burden for the flight crew in a phase where time is critical. Furthermore, cross-checking, which alone would lead to a marked reduction in the incidence of error, was once again excluded.

Since neither pilot was aware of this caution box, the question also arises as to the extent to which flight crews effectively process the operator's procedure revisions and whether there is any need for action. It appears rather improbable that among the operator's pilots only these two pilots, who were only by chance working together as a flight crew, were not familiar with these instructions. In the present case, a final safety net was therefore ineffective.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was licensed for VFR/IFR transport.
- Both the mass and centre of gravity of the aircraft were within the permitted limits according to the AFM at the time of the serious incident.
- The investigation did not produce indications of any pre-existing technical faults which might have influenced the serious incident.

3.1.2 Crews

- The pilots were in possession of the necessary licences for the flight.
- There are no indications of the pilots suffering health problems during the flight involved in the serious incident.

3.1.3 History of the flight

- In order to reduce the taxiing time, the flight crew planned to take-off on runway 33. Runway 15 was in use.
- With the route clearance the flight crew received the information that a take-off on runway 15 was envisaged and that they should repeat their request to use runway 33 later.
- After receiving the loadsheet, the flight crew calculated the take-off data for a full-length take-off on runway 15.
- The commander then entered this data into the primary flight plan using the multi-purpose control and display unit (MCDU).
- The flight crew entered the data for a take-off on runway 33 from the Delta intersection into the secondary flight plan.
- The commander then also calculated the take-off data for a take-off from the Golf intersection on runway 15 on his EFB, while the copilot calculated the take-off data for a take-off from the Hotel intersection on his EFB.
- To conclude the cockpit preparation, the flight crew performed the take-off briefing, in which they discussed a full-length take-off on runway 15 and a take-off on runway 33 from the Delta intersection.
- As the flight crew had to assume a delayed take-off on runway 33 according to the information provided by the ATCO, they chose to take-off on runway 15 and subsequently received at 12:56:47 UTC clearance to taxi on taxiway Bravo to runway 15.
- An Easyjet aircraft was ahead of BHP 2532 on taxiway Bravo.
- At 12:59:11 UTC, the crew of the Easyjet reported they were ready to take-off from the Golf intersection on runway 15.
- The crew of BHP 2532 then also decided to request a take-off from the Golf intersection.
- After a query, at 13:00:04 UTC the flight crew of BHP 2532 received the following clearance*: „(...) line up one five Golf and wait (...).”* At this time BHP 2532 was still on taxiway Bravo.

- As another aircraft was approaching, the flight crew of BHP 2532 enquired whether they could line up.
- At 13:00:41 UTC, the ATCO confirmed this and at 13:01:08 UTC, the flight crew received take-off clearance. At this time BHP 2532 was still taxiing to the take-off point.
- The flight crew initiated the take-off roll without stopping at the take-off point (rolling take-off).
- The set engine take-off power was based on the take-off calculations for the entire runway length of 3900 m. A runway length of 2370 m was available for a take-off from the Golf intersection.
- During the take-off roll, the commander felt that the acceleration in relation to the position on the runway was unusual. He noticed that the engine power set was incorrect and increased it to the maximum possible using the throttles.
- At this time the speed was 140 kt. This was below the rotation speed for a full-length take-off on runway 15 (157 kt), but greater than that for a take-off from the Golf intersection (136 kt).
- Approximately 790 m before the end of the runway, the commander began to rotate the aircraft at a speed of 150 kt – 250 m thereafter the aircraft was at a height of 35 ft. The rest of the climb was uneventful.

3.1.4 General conditions

- The choice of an intersection take-off was made at short notice while taxiing.
- The operating procedures stipulate that the copilot must cross-check the take-off data while taxiing, especially in the event of a runway change.
- Cross-checks while taxiing are performed by the pilots silently and therefore do not represent a closed loop.
- The weather conditions had no influence on the serious incident.

3.2 Causes

The serious incident is attributable to the fact that the aircraft did not achieve the necessary performance on take-off, because the flight crew performed the take-off from a taxiway intersection with an engine power which had been calculated for the entire length of the runway.

The following factors contributed to the serious incident:

- Procedures which require checking essential items in silence, which means that cross-checking cannot take place in the spirit of a closed loop.
- The decision to an intersection take-off was made at short notice.
- Additional cross-checking of the data entered into the flight guidance system during the line up, which had been recently introduced, was ineffective because the flight crew were unaware of it.

4 Safety recommendations, safety advices and measures taken since the serious incident

Safety recommendations

According to the provisions of Annex 13 of the International Civil Aviation Organization (ICAO) and Article 17 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, all safety recommendations listed in this report are intended for the supervisory authority of the competent state, which must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, any establishment and any individual is invited to strive to improve aviation safety in the spirit of the safety recommendations pronounced.

Swiss legislation provides for the following regulation regarding implementation in the Ordinance on the Safety Investigation of Transport Incidents (OSITI):

„Art. 48 Safety recommendations

1 The STSB shall submit the safety recommendations to the competent federal office and notify the competent department of the recommendations. In the case of urgent safety issues, it shall notify the competent department immediately. It may send comments to the competent department on the implementation reports issued by the federal office.

2 The federal offices shall report to the STSB and the competent department periodically on the implementation of the recommendations or on the reasons why they have decided not to take measures.

3 The competent department may apply to the competent federal office to implement recommendations."

The STSB shall publish the answers of the relevant Federal Office or foreign supervisory authorities at www.stsb.admin.ch in order to provide an overview of the current implementation status of the relevant safety recommendation.

Safety advices

The STSB may publish safety advices in response to any safety deficit identified during the investigation. Safety advices shall be formulated if a safety recommendation in accordance with Regulation (EU) No. 996/2010 does not appear to be appropriate, is not formally possible, or if the less prescriptive form of a safety advices is likely to have a greater effect. The legal basis for STSB safety advices can be found in Article 56 of the OSITI:

"Art. 56 Information on accident prevention

The STSB may prepare and publish general information on accident prevention."

4.1 Safety recommendations

None

4.2 Safety advices

4.2.1 Robust procedures

4.2.1.1 Safety deficit

On 6 October 2014, the crew prepared the Airbus A320-214 aircraft, registration HB-IOP, for the flight with the flight plan call sign BHP 2532 from Basel (LFBS) to Djerba (DTTJ), Tunisia. Runway 15 was in use. The crew calculated the engine power for the entire available runway length of 3900 m and entered this data into the flight management and guidance system (FMGS) in the primary flight plan. The calculated speeds V1, VR and V2 were 157 kt. The crew entered the data for a take-off on runway 33 from the taxiway Delta intersection in the secondary flight plan. Before starting the engines the commander calculated the data for a take-off on runway 15 from the taxiway Golf intersection on his electronic flight bag (EFB), which resulted in speeds of 136 kt and 138 kt respectively for V1, VR, and V2. The copilot calculated the data for a take-off on runway 15 from the taxiway Hotel intersection on his EFB.

While taxiing, the crew decided at short notice to save time by taking off from the taxiway Golf intersection, which offered an available runway length of 2370 m. Without stopping after lining up, they took off with an engine power which had been calculated for the entire length of the runway. This engine power did not meet the requirements for allowing the take-off to be continued or rejected within the remaining runway length in the event of engine failure at decision speed.

During the final stages of the take-off roll, the commander noticed that the engine power was too low, increased it to the maximum possible and at a speed of 150 kt began to lift off the aircraft by means of rotation. The subsequent climb and cruise were uneventful.

The investigation revealed that the operator's procedures stipulate that essential items such as confirming the take-off runway and checking the data entered into the FMGS are performed in silence by both pilots. This meant that neither pilot noticed that incorrect engine power and speeds had been entered for the take-off.

As a result of a similar incident a year earlier, the aviation operator had introduced a *„Before takeoff”* caution box. This includes six checklist items for both pilots and is intended to prevent take-offs with incorrect take-off data. The crew was unaware of this caution box.

4.2.1.2 Safety advice No. 2

The operator should optimise its procedures so that they exhibit high resilience. For example, applying a method of working in accordance with the closed loop principle can ensure that any errors or forgotten steps in the procedure can be quickly detected and rectified, especially in the case of reacting to a new situation. This should also include consideration of how much communication is appropriate within a multi-crew. On the one hand, the exchange of information should not be so great as to cause oversaturation or incorrect priorities to be set. On the other hand, situations where errors remain undetected due to insufficient communication or essential information is not made known to all crew members should be avoided.

4.3 Measures taken since the serious incident

On the same day the investigation of the serious incident was opened, the operator issued the following instruction and published it for the attention of all pilots of the operator (emphasis in the original text):

„Due to two company incidents in which takeoffs were performed with incorrect performance calculations / data entry in the FMS, ***intersection takeoffs are now prohibited with immediate effect.*** *The investigation of one of the incidents has been completed by the Safety Manager and the second incident investigation is still in progress. Both incidents are being investigated by the [former] Swiss Accident Investigation Board.*

The prohibition of intersection takeoffs will remain in force until the flight procedures are revised. The flight procedures are currently being reviewed and will be revised so that a robust procedure can be implemented which aims to avoid such errors being made by the crew.

For the purpose of this Readingfile, intersection takeoff means a takeoff from any other taxi way not linked to the beginning of the runway or leading to the normal point of takeoff of a runway in use. Notams and ATC instructions prohibiting a takeoff from the full length of the runway must be respected.

The layout of some aerodromes may make it difficult to determine whether or not you are performing an intersection takeoff. Below are some examples to assist you in adhering to this directive:

EDDL: Rwy 23L L1 and L2 permitted, L3 not permitted. Rwy 23R K1 permitted. Rwy 05R L9 permitted, L8 not permitted.

LSZH: Rwy 16 E1 permitted, E3 not permitted. Rwy 34 E9 permitted, E8 not permitted. LEPA: Rwy 24R H1 and H3 permitted.

LOWW: Use full length of the runway in use.

LIBR: Use full length of the runway in use.

LFSB: Use full length of the runway in use.

LWSK: Use full length of the runway in use.

GCTS: Rwy 08 B1 permitted, B2 not permitted. Rwy 26 B6 and B7 permitted.

Additionally the following policy will also be added to OM/A in the next revision and shall be adhered to immediately:

Performance or SID change: In order to enhance a safe taxi operation the flight crew shall delay all required modifications including performance calculations and briefings until the aircraft has come to a stop and the parking brake is set. Both flight crew members shall crosscheck and verify the performance calculation and entries in the FMS."

Amongst others the crew were informed in a so-called Reading File, with effect from 29 January 2015, about the following:

„(...). To increase the robustness of the procedures used in the taxi phase shortly before takeoff, a new set of callouts will be introduced as shown below. The new callouts will include a runway identification check together with a performance data verification by both pilots just before entering the runway for departure, followed by the "takeoff check".

Pilots are not required to reopen the performance module on the EFBs during this performance verification check. The verification shall rather be done by confirming that the data entered in the MCDU before ENG start are still applicable or that a change in conditions (runway, wx etc.), if applicable, has been correctly implemented."

Effective from 29.01.2015:

When cleared for lineup, before entering the runway:		
RWY___ / INTERSECTION*___ IDENTIFIED.. ANNOUNCE	**I**	**CM1**
CHECKED.. ANNOUNCE	**I**	**CM2**
Both pilots confirm that the line up is performed on the intended runway / intersection.		
PERFORMANCE VERIFIED...ANNOUNCE	**I**	**CM1**
CHECKED.. ANNOUNCE	**I**	**CM2**
Both pilots confirm that the applied takeoff data correspond to the runway / intersection used for takeoff and the actual conditions.		
(PACKS OFF)* / TAKEOFF CHECK.. ANNOUNCE	**I**	**CM1**
TAKEOFF ALL GREEN / (PACKS OFF)*.................................... ANNOUNCE	**I**	**CM2**
TAKEOFF ALL GREEN / (PACKS OFF)*.................................... ANNOUNCE	**I**	**CM1**
*If applicable		

In another Reading File the crew were informed about the cancellation of the intersection take off restriction amongst others as follows:

„Update 15.05.15: A SIRA (Safety Issue Risk Assessment) has been performed and with the change to our flight procedures which took place 29.01.15 and the time which the crews have had to become familiar with the new call outs, the measures which were taken are now considered to be sufficient to prevent reoccurrence. As such intersections take offs are now permitted."

In addition the following policy was announced:

„Additionally the following policy will also be added to OM/A in the next revision and shall be adhered to immediately:

Performance or SID change:

In order to enhance a safe taxi operation the flight crew shall delay all required modifications including performance calculations and briefings until the aircraft has come to a stop and the parking brake is set. Both flight crew members shall crosscheck and verify the performance calculation and entries in the FMS."

Payerne, 1 December 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

Berne, 10 November 2015

Annexes

Annex 1: Chronology of the serious incident

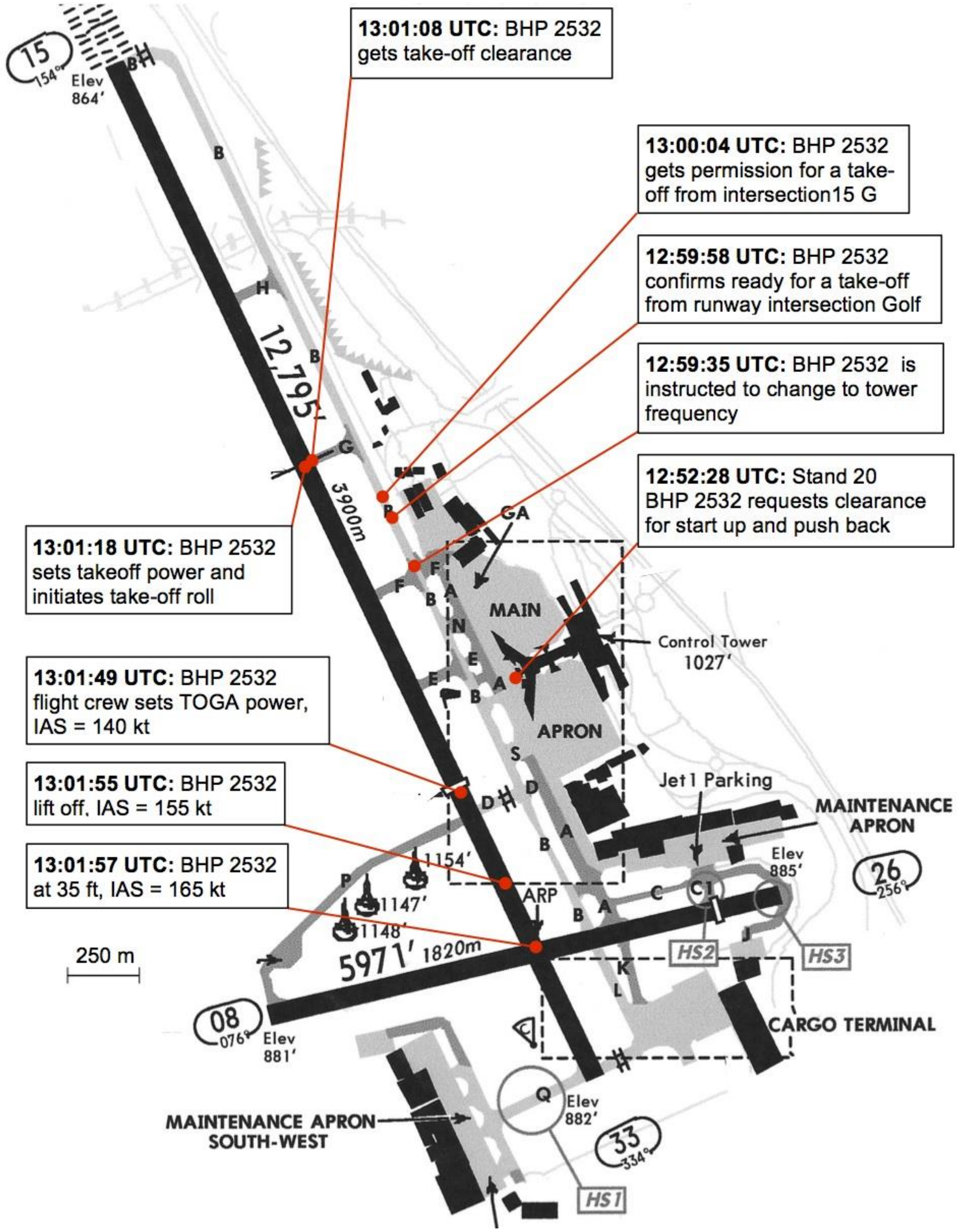

Figure 11: Edited copy from the Jeppesen manual (10-9A); the red dots indicate the respective position of aircraft BHP 2532 at the specified time. Take-off from the Golf intersection.