AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

		Reference		**CA18/2/3/10054**	
Aircraft Registration	9H-VJM	**Date of Accident**	13 October 2021	**Time of Accident**	0518Z
Type of Aircraft	BD-700-1A10 (Global 6000)		**Type of Operation**	Private (Part 91)	
Pilot-in-command Licence Type	Airline Transport Pilot Licence	**Age**	43	**Licence Valid**	Yes
Pilot-in-command Flying Experience		**Total Flying Hours**	7500	**Hours on Type**	2611
Last Point of Departure	O.R. Tambo International Airport (FAOR), Gauteng Province, South Africa				
Next Point of Intended Landing	Dubai International Aerodrome (OMBD), United Arab Emirates				
Damage to Aircraft (Substantial/Destroyed)	Substantial				

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

Echo gate at FAOR at Global Positioning System (GPS) co-ordinates determined to be 26°08'49.74" South, 028°15'24.13" East, at an elevation of 5 524 feet (ft)

Meteorological Information	Wind direction: 270°at 5kt; Visibility: 9999m; Temperature: 20°C						
Number of People On-board	2+1	**Number of People Injured**	0	**Number of People Killed**	0	**Other (On Ground)**	0

Synopsis

On Wednesday morning, 13 October 2021 at 0518Z, the crew on-board a Bombardier BD-700-1A10 aircraft with registration 9H-VJM was taxiing through the Echo security gate at O.R. Tambo International Aerodrome (FAOR) in Gauteng province for take-off on an international non-scheduled flight to Dubai International Aerodrome (OMBD). The crew did not communicate their intentions or request permission from the Airports Company South Africa (ACSA) gate controller for safe passage through the Echo gate. The 9H-VJM aircraft was following another aircraft, with registration mark ZS-AAK. The ZS-AAK crew had requested access from the ACSA gate controller to pass through the Echo gate, which was granted. After the ZS-AAK aircraft had gone through the gate, the 9H-VJM aircraft approached the gate, intending to pass through to the airside (tailgating) as well. At that time, the motorised gate had already started to close. The 9H-VJM crew attempted to veer-off to the left and then stopped. The gate continued to move to the close position for 11 seconds before it collided with the wing of the aircraft. The gate impacted the right-wing leading-edge number 2 slat of the aircraft, causing substantial damage to it.

The investigation revealed that the gate was not monitored at the time the 9H-VJM aircraft approached. Moreover, the crew did not follow the standard operating procedure to communicate their intentions and to request permission to pass through the gate.

Probable Cause

The motorised gate collided with the aircraft whilst the 9H-VJM crew was passing through to the airside for departure from FAOR.

Contributory Factors

- The crew did not communicate their intentions or request permission from ACSA/Echo gate control centre to pass through safely to the FAOR airside for departure.
- There are five frequency channels that the crew had to engage from the Fire-blade Operations (FBO) to the Echo gate, which translate to a high workload for the crew.

SRP Date	16 August 2022	Publication Date	18 August 2022

INTRODUCTION

Reference number	**:** CA18/2/3/10054
Name of owner	**:** Cavic Aviation Leasing (Ireland) 26 Co.
Name of the operator	**:** VistaJet Ltd
Type of operation	**:** Private (Part 91)
Manufacturer	**:** Bombardier Aerospace
Model	**:** BD-700-1A10 (Global 6000)
Nationality	**:** Republic of Malta
Registration markings	**:** 9H-VJM
Place	**:** Echo Gate, O.R. Tambo International Aerodrome (FAOR)
Date	**:** 13 October 2021
Time	**:** 0518Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability****.*

Investigation Process:

The AIID was informed of an accident on Wednesday morning, 13 October 2021, by air traffic control (ATC) at O.R. Tambo International Aerodrome (FAOR) involving a Bombardier BD-700-1A10 at FAOR Echo gate. The AIID appointed an investigator-in-charge and a co-investigator who dispatched to the accident site. The State of Design and Manufacture of the aircraft, which is Canada, was informed of the accident as per ICAO Annex 13 protocol, and had appointed a non-travelling Accredited Representative. The State of Registry and Operator, the Republic of Malta, was informed of the accident; however, they have not appointed an Accredited Representative. The AIID will lead the investigation and issue the final report.

The AIID reports are made available to the public at:
http://www.caa.co.za/Pages/Accidents%20and%20Incidents/Aircraft-accident-reports.aspx

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   - *Accident – this investigated accident*
   - *Aircraft – the Bombardier BD-700-1A10 involved in this accident*
   - *Investigation – the investigation into the circumstances of this accident*
   - *Pilots – the pilots involved in this accident*
   - *Report – this accident report*

2. *Photos and figures used in this report were obtained from different sources and may be adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or the addition of text boxes, arrows or lines.*

Disclaimer:
This report is produced without prejudice to the rights of AIID, which are reserved.

Table of Contents

Abbreviation	Description
'	Minute
"	Seconds
º	Degree
AFM	Airplane Flight Manual
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AMC	Airport Management Centre
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
AOC	Air Operator Certificate
APU	Auxiliary Power Unit
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
˚C	Degrees Celsius
CAR	Civil Aviation Regulations
CAVOK	Cloud and Visibility OK
CCTV	Closed Circuit Television
CDU	Control Display Unit
CLD	Clearance Delivery Control
CVR	Cockpit Voice Recorder
EMS	Electrical Management System
FAOR	O.R. Tambo International Aerodrome (ICAO code)
FBO	Fireblade Operations
FL	Flight Level
FO	First Officer
FDR	Flight Data Recorder
ft	Feet
GMC	Ground Movement Control
GPS	Global Positioning System
hPa	Hectopascal
ICAO	International Civil Aviation Organisation
m	Metre
METAR	Meteorological Routine Aerodrome Report
MHz	Megahertz
OMDB	Dubai International Aerodrome (ICAO code)
PIC	Pilot-in-command
QNH	Barometric Pressure Adjusted to Sea Level
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
SID	Standard Instrument Departure
SOP’s	Standard Operating procedures
TBO	Time Between Overhaul
UTC	Co-ordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency
Z	Zulu (Term for Universal Coordinated Time – Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On Wednesday morning, 13 October 2021, a Bombardier BD-700-1A10 aircraft, registered 9H-VJM with a call sign VistaJet 850 (VJT850) was preparing for take-off on a non-scheduled international flight from O.R. Tambo International Aerodrome (FAOR) to Dubai International Aerodrome (OMBD). Two cockpit crew members (pilots) and one cabin crew member were on-board the aircraft.

1.1.2 At 04:50:41Z, the crew of 9H-VJM called Clearance Delivery Control (CLD) on frequency 121.70-Megahertz (MHz) for clearance; the crew was asked to standby. At 04:52:42Z, the CLD controller called back the crew and cleared them on standard instrument departure (SID) Runway 21R Exobi 3B.

1.1.3 According to the information in the flight data recorder (FDR), the number 2 engine was started at 05:10:26Z, followed by the number 1 engine at 05:11:06Z.

1.1.4 At 0514Z, the 9H-VJM identified themselves on Denel Campus Radio 132.50 MHz and requested to proceed through the flight line at the Denel Campus for departure at FAOR for OMDB. The 9H-VJM aircraft was granted permission and requested to proceed at their own discretion, and to report "*through the Echo gate*".

1.1.5 Meanwhile, at 0457Z, another aircraft with registration ZS-AAK contacted Apron control on 122.65 MHz, requesting a parking bay at the Delta apron; the aircraft was allocated D7. At 04:59:26Z, another aircraft with registration marking ZS-TMB that was parked at Fire-blade Operations (FBO) area requested Apron control to open the Echo gate. Apron control then called the control room to request the gate controller to open the Echo gate. At 05:02:23Z, the ZS-TMB crew reported *"through the gate".* Thereafter, the ZS-AAK aircraft requested taxi from the Denel Campus run-up bay to the Echo gate for repositioning to the Delta apron at FAOR. The Denel Campus operator requested the crew of 9H-VJM to give way to ZS-AAK as the aircraft was already near the gate, which the crew of 9H-VJM acknowledged. The ZS-AAK crew then contacted Apron control on frequency 122.65 MHz requesting them to open the Echo gate.

1.1.6 According to Apron control, the ZS-AAK aircraft proceeded through the gate at 05:13:11Z. Once the aircraft was on the airside, they informed Apron control *"through the gate".* Apron control then called the control room and instructed the gate controller to close the gate. Apron control was not aware of the movement of the 9H-VJM aircraft as the crew did not call Apron control to open the gate. The next transmission heard on 132.50 MHz was "*Apron the gate*" which the Denel Campus operator assumed was 9H-VJM. Due to limited visibility of the gate from the Denel Campus operator station, the operator could not see that the gate was closing whilst the 9H-VJM aircraft was taxiing towards it (the gate). After the transmission "*Apron the gate*" was heard, the Denel Campus operator went to the

window to see (check) what was happening at the gate; that is when she observed the 9H-VJM aircraft stationary in the middle of the lane with the Echo gate very close or in contact with the aircraft's wing.

1.1.7 The Denel Campus operator immediately telephoned FBO to check if the 9H-VJM aircraft was on their frequency and to ascertain if they knew what was happening because the aircraft was not on frequency 132.50 MHz as communication could not be established.

1.1.8 FBO advised that they would send a vehicle to ascertain if the gate was just close to the aircraft or if it had impacted the wing of the aircraft. The 9H-VJM crew did not declare any emergency status or state their situation. When the FBO vehicle arrived at the Echo gate, they notified the Denel Campus operator that the gate had impacted the aircraft on the right-side wing. Aerodrome Apron control was also advised of the accident.

1.1.9 From the available closed-circuit television (CCTV) footage, *the ZS-AAK aircraft is seen exiting the gate and passing through to the airside. Thereafter, the 9H-VJM aircraft is seen taxiing towards the gate. The traffic lights installed at the airside of the gate are green at this time (this is visible in the footage). As the aircraft approaches the gate, the gate starts to close at a slow speed and the traffic light (green signal) switches off. However, it is not possible to see if the traffic light's red signal is active at this stage in the footage. (Note: The Denel gate control light, which is normally green at all times, was OFF due to an electrical power outage (load shedding) since 0500Z on the day. The gate has been non-operational and had been left open for approximately two years prior to the accident date.) The Echo gate is then observed to be in motion for a total of 39 seconds before it impacts the aircraft's right wing. Just prior to impact, the aircraft veers off to the left and stops. The gate continues to close (moving towards the fuselage of the aircraft) for another 11 seconds before it collides with the right-wing leading edge number 2 slat and stops.* The gate's length is approximately 70m from the fully open position to the close position.

1.1.10 The Echo gate is controlled remotely by the Airport Company South Africa (ACSA) through the Airport Management Centre (AMC). If the crew of any aircraft plans to enter or exit the Denel Campus, they would need to make radio contact with the Aerodrome Apron controller on VHF 122.65 MHz; the Apron controller is stationed at the Airport Management Centre (AMC), which is located in the Domestic Terminal building. Following communication with an aircraft, the Apron controller then telephones the gate controller via a landline to either open or close the gate. The gate controller is stationed in the control room located in the International Terminal building. The gate controller could monitor the gate via a CCTV screen at their workstation. Apart from selecting the gate either to OPEN or CLOSE position, the gate controller can also STOP the gate's movement at any point.

1.1.11 The accident occurred during daylight at the Echo gate at FAOR and at Global Positioning System (GPS) co-ordinates determined to be 26°08'49.74" South 028°15'24.13" East, at an elevation of 5 524 feet (ft).

Figure 1: The yellow pin (9H-VJM) indicates the point of impact with the gate.
(Source: Google Earth)

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	2	1	-	3	-
Total	**2**	**1**	**-**	**3**	**-**

1.3 Damage to Aircraft

1.3.1 The number 2 leading edge slat on the right wing was substantially damaged.

Figure 3: Deformation of the number 2 leading-edge slat on the right wing.

1.4 Other Damage

1.4.1 The security gate sustained minor structural damage during the accident sequence.

1.5 Personnel Information

Pilot-in-command (PIC)

Nationality	Spanish	Gender	Male	Age	43
Licence Type	Airline Transport Pilot Licence				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument				
Medical Expiry Date	23 February 2022 (Class 1); 23 February 2023 (Class 2)				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	7 500.0
Total Past 90 Days	164.7
Total on Type Past 90 Days	164.7
Total on Type	2 611.0

First Officer (FO)

Nationality	German	Gender	Male	Age	37
Licence Type	Commercial Pilot Licence				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument				
Medical Expiry Date	13 November 2021 (Class 1); 13 November 2022 (Class 2)				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	4 622.0
Total Past 90 Days	167.55
Total on Type Past 90 Days	167.55
Total on Type	1 397.08

1.6 Aircraft Information

Airframe:

Type	Bombardier BD-700-1A10	
Serial Number	9630	
Manufacturer	Bombardier Aerospace	
Year of Manufacture	2014	
Total Airframe Hours (at time of the accident)	5 959.32	
Last Maintenance Inspection (hours & date)	5 881.09	30 September 2021
Hours Since Last Inspection	78.23	
C of A (issue date)	1 July 2015	
C of A (expiry date)	30 June 2022	
C of R (issue date) (Present Owner)	26 May 2021	
Operating Categories	Private (Part 91)	
MTOW	45 132 kg	

Engine No. 1:

Type	Rolls Royce BR710A2-20
Serial Number	22389
Hours Since New	5 546.45
Hours Since Overhaul	Modular engine

Engine No. 2:

Type	Rolls Royce BR710A2-20
Serial Number	22388
Hours Since New	5 959.32
Hours Since Overhaul	Modular engine

1.7 Meteorological Information

1.7.1 The meteorological aerodrome report (METAR) for FAOR on 13 October 2021 at 0500Z was as follows: METAR FAOR 130500Z 27005KT CAVOK 20/M01 Q1025 NOSIG=

Wind Direction	270˚	Wind Speed	5 knots	Visibility	+ 10 km
Temperature	20˚C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	-1˚C	QNH	1025hPa		

1.7.2 The meteorological aerodrome report (METAR) for FAOR on 13 October 2021 at 0530Z was as follows: METAR for FAOR 130530Z 27005KT 240V310 CAVOK 20/M02 Q1025 NOSIG=

Wind Direction	270˚	Wind Speed	5 knots	Visibility	+ 10 km
Temperature	20˚C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	-2˚C	QNH	1025hPa		

1.7.3 Satellite image: Not relevant as visibility was OK (CAVOK).

1.7.4 According to the official weather report summary received from the South African Weather Service (SAWS), there was no significant weather warning or advisory over FAOR between 1515Z and 0530Z.

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (Malta CAA). There were no records indicating that the navigational system was unserviceable prior to the flight.

1.9 Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the Regulator (Malta CAA) and was fitted with three very high frequency (VHF) radios.

1.9.2 The crew was in radio contact with FBO personnel prior to start and taxi on frequency 130.725 MHz.

1.9.3 The aircraft was fitted with a transponder and was issued a squawk code 7334 by the CLD controller during communication with the crew on frequency 121.70 MHz. It was from this frequency that the crew obtained their departure clearance. The 9H-VJM crew was also in communication with CLD while the aircraft was still parked on the apron at FBO, before starting the engines for taxi.

1.9.4 According to available information, the 9H-VJM crew communicated on frequency 121.7 MHz to request clearance and start-up.

1.9.5 The 9H-VJM crew did not communicate with Aerodrome Apron control on frequency 122.65 MHz before taxiing to the Echo gate for safe passage to the airside. The gate started to close as the aircraft approached the gate.

1.9.6 According to the Denel Campus operator, the crew of 9H-VJM made contact on Campus radio VHF 132.50 MHz at 0514Z, requesting permission to taxi through the flight line for departure at FAOR for OMBD. The crew was requested to proceed at their own discretion and to report "*through the Echo gate*".

1.10 Aerodrome Information

1.10.1 The accident occurred at FAOR.

Aerodrome Location	O.R. Tambo International Aerodrome (FAOR), Gauteng province	
Aerodrome Status	Licensed	
Aerodrome Co-ordinates	26°08'01.30" South 028°14'32.34" East	
Aerodrome Elevation	5 558ft	
Runway Headings	03L/21R	03R/21L
Runway Dimension	4 421m x 60m	3 405m x 60m
Runway Used	21R	
Runway Surface	Asphalt	
Approach Facilities	Runway lights, PAPI, DVOR / DME (JSV), ILS LOC and ILS GP for both runways	
Tower Frequency (West)	118.10 MHz	
Tower Frequency (East)	118.60 MHz	
Approach Frequency (South)	124.50 MHz	
Approach Frequency (West)	124.50 MHz	
Approach Frequency (East)	123.70 MHz	

1.11 Flight Recorders

1.11.1 This aircraft was fitted with a flight data recorder (FDR), type L-3 Communication model FA2100, Part No. 2100-2045-22 with Serial No. 000998780 and a solid-state cockpit voice recorder (CVR), type L-3 Communication model FA2100, Part No. 2100-1025-24 with Serial No. 000931420.

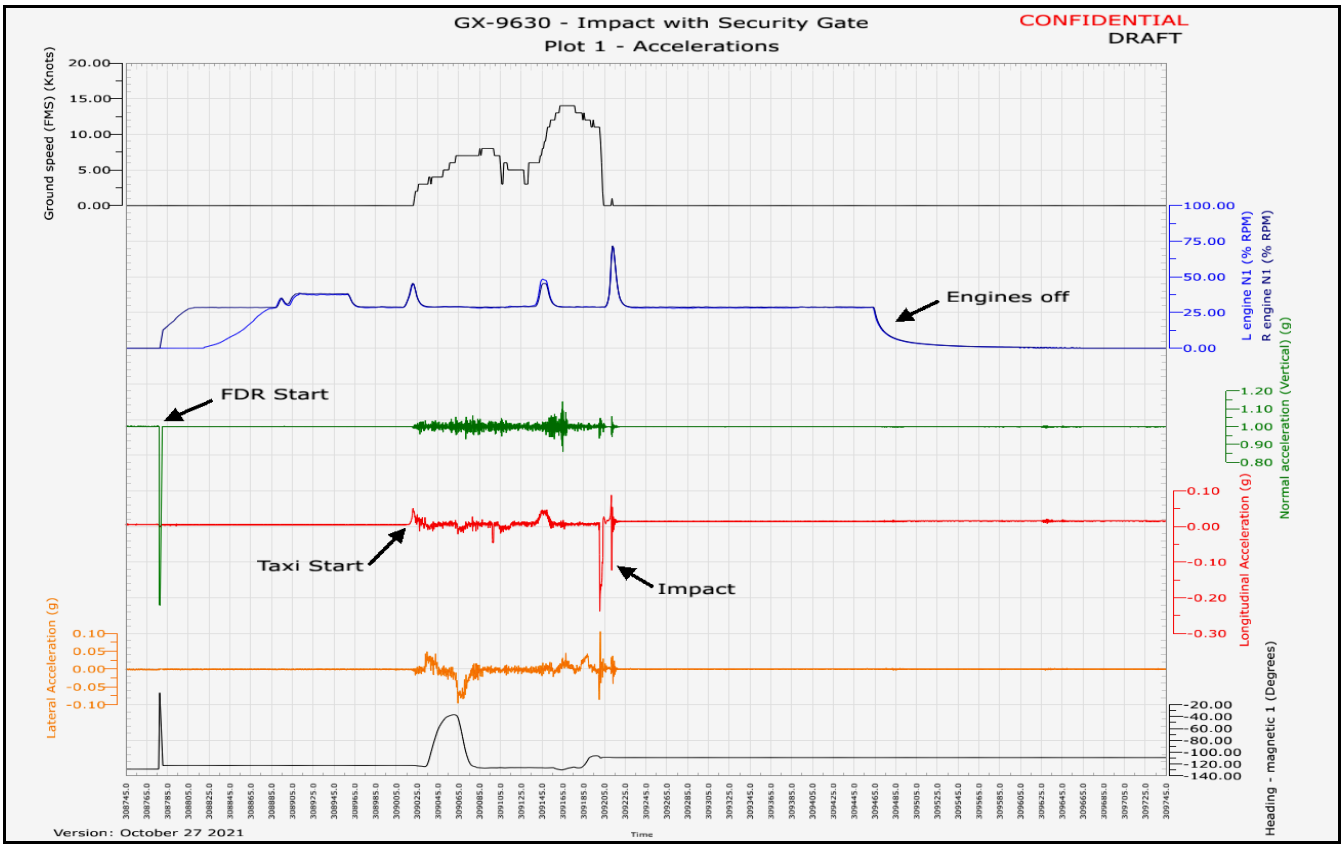
1.11.2 Both flight recorders were found still mounted in their original positions in the aircraft and were undamaged. Both units were removed from the aircraft and were downloaded on Thursday, 14 October 2021.

1.11.3 The investigation team had listened to the CVR recordings with the objective to prepare a transcript. The recording capacity of the units was 2 hours and 1 minute, however, it was found that the crew had not deactivated the non-thermal CVR circuit breaker following the accident and the entire recording was overwritten as they kept the auxiliary power unit (APU) running until the crew disembarked the aircraft, before it was towed back to the apron. This was in contravention to the standard operating procedures (SOP) of the operator. No communication pertaining to the accident was available on the CVR recordings except that the 'crew saw the green lights on the Denel Campus apron side' during a long conversation of the crew while they were conducting aircraft checks post-accident. Also, a noise in the background that sounded like a running auxiliary power unit (APU) could be heard in the recordings.

1.11.4 The raw FDR data was interrogated with the assistance of the aircraft manufacturer and the investigating authority of the State of Design and Manufacture. It was noted that the number 2 engine was started first (right side), followed by the number 1 engine (left side). It was also noted that the maximum speed at which the aircraft was taxied was 14 knots. Hydraulic pressures on all three systems were normal between 3 000 and 3 200 pounds per square inch (psi). The maximum brake pedal application was 41%, this was measured on the PIC side on the left pedal as he was taxiing the aircraft. The maximum brake pressures captured were as follows:

Item	Maximum pressures captured (psi)
Inboard brake pressure left	867
Inboard brake pressure right	1787
Outboard brake pressure left	867
Outboard brake pressure right	1784

1.11.5 The downloaded FDR parameters showed that the aircraft and all its systems were serviceable at the time and could not have contributed or caused the accident. The FDR data graph (below) displays no abnormalities with the operation of the aircraft.



Graph 1: FDR data shows no abnormalities with the operation of the aircraft.

1.12 Wreckage and Impact Information

1.12.1 The aircraft was taxied from the FBO apron area (where it was parked) to the Echo gate through the Denel Apron taxiway. As the aircraft approached the gate, it started to close. The last phase of the taxi was captured on CCTV camera which was mounted on the Denel Campus building, approximately 120 metres from the Echo gate on the left-side of the taxiway in use (see CCTV camera position in Figure 5).

Figure 5: The CCTV position at Denel Campus site. (Source: Google Earth)

Four screenshots of the video footage are presented as Figures 6, 7, 8 and 9 to illustrate the sequence of events as the gate impacted the aircraft.

Figure 6: In this screenshot, the ZS-AAK aircraft exits the gate as shown in the yellow window.

The total video footage duration is 1 minute and 19 seconds. The event leading to the accident was approximately 53 seconds. The footage starts with the ZS-AAK aircraft already passing through the Echo gate into FAOR airside (seen between the two large trees and moves out of frame 9 seconds later, see Figure 6). The gate moves towards the close position 6 seconds later after the ZS-AAK is out of frame. Thereafter, the 9H-VJM aircraft appears 7 seconds later on the Denel CCTV camera which was 120 metres away from the gate; the gate is still moving towards close position.

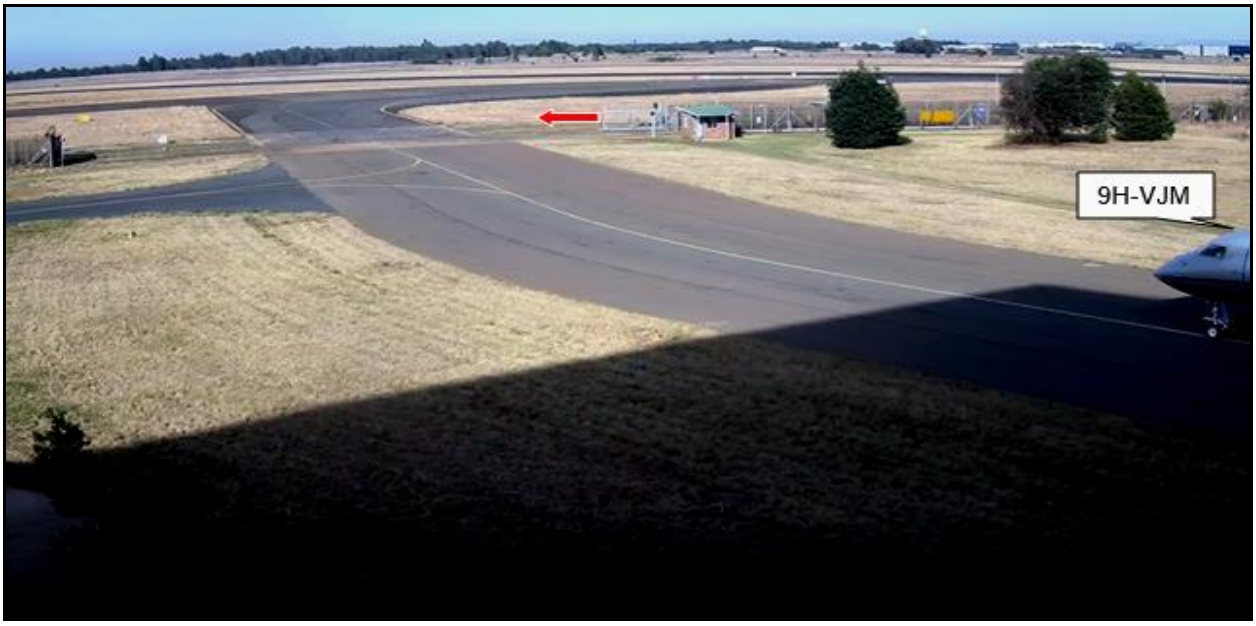


Figure 7: In this screenshot, the 9H-VJM aircraft approaches the gate, which had already started to close.

The 9H-VJM aircraft covers a distance of 120m in approximately 20 seconds and veers off to the left before it stops with its mid-section of the fuselage on the gate rail. (See Figure 8). *After appearing on the CCTV frame, the aircraft travels approximately 21 seconds before it stops.*

Figure 8: In this screenshot, the 9H-VJM aircraft stops after an attempt to veer off to the left.

The crew notices that the gate is coming towards the aircraft (closing) from the right-side and they veer off to the left and stop as the gate is already too close to the wing, but has not yet impacted the aircraft. The gate continues to move towards the aircraft for approximately 11 seconds until it impacts the aircraft's right-side wing leading edge on the number 2 slat and stops (see Figure 9).

Figure 9: In this screenshot, the gate stops moving after colliding with the right wing leading slat.

Figure 10: The gate whilst in contact with the leading-edge slat. (Source: Fireblade Aviation)

Figure 10 (above) was taken by the first responders to the accident scene. It illustrates the position of the gate relative to the damage on the leading edge slat, which was deployed at 20° as per the requirement during take-off.

1.13 Medical and Pathological Information

1.13.1 Not applicable.

1.14 Fire

1.14.1 There was no evidence of a pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was survivable as the crew was properly restrained. Also, the impact with the gate was at low (taxi) speed.

1.16 Tests and Research

1.16.1 No tests were carried out on the aircraft; however, damage assessment was conducted on the right-side leading slat, which was recommended for repair/replacement. The repair was

carried out by a local accredited aircraft maintenance organisation (AMO) at one of Denel Campus' facility hangars.

1.17 Organisational and Management Information

1.17.1 This was a positioning flight from FAOR to OMBD with only the crew on-board.

1.17.2 The operator was issued an Air Operating Certificate (AOC) by the State of Registry and State of Operator, which is the Republic of Malta, on 3 February 2017 with a re-issue on 12 November 2019.

1.18 Additional Information

1.18.1 Leading edge slat deployment

Source: Airplane Flight Manual (AFM), Chapter 4, Normal Procedures

The after-engine start checklist requires the crew to set the slats for departure. This check is again repeated in the taxi and take-off checklist as highlighted below.

B. After Engine Start Check

1.	APU	As required
2.	Electrics (AC/DC synoptic pages)	Checked
3.	Wing and cowl anti-ice	Checked / As required
4.	Slat / Flap lever	Check / Set for departure
5.	Flight controls	Checked
6.	Flight spoilers	Checked / Retracted
7.	GND LIFT DUMP	Checked

▼

4. TAXIING AND TAKE-OFF

A. Taxi Check

1.	Brakes	Checked
2.	Thrust Reversers (First Flight of the Day)	Checked
3.	Flight instruments	Checked and set
4.	Flight director	Set for take-off
5.	Fuel quantity and balance / XFEED SOV	Checked / Closed
6.	Slat / Flap lever	Set for departure
7.	Trims	Set for departure

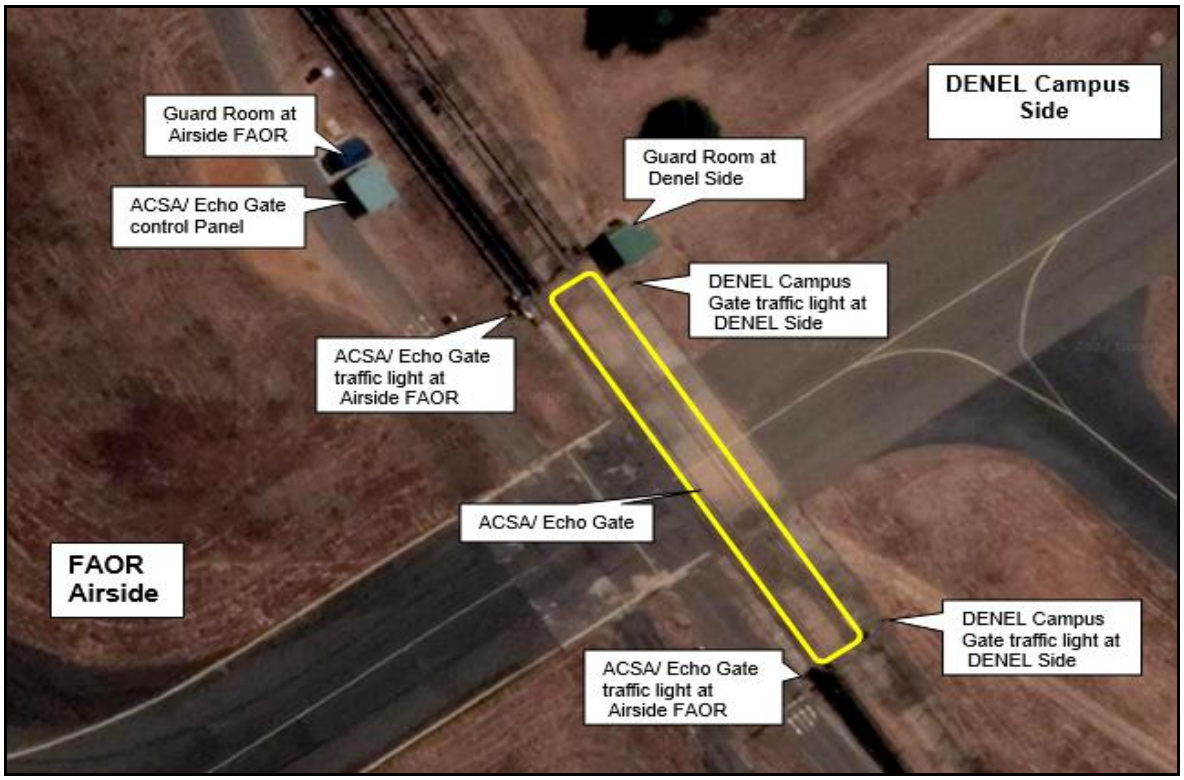


Figure 11: Aerial view of the Echo gate. (Source: Google Map)

1.18.2 Security gates

There are two gates at this location, namely ACSA (Echo gate) on the airport side and Denel gate on the Denel Campus side. The gates are approximately 2 metres (m) apart. The Denel Campus gate (see Figure 12) has been decommissioned several years ago and currently stands in the fully open position, however, its traffic lights on each side of the Apron (taxiways) are still functional and are always illuminating green as they stand open. There are security guards and guard facilities (guard houses) on both FAOR airside and Denel Campus side. The function of the guards is to prohibit any unauthorised movement of vehicles and personnel on either side of the gate.

Figure 12: The Denel Campus gate remains in the fully open position.

Next to the FAOR guard room, there is an Echo gate control panel (See Figure 16) with a functional Emergency Stop button. According to the Echo gate guard, they are not allowed to interfere with the function of the gate's operation at any given time as it is not part of their duty. The Echo gate is also equipped with a traffic light signal pole on each side of the taxiway. Each traffic light signal pole comprises four lights, that is, two on each side placed back-to-back (see Figure 13). Each traffic light signal pole faces the oncoming traffic from the FAOR and Denel Apron taxiways to regulate traffic. The bottom light illuminates red when the respective gate is closed or whilst closing. The top light illuminates green when the gate is fully open (see Figures 18 and 19).

The traffic signal lights for this gate are located on both sides of the Apron taxiway on the Denel Campus side. According to the 9H-VJM cockpit voice recordings (CVR), the crew stated that they noticed the illuminated green light at the time of their approach. However, these lights were not working properly (out of service) during the initial visit of the investigation team due to the electrical power outage (load shedding) that was scheduled from 0500Z in the area on the day of the accident. These traffic lights are not connected to an alternate power supply in case of power failures/outages.

Figure 13: The Denel Campus gate traffic light.

The aerodrome gate (ACSA/Echo gate) was functional at the time of the investigation's team visit, and it was being controlled remotely. The gate is equipped with safety barrier sensors, which failed in operation on the day of the accident. At the gate, five safety beams are installed on each end of the gate. When the gate is in motion and one of these beams is obstructed by an aircraft's fuselage, a vehicle or any similar type of object, this gate should stop automatically. The fuselage of the 9H-VJM aircraft obstructed all five safety beams, yet the gate did not stop; it continued to close for another 11 seconds after impacting the right wing of the aircraft before it finally stopped.

Figure 14: The Echo gate with three of the safety beams visible in the yellow windows.

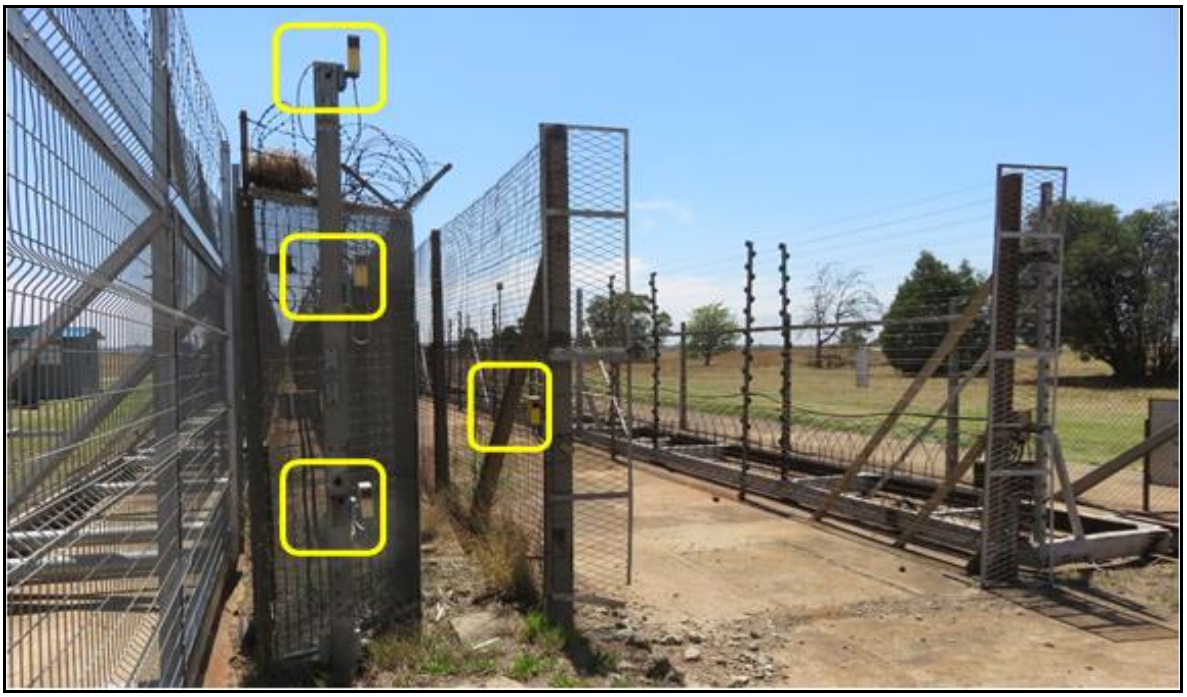


Figure 15: The Echo gate with four of the safety beams visible in the yellow windows.

A gate control box with seven buttons is installed near the guard house at the Echo gate on the airside (see Figures 16 and 17). The top red knob is the E-STOP (Emergency stop), which could be activated in case of an emergency, and thus, bring the gate to an immediate stop. The security guard, who was the only person at this station at the time, was not allowed to interfere with the operation of the gate and, therefore, did not activate the E-STOP knob. By the time this report was concluded, it was not clear who, and in what capacity was this person allowed to activate the E-STOP button.

Figure 16: Gate control box installed at the guard house at the Echo gate.

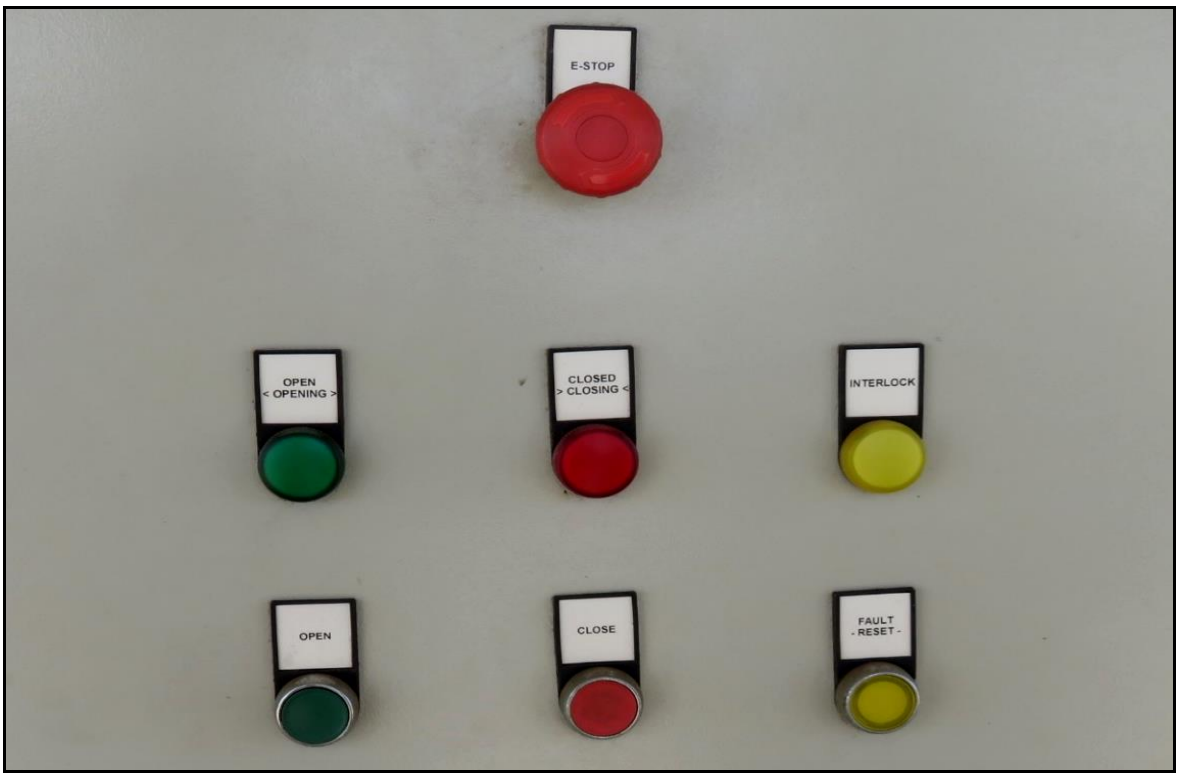


Figure 17: Gate control box showing the E-STOP button at the top.

A traffic light is located on both sides of the Echo gate, one near the guard house (gate open side) and the other, on the 'gate close' side. These lights were working at the time as the traffic light on the 'gate close side' was visible on the CCTV footage. The light was green while the gate was in the open position; as soon as the gate started to move towards 'close' position, the green light immediately switched off. Pictures in Figures 18 and 19 were taken on 19 October 2021 by the investigator. These traffic lights were not working on 13 October 2021 when the investigation team inspected the gate.

Figure 18: The traffic light at the gate open position.

However, these lights were working at the time of the accident, as the traffic light on the 'gate close side' was visible on the CCTV footage. The light was green while the gate was in open position; as soon as the gate started to move towards 'close' position, the green light switched off.

Several CCTV cameras were installed at the Echo gate. A demonstration of the remote gate operation from the ACSA control room revealed that the gate operation could be monitored through a second gate control screen, which is connected to the CCTV feed for live video.

Figure 19: The ACSA/Echo gate traffic light in the gate 'close' position.

According to ACSA procedures, the gate controller has to monitor the gate operation on the second screen during opening and closing phases for safe and obstacle free thoroughfare.

Figure 20: The FBO fenced off area and the gate view from the Denel Campus side.

The FBO apron is fenced off, and aircraft had to taxi through the security gate to the Denel Campus area. This gate is controlled by FBO personnel, located in the FBO building which is overlooking the apron.

Figure 21: The FBO apron area. The photograph was taken from the FBO centre.

Figure 22: The FBO apron gate and the visible traffic light (illuminating green).

1.18.3 Echo Gate Control

The ACSA/Echo is controlled remotely, unlike the FBO gate where the operations room (building) with large windows overlooks the apron and gate areas. The Denel Campus operator has a view of the entire taxiway and gate area from the Denel tower, if weather conditions (visibility) permit. *It is important to note that the initial closing phase of the Echo gate could not be seen from the Denel Campus operator's workstation even during clear weather conditions.* The Denel Campus controller's facility does not have any CCTV footage equipment as there are no cameras installed on their side of the gate. The Denel operator can only speak to an aircraft crew while the aircraft is still on their frequency. It should be noted that there is also a Denel gate adjacent to the Echo gate. This gate has been standing open (decommissioned) for several years now.

Pilots of aircraft that plan to enter or exit the Denel Campus area need to speak to the ACSA Airport Management Centre (AMC) on the VHF 122.65 MHz. The AMC is located inside the Domestic Terminal building.

The personnel in AMC who communicates with the aircraft would then instruct their fellow colleague via a landline in a control room that is located inside the International Terminal building, who would then open or close the gate as requested by AMC personnel.

The personnel in the control room could see the status of the gate via the CCTV cameras placed at the gate, and he/she has a gate view on the computer screen by activating the

OPEN, CLOSE or STOP window (see Figure 23). Should the operator want to view the status of the gate via CCTV footage, he/she needs to select a second screen and monitor the gate movement accordingly. This does not mean that the person is looking at live CCTV footage to see if the gate is closing or not, and/or if there is any aircraft approaching the gate. What the investigating team observed during their visit to the control room was that there are some pilots who are “tail gating” other aircraft in front of them and bypass communicating with AMC. In Figure 24, the aircraft in question is at the gate (footage). This is the view the personnel in the control room would have had access to. *This photograph is the playback footage on the day of the accident, taken by the investigation team during their visit to the control.*

The investigation team was not allowed to take photographs inside the AMC, which was a much more conducive work environment. It was, however, noted that the controller in the AMC did not have any CCTV footage (live feed) that he/she could view to assess the status at the gate.

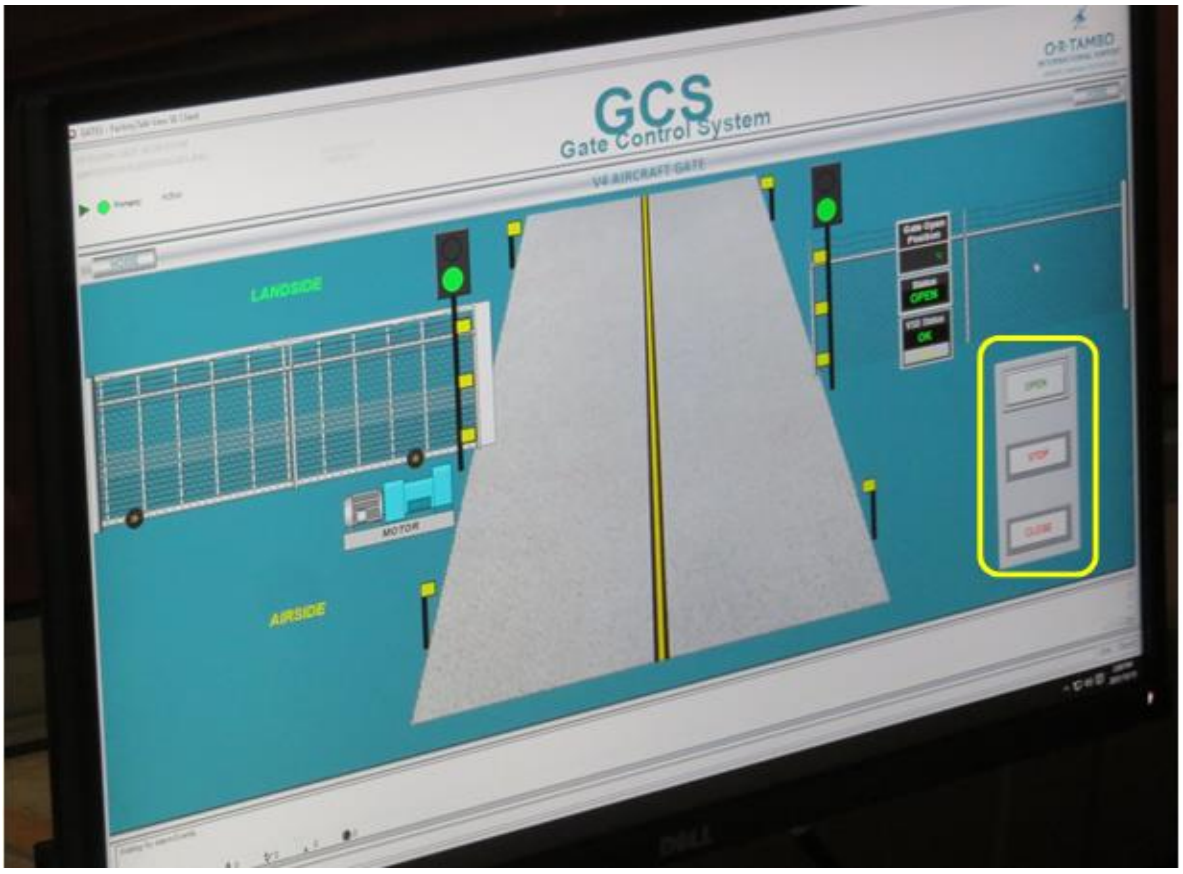


Figure 23: The gate control screen that the controller uses to OPEN, STOP or CLOSE the gate.

Figure 24: The CCTV footage view of the gate from the control room.

1.18.4. Cockpit crew statement

Both cockpit crew members provided the investigating team with the same statement.

*"9H-VJM (*VJT850) *was taxiing out from Fireblade's handling apron, we were contacting Denel tower on 132.5 and they clear us to go to E holding point RWY 21L and informed us that automatic door was clear (Green) to go and cross. We were following another plane, a Dornier 328, we were instructed to give way to them before the gate. The previous plane crossed the gate and when we were passing through the gate, the fence started to move hitting us on the right-wing leading slat edge. Green light was visible." (SIC)*

1.18.5. The current workload of the operator, according to Denel's statement.

All operators using Denel/ACSA Echo gate including FBO are expected to follow these procedures.

a) Contact FBO on their operational frequency.
b) Contact CLD for clearance.
c) Contact GMC for start
d) Contact TWR/GMC for taxiing
e) Contact Apron to Echo gate
f) Contact Denel Campus to confirm if any conflicting traffic is operating.
g) Contact TWR/GMC at the gate for crossing.

Seven frequency exchanges are required within a short time. The FBO had compiled an *Apron and Denel Operating Procedures* document (3 pages long), which they make available to flight crews that are not familiar with the Denel Campus to ensure seamless,

safe access to the Denel taxiway and the FBO apron. This procedure was made available to the crew of 9H-VJM prior to their inbound flight to South Africa. These procedures are applicable to arriving and departing aircraft that make use of the FBO facility.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any particular organisation or individual.

2.2. Analysis

2.2.1 <u>The Crew</u>

This was a multinational crew who were appropriately qualified to conduct the flight. It was the crew's first visit to the FBO facility. Prior to their flight to South Africa, they were provided with the *Apron and Denel Operating Procedures* document to be followed when taxiing and parking the aircraft at the FBO apron as it was a secure facility within the aviation campus area. The crew had not experienced any difficulty during the landing phase; they managed to taxi and park the aircraft at the FBO apron without any complications.

The crew gave way to the ZS-AAK aircraft while they were taxiing through the Echo gate. The ZS-AAK crew was familiar with the Echo gate procedures as the aircraft's parking is located at the Denel Campus area. The ZS-AAK aircraft was well clear of the gate and out of sight when the 9H-VJM aircraft was first observed on the CCTV camera, taxiing towards the gate. The gate had already started moving towards 'close' position when the aircraft was seen approaching the gate (footage). It was also noted in the footage that the airside traffic light, which was green, went off immediately when the gate started to move towards 'close' position.

There was no communication between the AMC controller and the 9H-VJM crew. As the AMC controller was not aware of the 9H-VJM aircraft that was approaching the gate, he/she most probably instructed the gate controller in the control room to close the gate, which was done.

It should be kept in mind that the AMC controller is only in radio communication with the aircraft crew that is requesting permission to either enter or exit the Denel Campus area. The person performing this function does not have access to any live video footage of the gate. The CCTV footage is only available to the gate controller in the control room.

Immediately when the gate started to move towards the 'close' position, the green traffic light switched off, (and could have changed to red even), however this was not visible on the video footage. It was noted that the green traffic signal went off 6 seconds before the aircraft appeared on the camera footage. The crew then taxied towards the gate for another 20 seconds. During this period there was no indication that the crew had observed the gate had started to move towards close position, or was there any change noticed in the taxi speed. Moments before the gate impacted the aircraft, the pilot-in-command who was taxiing (steering) the aircraft attempted to take some evasive action as the aircraft was seen swerving slightly to the left.

The crew taxied the aircraft towards the Echo gate without communicating with AMC. The crew was most probably pre-occupied in the cockpit at that stage, especially the First Officer (FO) who was seated on the right-side and should have been more vigilant as they taxied towards the gate; he would have noticed that the green light was not illuminating. Neither of the crew members noticed any of these signals. It is the view of the investigating team that the 9H-VJM crew attempted to *"tail gate"* the ZS-AAK aircraft that was in front of them, but they were far behind; meanwhile, the AMC controller instructed the gate controller to close the gate. The fact that the gate did not stop once the aircraft was taxiing across the threshold of the gate indicated that all the safety beams (sensors) were malfunctioning as they did not activate to automatically stop the gate from closing. This, most probably, caught the crew by surprise.

The CVR recordings were not secured (circuit breaker was not deactivated) following the accident, which is in contravention of the operator's procedures. This hampered the investigation as essential information was lost.

2.2.2 Aircraft

The aircraft was serviceable and had a Certificate of Airworthiness which was issued by the State of Registry (Malta) with an expiry date of 30 June 2022. According to the FDR data, the brakes were fully functional when applied by the crew at the gate. The aircraft had no mechanical defects that would have contributed or have caused the accident.

2.2.3 Environment

Fine weather conditions prevailed with good visibility at the time of the accident; the weather could not be considered to have contributed to this accident.

2.2.4 Echo Gate

The operation of this gate was found to be problematic due to the following reasons:

(i) The gate was controlled remotely from a control room located in the International Terminal building. The gate controller had no physical view of the gate and had relied solely on technology (CCTV cameras) to open and close the gate.

(ii) The work environment (space) of the gate controller who performs this critical function was found to be very cramped with a large number of people housed in a confined area. The gate controller could easily become distracted while he/she performs this important function.

(iii) The AMC facility was found to be a much more conducive work environment. It is not clear to the investigating team why the gate controller was not housed in the AMC facility and in proximity to the person who communicates with the aircraft crew to exit or enter the Echo gate.

(iv) Fundamental failures in this accident were the fact that the gate controller was not monitoring the CCTV camera screen as he/she did not take any action to STOP the gate before it collided with the aircraft. If the gate controller was vigilant and was monitoring the CCTV camera, he/she could have been able to prevent this accident.

(v) The fact that none of the five safety beams installed at the Echo gate activated to bring the gate to a stop was found to be a significant factor in this accident. The safety beams failed to operate.

(vi) Another significant safety barrier that failed was the Emergency STOP (E-STOP) button that was installed at the guard house. The guard on duty who witnessed the accident was not permitted to touch the knob. It is not clear what the procedures were with regards to the E-STOP as it was a safety barrier that failed the system. The investigation team could not get clarity on this matter.

2.2.5 Denel Security Gate

The Denel security gate was in the fully open position. It was determined that this gate was decommissioned several years ago and, therefore, was not operational and of no risk to the safe operation of aircraft making use of it. There is a security guard based at the gate 24-hours a day.

The Denel Campus controller was not able to physically see the initial phase of the Echo gate when it starts to close from the tower and, therefore, could not alert the 9H-VJM crew. Moreover, this station was not equipped with a live CCTV camera.

2.2.6 Conclusion

The crew did not follow the procedures that were made available to them on how to exit the Denel Campus as they did not contact the AMC to ensure that the Echo gate is open when they taxi to the airside. According to the CCTV footage, the aircraft taxied towards the Echo gate and, there was no indication from the crew that they were aware of the gate that was closing ahead of them. At this stage, the green traffic lights had switched off when the gate started to close.

The crew only became aware of the gate closing when they were crossing it. The PIC who was taxiing the aircraft attempted to swerve to the left prior to the gate colliding with the aircraft.

The gate had several safety barriers in place, but all of them failed on the day. (i) There was no intervention from the gate controller in the control room to stop the gate. (ii) The gate did not come to an automatic stop when the five safety beams were obstructed by the aircraft's fuselage. (iii) The E-STOP button that is located at the guard house of the Echo gate was not activated manually by the security guard who was the only person at the gate at the time as he was not permitted to touch it. (iv) It was further noted that the security guard at the Echo gate had no direct communication with either the AMC or the gate controller.

It is not clear why the Echo gate was not left open as was the case with the Denel Campus gate because both gates, which are in proximity to each other, were guarded on a 24-hour basis.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions or a combination thereof, which led to this accident.

- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2. Findings

The Crew

3.2.1 The PIC was in possession of an Airline Transport Pilot Licence (ATPL). According to his logbook, he had flown a total of 7 500.0 hours, of which 2 611.0 hours were on the aircraft type.

3.2.2 The PIC was issued a valid Class 1 aviation medical certificate on 28 January 2021 with an expiry date of 23 February 2022.

3.2.3 The FO was in possession of a Commercial Pilot Licence. According to his logbook, he had flown a total of 4 622.0 hours, of which 1 397.08 hours were on the aircraft type.

3.2.4 The FO was issued a valid Class 1 aviation medical certificate on 29 October 2020 with an expiry date of 13 November 2021.

3.2.5 The crew was informed about the FBO *Apron and Denel Campus Operating Procedures* prior to their flight to South Africa. This was the crew's first visit to this facility.

The Aircraft

3.2.6 The aircraft was issued a Certificate of Airworthiness on 1 July 2015 with an expiry date of 30 June 2022.

3.2.7 The aircraft was issued a Certificate of Registration on 26 May 2021.

3.2.8 The last scheduled maintenance inspection carried out on the aircraft prior to the accident flight was certified on 30 September 2021 at 5 881.09 airframe hours. The aircraft had accumulated a further 78.23 airframe hours since the said inspection.

3.2.9 There were no recorded defects entered in the technical log of the aircraft prior to the flight, and there was no mechanical malfunction detected with any of the systems from the FDR data.

3.2.10 The number 2 leading edge slat on the right wing was substantially damaged and had to be replaced.

Environment

3.2.11 Fine weather conditions prevailed at the time of the accident. The weather had no bearing to this accident.

Aviation Operating Certificates (AOC)

3.2.12 The operator was in possession of a valid AOC certificate that was issued by the State of Registry, which is the same as the State of Operator, on 3 February 2017. The AOC certificate was re-issued on 12 November 2019.

Aerodrome

3.2.13 FAOR is a licensed facility.

3.2.14 The aerodrome apron controller who communicated with the 9H-VJM crew on VHF 122.65 MHz was based in the AMC in the Domestic Terminal building.

3.2.15 The gate is controlled remotely by a gate controller who is located in the control room in the International Terminal building.

3.2.16 There was a security guard at the gate at the time of the accident.

3.2.17 There is an E-STOP (Emergency Stop) button at the guard house at the gate which, when activated, would stop the motion of the gate. The security guard was not permitted to interfere with the operation of the gate and, therefore, did not activate the E-STOP button.

3.2.18 There are five safety beams installed at the gate, which are designed to stop the gate once the beam/signal is disturbed/obstructed by an aircraft's fuselage, vehicle, person, etc. This function was inoperative.

3.2.19 There are several CCTV cameras installed at the gate which allow the gate controller to monitor the gate on a monitor (screen) at the workstation.

3.2.20 The gate controller has the option to STOP the gate immediately via his/her gate control system, should he/she observe any potential risk that could result in damage to an aircraft/vehicle or injury to a person(s).

3.2.21 There was no notice/information board at both sides (airside and land side) of the gate that informs pilots to obtain clearance from Apron control on frequency 122.65 MHz before proceeding through the gate.

3.2.22 The gate was already closing when the aircraft approached the gate.

3.2.23 The traffic light on the gate 'close' side was green (as seen on the CCTV footage). When the gate started to move towards the 'close' position, the light switched off.

3.2.24 The Denel Campus gate was decommissioned several years ago and now stands open.

3.2.25 The Denel Campus gate traffic light was not working at the time due to a power failure in the area.

3.2.26 The FBO apron area is fenced off/gated. The FBO gate was in the open position when the crew taxied out.

Radio Communication

3.2.27 The crew communicated with FBO operations on VHF 130.725 MHz.

3.2.28 The crew communicated with CLD on VHF 121.70 MHz.

3.2.29 The crew did not communicate with FAOR tower on VHF 118.10 MHz.

3.2.30 The crew communicated with Denel Campus operator on VHF 132.50 MHz.

3.2.31 The crew allowed the ZS-AAK aircraft to taxi out of the gate ahead of them by giving them way.

3.3 Probable Cause

3.3.1 The motorised gate collided with the aircraft whilst the crew was passing through to the airside for departure from FAOR.

3.4 Contributory Factors

3.4.1 The crew did not communicate their intentions or request permission from ACSA/Echo gate control centre to pass through safely to the FAOR airside for departure.

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3.4.2 There are five frequency channels that the crew had to engage from the FBO to the Echo gate, which translate to a high workload for the crew.

3.4.3 All the safety barriers that were put in place at the Echo gate failed at the time of the accident.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2. Safety Recommendations

4.2.1 (a) It is recommended that the Echo gate be left OPEN to avoid a recurrence of this accident. Should security be of a concern, it is recommended that an additional security guard be deployed at the gate.

b) It is recommended that the function conducted by the control room of OPENING and CLOSING the gate after receiving a telephone call from the AMC be moved to the AMC facility or consider a single frequency for the control of the Echo gate.

c) It is recommended that notice boards be placed at Echo (V4) gate. These notice boards should be visible at night as well as during inclement weather conditions by day. This board should display a clear STOP sign and the following wording:

BEFORE PROCEEDING THROUGH THE GATE, PLEASE CONTACT ACSA GATE CONTROL ON THE VHF FREQUENCY 122.65 MHz.

The same information board should be placed on the Denel Campus side of the gate.

d) It is recommended that ACSA consider empowering security guards at the gate by reviewing their SOPs to allow them to activate the E-STOP (Emergency Stop) button at the control box at the guard house should they witness any potential risk which might result in an incident or accident.

4.2.2 In the interest of safety, the following safety recommendations are issued to Denel-Aeronautics for consideration to minimise and mitigate the recurrence.

i) Communication recording equipment should be connected to an alternate power source to prevent a recurrence of this event. In this case, all communication between the Denel Campus operator and the 9H-VJM aircraft (Vista-Jet 580) was lost due to lack of an alternate power source. Based on the above, it is recommended that the recorded equipment should also be connected to a power supply unit to ensure that there is no disruption should there be a power failure, and when the backup generator becomes active.

ii) It is recommended that the tower layout be changed to allow the Denel Campus controller a better view of the Echo gate from the tower.

iii) It is recommended that the Denel Campus controller has access to live CCTV footage of the gate.

4.3 Status of Safety Recommendations Issued

4.3.1 Both parties have acknowledged and accepted the safety recommendations from AIID and have provided alternative means to some of the Safety recommendation which were not implemented.

5. APPENDICES

5.1 None.

This report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa