SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-57

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10262				
Classification	Accident	**Date**	1 January 2023	**Time**	1935Z
Type of Operation	Remotely Piloted Aircraft System – Surveillance (Part 101)				
Location					
Place of Departure	Sibanye Platinum Hex River Helipad, Rustenburg, North West Province	Place of Intended Landing	Sibanye Platinum Hex River Helipad, Rustenburg, North West Province		
Place of Occurrence	Approximately 1.5 kilometres west of Sibanye Platinum Hex River Helipad, Rustenburg, North West Province				
GPS Co-ordinates	Latitude	25° 39'34.48" S	Longitude	27° 15' 49.67" E	Elevation	3 694 ft
Aircraft Information					
Registration	ZT-XNL				
Make; Model; S/N	ARACE, Sirin Multirotor UAV (Serial Number: SIR0015)				
Damage to Aircraft	Substantial	Total Aircraft Hours	815.75 hours		
Pilot-in-command					
Licence Type	Remote Pilot Licence (RPL)	Gender	Male	Age	26
Licence Valid	Yes	Total Hours	436.52	Total Hours on Type	436.52
Total Hours 30 Days	± 81.00	Total Flying on Type Past 90 Days	242.52		

People Controlling	1	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0

What Happened

On Sunday evening, 1 January 2023, an Arace Sirin Multirotor remotely piloted aircraft (RPA) with registration ZT-XNL was launched for aerial surveillance from Sibanye Platinum Hex River Helipad in Rustenburg, North West province, with the intention to return to the same helipad. Visual meteorological conditions (VMC) by night prevailed at the time of the flight which was conducted under beyond visual line of sight (BVLOS) rules and under the provisions of Part 101 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot stated that the pre-flight checks were conducted on the RPA with no anomalies detected. The battery voltage indicated 100 percent (%) prior to RPA launch. The pilot launched the RPA which steadily climbed to 400 feet (ft) and proceeded to the initial way point as planned. After reaching the intended position to start aerial surveillance, the RPA lost signal, disconnected from the controller unit, and failed to return to launch position.

The pilot used the RPA's recorded flight information on Google Earth search engine to locate the RPA. He later retrieved the RPA approximately 1.5 kilometres (km) west of the launch site. It had sustained damage to the propeller blades, camera and the fuselage. There were no reported injuries on the ground.

Figure 1: Yellow line shows the flight path of ZT-XNL. G is the way point (intended surveillance area). The end of the yellow line, indicated by the red star, is where the RPA was located. (Source: Operator)

Figure 2: The ZT-XNL RPA after recovery. (Source: Operator)

Findings

1. The pilot was initially issued a Remote Pilot Licence (RPL) on 25 June 2021 with an expiry date of 30 June 2023. The pilot had beyond visual line of sight (BVLOS), visual line of sight (VLOS) and multirotor (MR) ratings and endorsements. A Class 3 medical certificate was issued to the pilot on 16 May 2021 with an expiry date of 16 May 2025 with no restrictions. The pilot was properly licensed and medically fit to remotely pilot the flight in accordance with the existing regulations.

2. The operator was issued a Remotely Piloted Aircraft System Letter of Approval (RLA) by the Regulator (South African Civil Aviation Authority) on 26 August 2022 with an expiry date of 13 October 2023. The last inspection conducted on the RPA prior to the accident flight was on 14 December 2022 at 750.82 hours. The RPA was flown a further 64.93 hours after the said inspection. According to the RPA's maintenance records, ZT-XNL was maintained in compliance with the regulations and was airworthy when it dispatched for surveillance.

3. The operator had the Remotely Piloted Aircraft System Operating Certificate (ROC) that was issued by the Regulator on 31 October 2022 with an expiry date of 31 October 2023. The ZT-XNL RPA type was endorsed on the ROC and approved for BVLOS operations.

4. Arace Sirin RPA Information (Source: www.araceuas.com/sirin/)

   The Sirin can be airborne up to 85 minutes and cover more than 40 km in a single flight.

   Field deployment takes less than 1 minute and requires no assembly.

   Folds into a compact size for easy storage and transportation (including backpack options).

   Li-ion battery which can be recharged 3-4x compared to traditional LiPo batteries which is what is used on most commercially available drones. Also, it only needs a single battery to fly.

   Multiple redundancy for safe operation:

   - ✓ *Triple IMUs*
   - ✓ *Dual Compass*
   - ✓ *Dual GNSS/GPS (multi constellation)*
   - ✓ *No pre-flight calibration is required.*
   - ✓ *Numerous built-in failsafe features.*

   It can be equipped with various state-of-the-art, single, or dual sensor payload. Long range, optical zooming daylight cameras, as well as thermal cameras.

   Operational radius is up to 20 km and can function as a relay with Arace point to multi-point Mobile Remote Viewing Terminal (MRVT).

5. Universal battery eliminator circuit (UBEC) (Source: https://www.kdedirect.com/blogs/news/esc-and-ubec-basics#:~:text=A%20UBEC%20(universal%20battery%20eliminator,from%20one%20primary%20battery%20source):

   A UBEC (universal battery eliminator circuit) is purely a device that converts high voltages (such as 25 V from a 6S LiPo) to lower voltages to allow the full Unmanned Aircraft Systems (UAS) to be powered from one primary battery source.

   As is best practice for drones, the power for flight-electronics and cameras are provided via secondary electronics, such as a UBEC, to maintain isolation between electronics and keep any noise and interference from affecting flight performance.

6. Post-accident investigation conducted by the operator:

   AIRDATA and Mission Planner were used to determine the cause of the accident. Bin file 2023-01-01 21-27-44.bin was analysed to determine the root cause of the accident. The operator reported the following observations based on the AIRDATA flight logbook and Mission Planner information:

   - *The RPA was climbing gently as per the pilot-in-command (PIC) Accident Report (AR). We then see the RPA moving forward, as the PIC switches flight modes, after the RPA reaches the way point it loses signal.*
   - *The RPA reached a height of 400 ft before continuing with the mission. It was noted that at the end of the log that it just stops with no warning from the RPA.*
   - *It was noted that the RPA just loses total power as both the Volts and Amps start dropping after the RPA reached a height of 400 ft.*

- *As per the IR, there were no inputs except the mode change from ALT hold to auto was recorded, unfortunately, the RPA lost power before the PIC could switch the RPA to RTL.*

Sequence of Events (UCT Time):

At 19:27:44 The RPA was switched on.
At 19:27:59 the RPA took off.
At 19:29:10 the RPA reached a height of 400 ft.
At 19:35 the RPA reached the first way point and started to turn to go to the next way point.
At 19:35:57 the RPA lost all power and crashed shortly after.

Conclusion:

It is possible that the accident was due to the UBEC failing during flight. Based on the logs that the RPA motors just stopped turning during flight.

Probable Cause

UBEC failure during flight caused the RPA to suddenly lose rotary power after reaching 400ft above ground level (AGL) and subsequently crashed in a residential area.

Contributing Factor

None.

Safety Action

Following the accident, the operator determined that they would source reliable battery power regulators to prevent a recurrence of a similar failure during operations.

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 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

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