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	CA18/2/3/10347										
Classification	Accident		**Date**	6 July 2023			**Time**	2259Z			
Type of Operation	Unmanned Aircraft System – Surveillance (Part 101)										
Location											
Place of Departure	Arcelor Mittal near Vanderbijlpark, Gauteng Province		Place of Intended Landing			Arcelor Mittal near Vanderbijlpark, Gauteng Province					
Place of Occurrence	Arcelor Mittal near Vanderbijlpark, Gauteng Province										
GPS Co-ordinates	Latitude	26^{0}38'39.4" S		Longitude	27^{0}49'07.8" E		Elevation	4923 ft			
Aircraft Information											
Registration	ZT-YPM			Class	3A						
Make; Model; S/N	Mavic 2; Enterprise Advanced (Serial Number: MAV117)										
Damage to Aircraft	Substantial			Total UAS Hours			61.01				
Pilot-in-command											
Licence Type	Remote Pilot Certificate			Gender		Male	Age	31			
Licence Valid	Yes		Total Hours	22.27		Total Hours on Type		22.27			
Total Hours 30 Days	10.2			Total Flying on Type Past 90 Days			19.21				
People Controlling	1	**Injuries (On ground)**	0	**Fatalities**	0	**Fatalities (on ground)**	0				

What Happened

On 6 July 2023, an unmanned aircraft system (UAS) with registration ZT-YPM was launched for surveillance of a steel mill factory plant at Arcelor Mittal near Vanderbijlpark, 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.

The pilot reported that he completed two surveillance flights which were uneventful. In preparation for the third flight, he stated that he completed a pre-flight check with no anomalies found. Thereafter, the UAS was launched with the battery power at 100 percent, and the UAS climbed to 117 metres (m) (383 feet [ft]) above ground level (AGL) to survey the area and to take pictures. Approximately 4 minutes into the flight whilst at 378 ft, there was loss of connection between the remote pilot station and the UAS. The pilot engaged the return-to-home function, but there was no response. He then made his way to the last recorded position of the UAS and found it crashed. The UAS sustained substantial damage to one of the propellers and the battery. No person was injured on the ground.

The following weather information was obtained from the pilot's questionnaire:

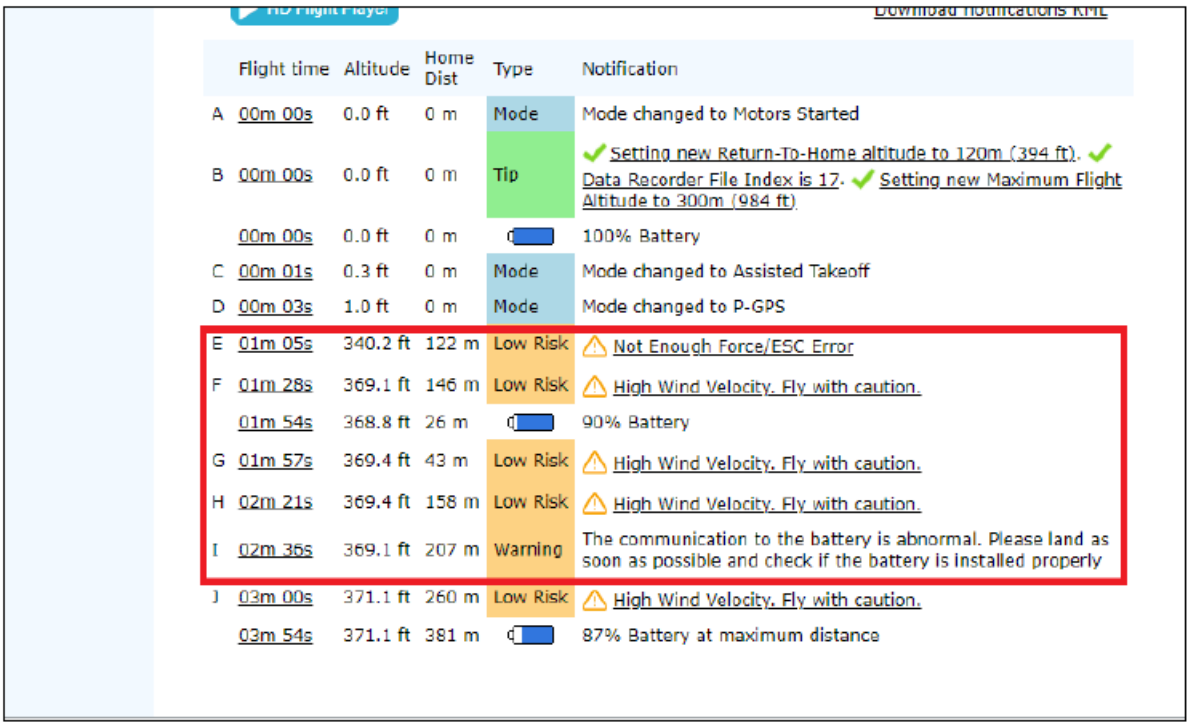
Wind Direction	360^0	Wind Speed	7kts	Visibility	9999
Temperature	22^0C	Cloud Cover	CAVOK	Cloud Base	CAVOK
Dew Point	Unknown	QNH	Unknown		

Figure 1: Aerial view of the accident site at Arcelor Mittal near Vanderbijlpark. (Source: Google Earth)

Figure 2: The UAS at the accident site. (Source: Pilot)

Post-accident inspection:

The UAS data was downloaded for further data analysis.



	Flight time	Altitude	Home Dist	Type	Notification
A	00m 00s	0.0 ft	0 m	Mode	Mode changed to Motors Started
B	00m 00s	0.0 ft	0 m	Tip	Setting new Return-To-Home altitude to 120m (394 ft). Data Recorder File Index is 17. Setting new Maximum Flight Altitude to 300m (984 ft)
	00m 00s	0.0 ft	0 m		100% Battery
C	00m 01s	0.3 ft	0 m	Mode	Mode changed to Assisted Takeoff
D	00m 03s	1.0 ft	0 m	Mode	Mode changed to P-GPS
E	01m 05s	340.2 ft	122 m	Low Risk	Not Enough Force/ESC Error
F	01m 28s	369.1 ft	146 m	Low Risk	High Wind Velocity. Fly with caution.
	01m 54s	368.8 ft	26 m		90% Battery
G	01m 57s	369.4 ft	43 m	Low Risk	High Wind Velocity. Fly with caution.
H	02m 21s	369.4 ft	158 m	Low Risk	High Wind Velocity. Fly with caution.
I	02m 36s	369.1 ft	207 m	Warning	The communication to the battery is abnormal. Please land as soon as possible and check if the battery is installed properly
J	03m 00s	371.1 ft	260 m	Low Risk	High Wind Velocity. Fly with caution.
	03m 54s	371.1 ft	381 m		87% Battery at maximum distance

Figure 3: Aircraft experienced an abnormal battery warning.

Sequence of events

At 21:03 UTC: The pilot armed the aircraft and ascended to 400 ft AGL.
At 21:05 UTC: 2 minutes into the flight, the aircraft gave an "abnormal battery" warning.
At 21:07 UTC: The aircraft disconnected from the C2 link.

Conclusion

The aircraft disconnected from the C2 link shortly after take-off.
The investigation revealed that the battery terminals had red dust inside the terminals.

The warning happened just before the UAS crashed. There was a red dust found in the battery terminals during the investigation.

Findings

1. The pilot was issued a Remote Pilot Licence (RPL) by the Regulator (SACAA) on 28 January 2022 with an expiry date of 31 January 2027. The pilot's licence was endorsed with a visual line of sight (VLOS) rating.

2. The pilot's Class 3 medical certificate was issued on 28 January 2022 with an expiry date of 31 January 2027 with no medical restrictions.

3. The remote maintenance technician (RMT) who conducted maintenance on the UAS was initially issued a RMT Licence on 21 June 2023.

4. The operator was issued a Remotely Pilot 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 that was issued to the current owner on 24 August 2022.

6. The UAS was initially issued a Remotely Piloted Aircraft Systems Letter of Approval (LOA) on 22 September 2022 with an expiry date of 21 September 2023.

7. The UAS was a Class 3A and was approved to operate beyond visual line of sight (BVLOS) at a radius of 25 kilometres and at a height of 1650 feet above ground level (AGL).

8. The UAS's last mandatory periodic inspection was conducted on 14 June 2023 at 42.46 total hours. It accumulated a further 18.55 hours since the last mandatory periodic inspection (MPI).

9. There was sufficient battery power remaining at 87% at the time of the crash.

Probable Cause(s)

The UAS disconnected from the remote pilot station as a result of the red dust that had accumulated on the battery terminal.

Contributing Factor(s)

None.

Safety Action(s)
None.
Safety Message
UAS pilots are advised to ensure that the weather conditions are suitable for operations prior to deploying their UASs for any mission/flight.
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