Serious Incident

Aircraft Type and Registration:	UAS Prion Mk3	
No & Type of Engines:	1 Parallel-twin-120cc engine	
Year of Manufacture:	2023 (Serial no: 3-0021)	
Date & Time (UTC):	6 March 2023 at 1352 hrs	
Location:	West Wales Airfield	
Type of Flight:	Private - Test & Evaluation	
Persons on Board:	Crew - None	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to nose gear, boom, fuselage and right wingtip	
Commander's Licence:	N/A	
Commander's Age:	26 years	
Commander's Flying Experience:	166 hours (of which 166 were on type) Last 90 days - 7 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the operator.	

Synopsis

The aircraft was operating at West Wales Airport when the remote pilot observed the engine had stopped. The aircraft had lost all electrical power but continued to fly briefly before disappearing behind a hedge. The aircraft landed a short distance beyond the south-western edge of the airfield. It sustained minor damage; there was no damage to property or injuries to people.

The operator has taken two safety actions.

History of the flight

The operator was conducting the second of two flights to complete validation of the aircraft's autopilot.

The plan involved the aircraft taking off from West Wales Airfield (WWA); operating in visual line of sight (VLOS) within the air traffic zone (ATZ), and beyond visual line of sight (BVLOS) below 3,000 ft amsl within 1.8 km of the remote pilot (RP), all within danger area D202D.

The RP conducted the takeoff at 1215 hrs and handed control of the aircraft to the RP station operator (RPSO).

A number of tests were conducted to validate the autopilot and flight control systems. At 1350 hrs the RP observed that the engine had stopped, with the aircraft 1,000 ft agl over the centre of the airfield and routing along the northern edge of Runway 25. He informed the RPSO that he was taking control by saying "my bird" to which the RPSO acknowledged "your bird". However, the RP then advised the RPSO that he was not able to gain control; the RPSO then attempted to regain control but without success.

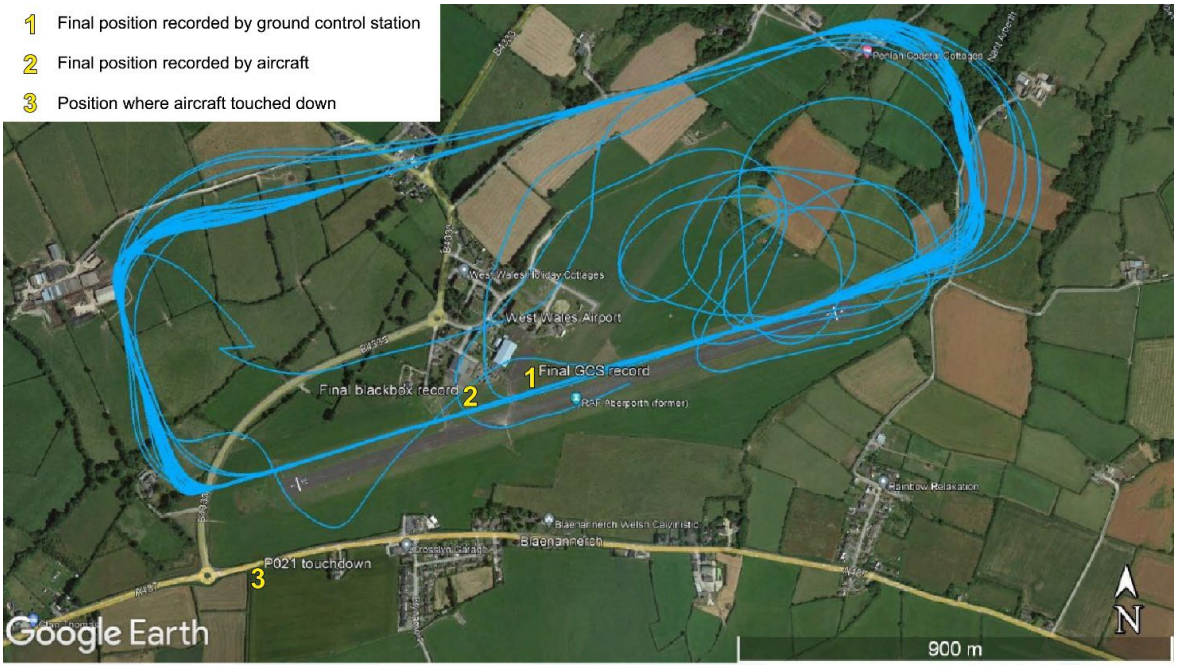

Figure 1

Track of UAS Prion during accident flight

The RPSO advised ATC of the situation. Meanwhile, the aircraft continued further along the direction of Runway 25 for about 30 seconds before turning right and circling, then disappearing from the RP's sight beyond a hedge (Figure 1).

Accident site

The aircraft was found just beyond the south-western end of the airfield to the east of the A487/B4333 roundabout. It had landed on its wheels but suffered damage to the nose gear, right wingtip and fuselage. There was no damage to property or injuries to people.

Aircraft information

The Prion Mk3 is a fixed wing monoplane with a 4-stroke petrol engine, which uses an electronic fuel injection system and an electric alternator generator. It has a maximum takeoff mass of 55 kg with up to a 4.5 m wingspan and is 3 m in length. The airframe remains visible to the naked eye within a flight envelope of 1,000 m lateral distance up to an altitude of 1,000 ft agl.

Electrical power provision and distribution

The Prion MK3 uses ground power prior to engine start. Once the engine has started, power is supplied by an on-board alternator generator. In the event of the generator failing, there is an emergency lithium polymer battery, which will continue to power the systems for a minimum of two hours (calculated at 20°C). This battery is tested for charge before each flight and is continuously charged by the alternator generator while the engine is running.

There is a warning system fitted to ensure this battery is connected before flight. The field crew could monitor the charge status of the emergency battery using the flight telemetry system, if selected for display.

After flight, the aircraft is connected to ground power, which also charges the emergency battery.

Aerodrome information

WWA is a licenced aerodrome situated at Aberporth on the west coast of Wales and lies within the danger area D202D, where extensive UAS activities occur.

Organisational information

Operator safety case

For flights within WWA under extended visual line of sight (EVLOS) rules, the aircraft was to remain within 2,000 m lateral distance from the RP up to an altitude of 1,000 ft agl.

The operator safety case considered a number of scenarios. This included the loss of aircraft flight control and telemetry systems during flight, engine failure and flyaway. The emergency response plan for a flyaway recognised that the cause could be the result of total systems failure wherein, with the *'more dramatic failure of the autopilot, the aircraft will likely ditch.*'

The mitigations put in place for flyaway included the use of pre-flight checklists to assure system functionality, together with the use of buffer zones for flights operating under VLOS/EVLOS and segregated airspace when operating under BVLOS. The buffer zone applied to operations within an ATZ was established at 500 m horizontal 500 ft vertical separation from the edge of the ATZ.

There was no specific scenario that considered total loss of electrical power.

Operator investigation

The operator's post flight investigation determined the accident occurred as a result of the total loss of electrical power. This occurred on the second flight of the day once the emergency battery became discharged, resulting in loss of flight control, communication with both the RP and the RPSO and the shutdown of the engine. Consequently, the aircraft glided to the point it touched down.

The investigation established that the alternator generator system was not delivering power nor charging the emergency battery because of an incorrect wiring connection which had not been identified during assembly. Prior to the accident, the wiring for each airframe was unique. The operator has since standardised the schematics and wiring across the fleet. It also identified that the field crew had not selected the option on the flight telemetry system to enable them to monitor the voltage of the back-up battery.

The investigation established that the powerplant had been changed the previous day, but that validation of the performance of the alternator generator system had not been carried out. It identified that the fault existed for the first flight of the day which lasted only 35 minutes but which, consequently, did not fully deplete the emergency battery. The fault was not identified prior to the second flight since the emergency battery was charged by the ground power connection prior to flight, preventing the pre-flight check from identifying that the emergency battery charge had been depleted during the first flight.

The operator identified that the after-flight check list was missing a check of the emergency battery status prior to the aircraft being connected to the ground power. It also improved the engine monitoring graphical interface flight telemetry system (Figure 2) to include voltage indication of the emergency battery to allow its charge status to be monitored in flight. This would indicate if the alternator generator system was faulty.

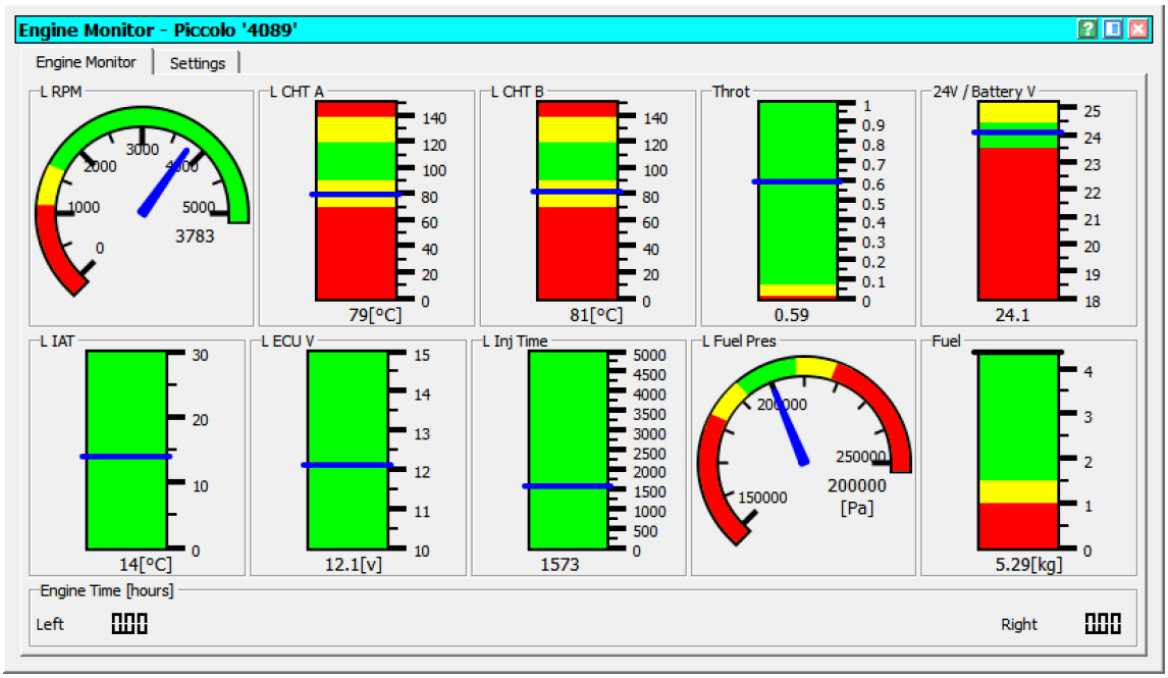

Figure 2

Engine monitor with emergency battery voltage (top right) indication

Analysis

The flight was conducted within the confines of the WWA ATZ and consequently the aircraft remained in sight of the RP at all stages up to the final moments when it disappeared behind the hedge.

The accident occurred once the emergency battery had become depleted of all charge. This resulted in the loss of communications by the RPSO, and the RP followed by the loss of propulsion.

The mitigations of a buffer zone helped limit the risk of escalation of the consequences of total loss of power. However, while the operator recognised the consequences of a total systems failure, it had not explicitly considered total loss of electrics within its safety case.

The management of the threat of loss of electrical power was ineffective since the means by which the field crew could identify a malfunction of the alternator generator system had not been enabled. Additionally, assurance of the serviceability of the system through a check of the charge status of the emergency battery during pre-flight was ineffective since there was no check of its charge status prior to connection of ground power post flight.

Conclusion

The aircraft suffered the total loss of electrical power as a result of the malfunction of the alternator generator to maintain the charge of the emergency battery and deliver power to the systems. This was the consequence of an incorrect wiring connection. The means to provide warning to the field crew of an alternator generator malfunction was not selected in the flight telemetry system. Further, the pre-flight check of the charge status of the emergency battery was not an effective means of establishing the alternator generator system was functioning properly.

Safety action

The operator has taken the following safety action.

- The operator has standardised the wiring and schematics across the fleet.
- The operator has amended their after-flight check list to establish the charge status of the emergency battery, prior to the connecting of ground power to the aircraft, as a means to verify the functionality of the power generation and charging system.
- The operator has included voltage indication of the emergency battery in the engine monitoring graphical interface to indicate alternator generator system performance.