SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-58

UAS LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/3/2/1416							
Classification	Serious Incident	**Date**	10 June 2023			**Time**	1947Z	
Type of Operation	Remotely Piloted Aircraft System – Surveillance (Part 101)							
Location								
Place of Departure	Sibanye Stillwater Protection Services, Carletonville, Gauteng Province		Place of Intended Landing		Sibanye Stillwater Protection Services, Carletonville, Gauteng Province			
Place of Occurrence	Sibanye Stillwater, Protection Services, Carletonville, Gauteng Province							
GPS Co-ordinates	Latitude	26º23'30" S	Longitude	027º29'44" E		Elevation	5400 ft	
Aircraft Information								
Registration	ZT-WZR		Class	3A				
Make; Model; S/N	Arace Sirin (Serial Number: SIR0011)							
Damage to Aircraft	Substantial		Total UAS Hours	616.46				
Pilot-in-command								
Licence Type	Remote Pilot Licence (RPL)		Gender	Male		Age	34	
Licence Valid	Yes	Total Hours	628.53	Total Hours on Type		628.53		
Total Hours 30 Days	20		Total Flying on Type Past 90 Days	26.8				
People Controlling	1	**Injuries**	0	**Fatalities**	0	**Injuries (on ground)**	0	

What Happened

On Saturday evening, 10 June 2023, an Unmanned Aircraft System (UAS) Arace Sirin registered ZT-WZR was launched on a surveillance flight at Sibanye Stillwater Protection Services in Carletonville, Gauteng province. The flight was conducted under beyond visual line of sight (BVLOS) rules by night and under the provisions of Part 101 of the Civil Aviation Regulations (CAR) 2011 as amended.

According to the pilot, he set-up the UAS for the flight and, thereafter, conducted the pre-flight inspection, which was normal. The battery indicated 23 Volts (V) at 92% prior to the launch. Thereafter, the pilot launched the UAS and it climbed and hovered approximately 5 to 10 metres (m) in altitude hold (ALT Hold) mode. (*Assisted flight mode with ALT Hold only has a warning to use the UAS in this mode with caution, especially in windy conditions*). The pilot then switched from ALT Hold mode to Loiter mode and perform the UAS manoeuvrability test by yawing the UAS to the left and to the right. A potential thrust loss warning appeared on the remote pilot station and the UAS lost altitude. Corrective efforts by the pilot were unsuccessful and the UAS crashed.

The operator reported that when the battery is fully charged, it will indicate a voltage of 25.2 V. Prior to take-off, the battery power read 10.6 V, but the pilot had a reading of 23 V on his remote pilot station

screen. The battery power may have depleted, and thus, likely caused the thrust loss. This led to the UAS crashing against the wall.

The accident occurred at nighttime at Global Positioning System (GPS) co-ordinates determined to be 26°23'30" South 027°29'44" East, at an elevation of 5400 feet (ft).

Figure 1: Aerial view of the site. (Source: Google Earth)

Figure 2: The UAS as it came to rest against the wall. (Source: Pilot)

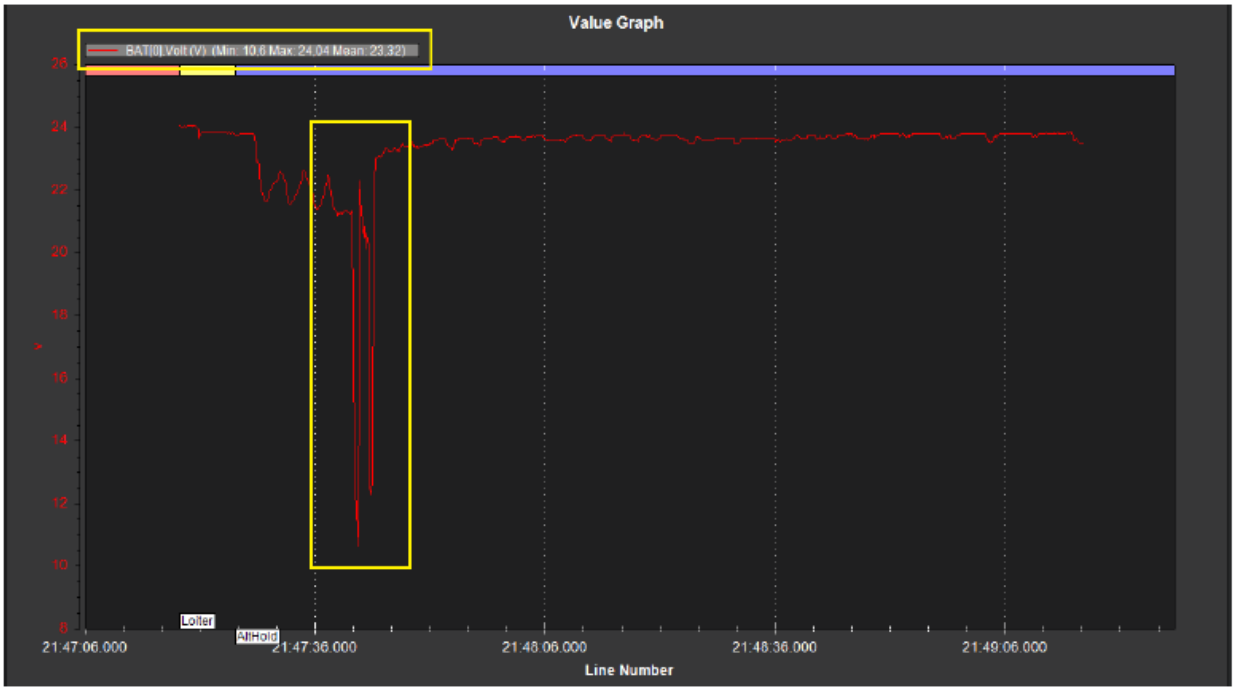
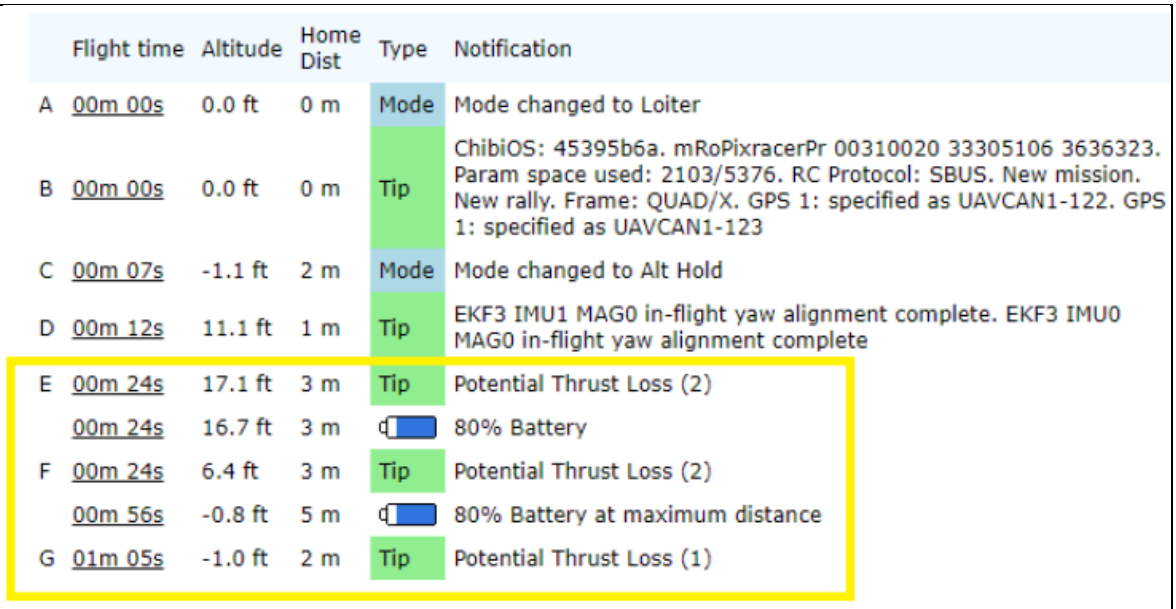


Figure 3: The battery read 10.6 V at take-off. (Source: Operator)



	Flight time	Altitude	Home Dist	Type	Notification
A	00m 00s	0.0 ft	0 m	Mode	Mode changed to Loiter
B	00m 00s	0.0 ft	0 m	Tip	ChibiOS: 45395b6a. mRoPixracerPr 00310020 33305106 3636323. Param space used: 2103/5376. RC Protocol: SBUS. New mission. New rally. Frame: QUAD/X. GPS 1: specified as UAVCAN1-122. GPS 1: specified as UAVCAN1-123
C	00m 07s	-1.1 ft	2 m	Mode	Mode changed to Alt Hold
D	00m 12s	11.1 ft	1 m	Tip	EKF3 IMU1 MAG0 in-flight yaw alignment complete. EKF3 IMU0 MAG0 in-flight yaw alignment complete
E	00m 24s	17.1 ft	3 m	Tip	Potential Thrust Loss (2)
	00m 24s	16.7 ft	3 m		80% Battery
F	00m 24s	6.4 ft	3 m	Tip	Potential Thrust Loss (2)
	00m 56s	-0.8 ft	5 m		80% Battery at maximum distance
G	01m 05s	-1.0 ft	2 m	Tip	Potential Thrust Loss (1)

Figure 4: Potential loss of thrust warning on motor 2. (Source: Operator)

The operator reviewed the log analysis report post-accident. It revealed that there was a thrust loss on motor 2 which led to the crash of the UAS.

Sequence of events as per the flight log:

At 19:47 UTC: The pilot armed the UAS in “Alt Hold” mode and ascended to 33.1 ft above ground level (AGL).

At 19:47 UTC: The aircraft experienced potential thrust loss on motor 2.

At 19:47 UTC: The aircraft rapidly descended and crashed on the ground.

The aircraft had a potential thrust loss when the aircraft took off.

The battery had 10.6 V at the time of take-off; this caused the potential thrust loss.

The battery was more than a year old.

The UBEC was tested and found to be in good condition. This indicated that there was no unit power failure at the time of the accident.

The operator’s conclusion:

The aircraft had a potential thrust loss and descended too rapidly.

The volts were too low to for the aircraft to generate lift.

The operator’s recommendations:

All batteries older than a year must be recalled for testing.

The Original Equipment Manufacturer (OEM):

1 The OEM facility is located in the town of Páty, Hungary where the elevation is approximately 656 feet (200m).

2 According the OEM's website (www.araceaus.com) the maximum take-off weight (MTOW) for the Sirin is 2.98 kg (EU RPAS Class 2) with a maximum payload of 500 grams (g).

3 Response from the OEM on incidents relating to the "Potential Thrust Loss":

(i) The atmospheric conditions in which the UAS are flown in South Africa differ from Hungary. The density altitude condition in South Africa and, especially the Highveld areas, is approximately eight times higher than in Hungary.

(ii) In Hungary, the UASs are fitted with new batteries and new motors when they are flown. Battery power (voltage) is of paramount importance to ensure the optimal effectiveness of the four motors at all times. The OEM recommended that the operator limit their flight time to levels above 50% battery power.

(iii) The UAS was fitted with a transponder which increased the take-off weight. The OEM does not fit any supplementary devices to its UAS.

(iv) Pilots must avoid flying in strong wind conditions.

(v) The OEM is continually monitoring the data provided to them by operators in various parts of the world and constantly aims to improve reliability. Several of the components (for example, the motors) are obtained from independent vendors, and the reliability of the components is only tested during operation. One of the critical parts of the motor is the bearing, which is also sourced from different vendors, although the OEM strives to use only one supplier which they had found (since they have been in production) to be offering the better performing bearings.

(vi) The motors fitted to the UAS have a service life of 500 hours, whereafter, they must be replaced.

Findings

1. The pilot was initially issued a Remote Pilot Licence (RPL) by the South African Civil Aviation Authority (SACAA) on 30 September 2022 with an expiry date of 30 September 2024. The pilot had a BVLOS rating which was issued on 10 February 2022.

2. The pilot had the UAS type endorsed on his licence. The pilot had a valid Class 3 aviation medical certificate that was issued on 7 November 2019 with an expiry date of 30 November 2023.

3. The UAS was issued a valid Remotely Piloted Aircraft Systems Letter of Approval (LOA) on 30 July 2021 with an expiry date of 29 July 2023.

4. The operator was issued a valid Remotely Piloted Aircraft Systems Operating Certificate (ROC) on 31 October 2022 with an expiry date of 31 October 2023.

5. The UAS had a valid Certificate of Registration (C of R) that was issued on 5 March 2021.

6. The operator had a valid Landowner Permission Certificate that was issued on 1 January 2023 with an expiry date of 31 December 2023.

7. The last mandatory periodic inspection (MPI) was conducted on 17 May 2023 at 569 hours. At the time of accident, the UAS had 616.46 hours. The UAS was flown a further 47.46 hours since the last MPI.

8. On 8 June 2023, the UAS motors were inspected for damages; they were found to be in good condition.

Probable Cause

The battery depleted rapidly which led to the loss of thrust and caused the UAS to lose height and impact against the wall.

Contributing Factor(s)

None.

Safety Action

The operator recommended that batteries older than a year be recalled for testing. This was implemented by the operator.

Safety Message and/or Safety Recommendation(s)

None.

About this Report

The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desk top enquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence.

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
In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, 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.
Disclaimer
This report is produced without prejudice to the rights of the AIID, which are reserved.

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa