Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

ACCIDENT
Unmanned Aircraft, MNA GEN 3.8
Balbriggan, Co. Dublin

4 June 2023

An Roinn Iompair
Department of Transport

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13[1] to the Convention on International Civil Aviation, Regulation (EU) No 996/2010[2] and Statutory Instrument No. 460 of 2009[3], safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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[1] **Annex 13**: International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.
[2] **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.
[3] **Statutory Instrument (SI) No. 460 of 2009**: Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.

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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI No. 460 of 2009, on 4 June 2023, the Chief Inspector of Air Accidents, appointed Kate Fitzgerald as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

Aircraft Type and Registration:	**MNA GEN 3.8 (Unmanned Aircraft)**
No. and Type of Engines:	**8 x T-Motor U8 Electric Motors**
Year of Manufacture:	**2023**
Date and Time (UTC)[4]:	**4 June 2023 @ 12:55 hers**
Location:	**Balbriggan, Co. Dublin**
Type of Operation:	**Urban Delivery**
Injuries:	**Nil**
Nature of Damage:	**Substantial**
Remote Pilot Qualifications:	**Remote Pilot Certificate of Theoretical Knowledge with European Union Aviation Safety Agency (EASA) A1/A3[5] and Standard Scenario (STS) certification.** **Practical Skills Assessment at a Declared Unmanned Aircraft Systems Training Organisation (DUTO) Recognised by the Irish Aviation Authority (IAA)**
Remote Pilot's Age:	**26 years**
Remote Pilot's Flying Experience:	**28 hours**
Notification Source:	**The Operator**
Information Source:	**The Operator**

[4] **UTC**: Co-ordinated Universal Time. All times in this report are quoted in UTC unless otherwise stated; local time was UTC +1 hour on the date of the accident.

[5] **EASA A1/A3:** In EASA definitions for unmanned aircraft operations, A1 allows an operator to '*fly over people but not over assemblies of people*' and A3 allows an operator to '*fly far from people*.'

SYNOPSIS

Whilst descending to delivery height, during a routine flight to a customer's address in Balbriggan, Co. Dublin, the Unmanned Aircraft (UA) impacted a nearby building. This impact caused the UA's control system to initiate its flight termination protocol which included deployment of the onboard ballistic parachute. The UA descended, impacted the ground in a clear area adjacent to the building, and was substantially damaged. No injuries were reported to the Investigation.

NOTIFICATION AND RESPONSE

The AAIU was notified of the occurrence by the Operator on 6 June 2023.

PREAMBLE

At the time of the occurrence, the operation involved the delivery of small packages to customers in the Balbriggan area who ordered online through an app (mobile device application). A staff member, referred to as the Mission Controller, generated a flight path to a customer's address, avoiding assemblies of people and overflight of sensitive areas such as schools. A Remote Pilot monitored the flight and could intervene directly to control the UA if required. Prior to delivery, a Visual Observer[6] was dispatched to the customer's address to assess the ground and air risk at the location. The Visual Observer was in radio communication with the Remote Pilot at all times and could change the delivery location or abort the delivery at any stage. Upon arrival at a delivery address, the UA descended to approximately 14 metres (m) above the ground and the packages were lowered on a thread (**Photo No. 1**). When the package reached the ground, the thread was automatically released and the UA returned to its operating base.

Photo No. 1: A MNA GEN 3.8 during a typical urban delivery flight *(AAIU)*

[6] **Visual Observer:** The Visual Observer predominantly acts as an airspace monitor for each flight to ensure no conflict with manned aircraft. The Visual Observer is also used as an additional ground risk monitor, to ensure each delivery can be safely conducted without interference from uninvolved third parties.

1. FACTUAL INFORMATION

1.1 History of the Flight

At 12:53 hrs on 4 June 2023, the UA departed from its operating base in Balbriggan, Co. Dublin, on a delivery flight in the local area. The delivery location was in an urban area close to apartment buildings located approximately one kilometre (km) north-east of the Operator's base. The climb and cruise phases of the flight were completed uneventfully. When the UA arrived at the delivery location, it commenced a descent to the pre-defined normal delivery height of 14 m. In the case of the subject occurrence, the UA initially descended to 12.29 m. Then using a LiDAR[7] system it recalculated the height above the ground before commencing an adjustment to the 14 m target delivery height.

During this adjustment to 14 m, the propellers on the left side of the UA made contact with an adjacent building which was subsequently estimated by the Operator to be 12.99 m in height. Almost immediately following the impact, the UA's control system detected a critical failure (loss of control) and activated the Flight Termination System (FTS). The FTS shut down the UA's electric motors and deployed the UA's onboard ballistic parachute system.

At the time the FTS was initiated, the UA was below the minimum effective deployment height for the parachute (47 m). The UA impacted the ground 1.1 seconds after parachute deployment and came to rest close to the planned delivery location in a concreted area between apartment buildings. A Visual Observer employed by the Operator was at the site prior to the delivery to ensure that the location was clear of obstacles and people.

The Operator initiated their Emergency Response Procedure (ERP) and immediately deployed a team to the accident site. The team assessed the site and took photographs before recovering the UA back to their operating base. The Operator informed the Investigation that its subsequent analysis of the UA flight logs indicated that all systems were operating normally up until the time of impact with the building.

1.2 Injuries to Persons

No injuries were reported to the Investigation.

1.3 Damage to Aircraft

The UA was substantially damaged in the occurrence. The damage included multiple cracks in the frame, cracks in the bracket connecting the right frame to the right arm, a sheared bolt in the front left bracket, cracks in all four front propeller blades and minor scrapes and cracks in the four rear propeller blades, bending of the front arm, the parachute tube had detached from its mount, and dents/cracks were observed to other areas of the UA.

1.4 Other Damage

No third-party damage was reported to the Investigation.

[7] **LiDAR:** Light Detection and Ranging using a pulsed laser to measure distance.

1.5 Personnel Information

As described in the preamble, the operating crew for the accident flight comprised a Mission Controller, a Remote Pilot and a Visual Observer. Both the Mission Controller and the Visual Observer had completed role-specific training specified by the Operator and held current authorisations from the Operator to carry out those roles. The Remote Pilot held a current European Union Aviation Safety Agency (EASA) Remote Pilot Certificate of Theoretical Knowledge issued by the IAA. The Remote Pilot completed a practical skills assessment on 1 December 2022 at a Declared Unmanned Aircraft System (UAS) Training Organisation (DUTO) recognised by the IAA. At the time of the occurrence the Remote Pilot had 27.81 hours (406 flights) experience.

1.6 Aircraft Information

The MNA GEN 3.8 UA is a lightweight, coaxial[8], octorotor[9] UA, primarily constructed from lightweight plastics and carbon fibre with a maximum take-off weight of 23.6 kgs. The UA's components are a mixture of off-the-shelf parts sourced from third party providers and bespoke elements designed to the Operator's own specifications. Final assembly of the UA takes place near the Operator's flight-testing facility in Co. Offaly, Ireland. The UA has a maximum payload of 2.25 kgs which can be loaded into a cargo compartment located in the main body. During an urban delivery and when at a pre-set height, small packages are lowered from the cargo compartment on a thread, through two small cargo doors. The package, with approximately 14 m of thread, is left on the ground at the delivery location.

A ballistic parachute is fitted that is automatically deployed if a loss of control or other critical malfunction is detected. It can also be deployed manually by the remote pilot.

The subject UA (serial number MNA-1630) was manufactured in April 2023. It had accumulated a total flying time of 30.5 hours and 512 cycles (1 flight = 1 cycle). The UA did not require a Certificate of Airworthiness.

The UA did not have an automatic obstacle collision avoidance system fitted, nor was one required (**Section No. 1.12** contains further information).

[8]**Coaxial:** In this case, '*coaxial*' refers to the fact that two motors were mounted on a common axis, with two motors mounted on each of four arms.
[9]**Octorotor:** A UA with eight rotors.

1.7 Meteorological Information

Met Éireann, the Irish meteorological service, provided details of the estimated meteorological conditions prevailing in the Balbriggan area at approximately 12:54 hrs on the day of the accident. These are outlined in **Table No. 1**.

Meteorological Situation:	Ireland was under the influence of high pressure and a light to moderate easterly flow.
Surface Wind: **Between surface and 300 feet (ft):**	East to north-east, 8-12 knots (kt) Varying between north-east and south-east, 10-12 kt
Visibility:	40+ km
Weather:	Dry and sunny
Cloud:	Few (1-2/8ths) fair weather cumulus cloud with bases between 2,500 and 3,000 ft.
Surface Temperature/ Dew Point:	18/8 degrees Celsius
Mean Sea Level (MSL) Pressure:	1026 Hectopascals (hPa).

Table No. 1: Estimated weather conditions in the Balbriggan area at the time of the occurrence

The Operator informed the Investigation that the conditions at their base of operations were clear, dry and sunny with wind speeds of approximately 6.5 m/s (12.6 kt), from a south-easterly direction. The Technical Report prepared by the Operator after this occurrence opined that these meteorological conditions would have resulted in turbulent conditions below the roof level of the buildings.

1.8 Operator Information

At the time of the occurrence, the Operator of the UA held Line of Sight (LOS) authorisation in the Specific Category[10] from the IAA to carry out a delivery service in the Balbriggan area. The Operator held a Light Unmanned Aerial System Operator Certificate (LUC) issued on 20 May 2021.

An LUC is an organisational approval certificate issued by a National Aviation Authority (NAA), in this case, the IAA. It is issued once the NAA is satisfied that an organisation is capable of, amongst other things, assessing the risk of specific operations. The NAA will assign privileges to the UA operator based on the organisation's level of maturity.

[10] COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, define three categories of Unmanned Aircraft System: '*open*', '*specific*' and '*certified*'. '*Specific*' category relates to operations that present a greater risk than that of the '*open*' category, or where one or more elements of the operation fall outside the boundaries of the '*open*' category. Operations will require an operational authorisation from the CAA (National Civil Aviation Authority), based on a safety risk assessment.' The '*certified*' category is still under development by EASA.

The Operator's LUC, extant at the time of the accident, stated that the UA must be fitted with an '*Operational Flight Termination System (FTS) Parachute',* and be operated at a maximum height of 120 m unless otherwise approved by the IAA. Operations were further restricted to within 2 km of the Operator's base and were to be conducted in accordance with Visual Line Of Sight (VLOS) operations with a requirement to have *'Visual Observer(s)*' in attendance at the delivery location.

1.9 Mission Planning

The ordering procedure at the time of the occurrence was for the customer to select a delivery location using a map shown on the Operator's app. The Operator's Visual Observer then travelled to the delivery location and assessed it for suitability. The Visual Observer could then adjust the delivery location if necessary. The Visual Observer did not have any instrument to assist them in assessing the height of buildings in the vicinity of a delivery location and were reliant on training and experience. All delivery locations were approved by the Mission Controller on duty before the order proceeded. The Operator's standard procedures contained a checklist to assist Visual Observers in selecting a suitable delivery location. The checklist recommended that the Visual Observer should consider:

- 2m minimum radius
- Proximity to houses
- Overhead wires
- Lamp posts
- Cars
- Trees/bushes
- Overhanging branches
- Sloped ground

In this occurrence, the customer had selected a delivery location that was inside a gated area of an apartment complex and was not accessible by the Visual Observer. Therefore, the Visual Observer adjusted the delivery location to outside the gates. The delivery location from the ground and from above is shown in **Figure No. 2**. Notably, green moss on an adjacent roof may have appeared to the Remote Pilot to be a flat, ground-level area, rather than the roof of an apartment building.

The app used by the Operator showed a blue target circle with an outer grey circle indicating the delivery location. These circles did not represent any particular distance and could change in size. The Operator informed the Investigation that since this occurrence it has updated its app so that the outer grey circle now represents a 2 m zone to be used by a Remote Pilot / Mission Controller as guidance.

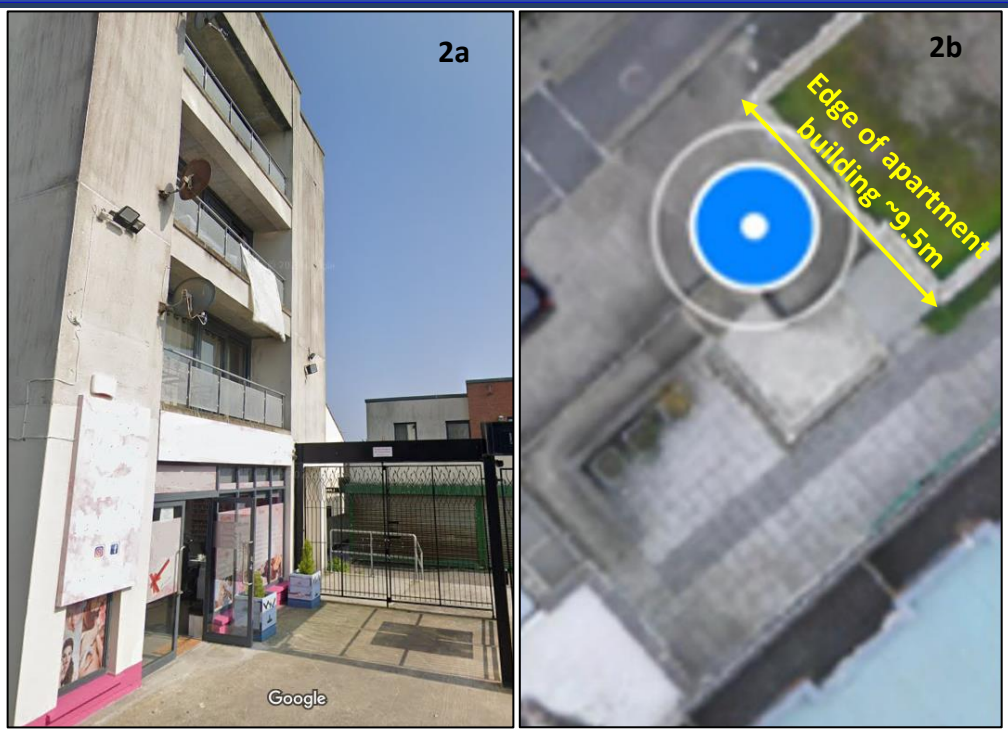

Figure No. 2: Delivery location taken from the ground **(2a)**, and mapping as displayed in the Operator's App at the time of the occurrence **(2b)** (yellow text added by Investigation)

1.10 Relevant Regulatory Information

1.10.1 Definition of Accident and Serious Incident

The Investigation notes that the definition of an accident that is given in S.I. No. 24 of 2023, '*Irish Aviation Authority (Unmanned Aircraft Systems (Drones))*' which was extant at the time of the subject accident is substantially different to the established definition included in S.I. No. 460 of 2009, '*Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009'* and in Regulation (EU) 996/2010, '*on the investigation and prevention of accidents and incidents in civil aviation*' and ICAO Annex 13. The definition of accident contained in S.I. No. 24 of 2023 is:

> *'*[…] *an occurrence associated with the operation of an Unmanned Aircraft System (UAS), which takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which a person is fatally or seriously injured as a result of direct contact with –*
>
> *(a) any part of the UAS, or*
>
> *(b) parts of the UAS that have become detached;'*

The definition of serious incident contained in S.I. No. 24 of 2023 is:

> *'*[…] *an incident involving circumstances indicating that there was a high probability of an accident associated with the operation of an unmanned aircraft, which takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down. The difference between an accident and a serious incident lies only in the result.'*

The definition of an accident that is given in, S.I. No. 460 of 2009[11], Regulation (EU) 996/2010 and ICAO Annex 13 is:

> '[…] *an event associated with the operation of an aircraft with the intention of flight which, in the case of manned aircraft, takes place from the time any person boards the aircraft with the intention of flight until such time as all persons have disembarked, or in the case of unmanned aircraft, takes place between the time the aircraft is ready to move for the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which—*
>
> *(a) a person is fatally or seriously injured as a result of—*
>
> *i. being in the aircraft,*
> *ii. direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or*
> *iii. direct exposure to jet blast,*
>
> *except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew,*
>
> *or*
>
> *(b) the aircraft sustains damage or structural failure which—*
>
> *i. adversely affects the structural strength, performance or flight characteristics of the aircraft, and*
> *ii. would normally require major repair or replacement of the affected component* […]'

The definition of a serious incident that is given in S.I. No. 460 of 2009[12] Regulation (EU) 996/2010, and ICAO Annex 13 is:

> '[…]*an event involving circumstances indicating that there was a high probability of an accident associated with the operation of an aircraft with the intention of flight* […]'

The Investigation highlighted to the IAA that this difference in definitions has the potential to cause confusion regarding what type of occurrences must be reported to the AAIU. The IAA informed the Investigation that S.I. No. 24 of 2023 will be superseded by an updated Statutory Instrument which will directly reference the definitions of accident and serious incident in Regulation (EU) 996/2010 and consequently will also align with the definitions of accident and serious incident contained in SI No. 460 of 2009, and ICAO Annex 13.

[11] There are some minor vocabulary differences between the definition of an accident given in Regulation (EU) 996/2010 and SI No. 460 of 2009.
[12] There are some minor vocabulary differences between the definition of a serious incident given in Regulation (EU) 996/2010 and SI No. 460 of 2009.

1.10.2 Reporting of Occurrences

With regards to reporting of occurrence S.I. No. 24 of 2023 states:

> *'In the case of an accident or serious incident, the operator of the UAS shall immediately notify the UAS Division of the Authority, an Garda Síochána, and in accordance with the Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009, the Air Accident Investigation Unit.'*

S.I. No. 460 of 2009 states:

> *'When an accident or serious incident to which these Regulations apply occurs, the pilot in command, or if he or she is incapacitated, the operator of the aircraft, shall, as soon as practicable, send notice of the accident or serious incident to the Chief Inspector at the AAIU by the most rapid practicable means available and, in the case of an accident, shall also immediately notify An Garda Síochána or, if it occurs outside the State, the appropriate local authorities.'*

1.11 Operator's Emergency Response Procedure

The Investigation notes that both the Operator's Operations Manual that was extant at the time of the accident, and a more recent issue of the same Operations Manual (Issue 2, Revision 2, dated 09 April 2024), contain the following information in section 7.1.1, *Emergency Response:*

> *'The MC* [Mission Controller] *has the responsibility for initiating and managing the ERP* [Emergency Response Plan] *including alerting relevant authorities and entities e.g., ATC, AAIU,* […]'

Sections 7.1.3 of both issues of the Operations Manual contains a flow chart of the actions that must be taken in the event of a '*Drone Down'*. This flow chart contains a box that states:

> '*ERM* [Emergency Response Manager] *will confirm when aircraft/debris can be removed after liaising with relevant authorities*'.

In this case, the AAIU was notified two days after the occurrence, and the UA had been removed from the scene of the occurrence prior to the AAIU being notified. The Investigation notes that the Operator's Operations Manual does contain the requirement to notify relevant authorities prior to moving the UA wreckage. The AAIU operates a 24-hour telephone service, details of which are available on AAIU.ie.

1.12 EASA Specific Assurance and Integrity Level

The European Union Aviation Safety Agency (EASA) has developed a risk-based classification system for UAS operations. Each operation is assigned a Specific Assurance and Integrity Level (SAIL) based on a six-point scale. The SAIL for each operation is determined by the outcome of a Specific Operations Risk Assessment (SORA). Higher SAIL levels are associated with more complex operations where the potential consequence of a failure is more serious than operations that have lower SAIL levels. To gain approval to operate at a particular SAIL level, operators must demonstrate compliance with Operational Safety Objectives (OSOs). OSOs cover a broad range of requirements including the competence of the operator, the competence of the UA manufacturer, system safety and reliability, operational procedures, and crew training. The OSOs become increasingly stringent at higher SAIL levels, and following demonstration of compliance with these objectives an operator is permitted to operate at a higher SAIL level.

At the time of the occurrence, the subject Operation was classified as SAIL II. Since the occurrence the Operation has undergone substantial development (including a change in location and operating without a Visual Observer for every flight) and is now classified as a SAIL III operation. The risk assessment carried out for the SAIL III operation includes more detailed work to define a '*shelter factor*[13]' for the new location, a test programme for the emergency ballistic parachute, and use of a downwards facing camera at the delivery location to assess the ground risk in real-time. These mitigations were deemed by the Operator to negate the need for a Visual Observer.

In light of this change, and the fact that the UA does not have an automatic obstacle collision avoidance system installed, the Investigation asked the Operator how the risk of collisions with temporary structures such as cranes, or new structures was managed. The Operator informed the Investigation that the enroute risk of a collision with such structures was managed by operating procedures. '*Procedure P-001, Base Operations Manager, Management of Adjacent Area Risk*' of the Operator's Operations Manual which requires a weekly survey of the entire approved flight geography. The routes that must be used for the survey are pre-defined to ensure that the complete area is covered.

In addition, the UAs cruise at a height of 65 m and only descend (vertically) when they are directly above the delivery location. At the delivery location the UA calculates its position based on LiDAR data and a terrain database. The Remote Pilot further verifies that the delivery location is clear by visually inspecting the location using the downward facing camera installed on the UA.

[13] **Shelter Factor:** A factor that is used as a mitigation when assessing the risks associated with a population being exposed to the overflight of UAs. The shelter factor provides an estimate of the percentage of time members of the public spend outdoors versus the time they are indoors and consequently not at risk.

1.13 Operator's Safety Actions

Following completion of an internal investigation, the Operator implemented several Safety Actions which included:

- Revised separation requirements of 3.1 m laterally for obstacles that are over 11.2 m high.
- Preventing the positioning of delivery pins (in the App) too close to obstacles.
- An automatic pre-flight check of the drop location that automatically references aerial LiDAR survey data and will determine if there are any obstacles or structures above 11.2 m that exceed the required clearance criterion within the delivery area and surrounding buffer. This alerts the Mission Controller and will also prevent the aircraft taking off.
- Prohibiting delivery to '*common areas*' with uninvolved persons[14].
- Revised flight control software to improve positional accuracy at the delivery location.
- Updating of operations documents and training to capture the changes identified in the Safety Actions.

The Investigation asked the IAA if they would normally review a UA operator's safety actions in cases such as this. The IAA said that they would have visibility of occurrences reported under SI No. 24 of 2023. An operator would not be required to report less serious occurrences, but the IAA would see these reports, and any remedial actions taken, during regular audits of an operator's Safety Management System.

1.14 Mechanical Turbulence

Mechanical turbulence is a type of air disturbance caused by the presence of obstacles such as mountains, buildings, or trees, which force airflow to diverge or converge around them, creating eddies and turbulent conditions. Its intensity is directly influenced by factors such as the wind speed and the roughness or height of the obstructions, as well as the atmospheric stability near the surface.

2. ANALYSIS

2.1 UA Operations

The identification of an appropriate delivery location is a key task in urban delivery missions and presents unique challenges. At the time of this occurrence, the Operator had processes in place to ensure that delivery locations were suitable including the deployment of a Visual Observer. However, when looking at the 2D image of the delivery location, the Remote Pilot was not able to ascertain the height of the nearby buildings and may have misidentified an apartment building as a flat grassy area. Consequently, when the UA was adjusting to the delivery height, it was lower than the adjacent building and the Remote Pilot did not have sufficient information to ensure lateral separation between the UA and the building. The Visual Observer did not communicate any concerns about the disposition of the UA to the Remote Pilot and it is also possible that mechanical turbulence around the buildings in the vicinity of the delivery location caused the UA to move laterally and impact the building. The

[14] **Uninvolved person:** a person who is not participating in the UAS operation or who is not aware of the instructions and safety precautions given by the UAS (drone) operator.

UA was not fitted with an automatic obstacle collision avoidance system, nor was one required.

At the time of the occurrence, the UA was below the minimum effective deployment height for the ballistic parachute. This meant that the parachute could not effectively arrest the descent of the UA, although the parachute's deployment would have reduced the energy of the impact.

Since this occurrence the Operator has implemented safety actions to mitigate the possibility of a reoccurrence. These safety actions include updated procedures to check for obstacles close to delivery locations using LiDAR survey data, increased lateral separation limits from buildings over 11.2 m high, prohibiting delivery locations that are in '*common areas*' with uninvolved people and improvements to the flight control software which would increase the positional accuracy of the UA at the delivery location.

Since the occurrence, the UA Operator has continued to develop and has gained regulatory approval to operate at SAIL III. The Operation now operates without a Visual Observer. The Investigation notes the mitigations that were put in place (such as a downwards facing camera at the delivery location to assess the ground risk in real-time, more detailed work to define a '*sheltering factor*' and a test programme for the emergency ballistic parachute) to negate the need for a Visual Observer. In addition, the Investigation notes the Operator's procedures to mitigate the risk of a collision with a temporary obstacle. These procedures include a weekly survey of the entire approved flight geography, procedures to ascend/descend vertically and cruise at a height of 65 m, verifying position based on LiDAR data and a terrain database and a visual check of the delivery location by the remote pilot using the UA's downward facing camera. Due to the Safety Actions taken, no Safety Recommendations are made to the Operator.

2.2 Reporting of Accidents and Serious Incidents

The definitions of an accident and a serious incident included in S.I. No. 24 of 2023 (Irish Aviation Authority (Unmanned Aircraft Systems (Drones)) which was extant at the time of the subject accident are different to the established definitions given in S.I. No. 460 of 2009 Regulation (EU) 996/2010, and ICAO Annex 13. The definition of an accident in S.I. No. 24 of 2023 requires an operator to report an occurrence involving a UA to the IAA only if a person is fatally or seriously injured, whereas S.I. No. 460 of 2009, Regulation (EU) 996/2010, and ICAO Annex 13 require an operator to report an occurrence to the AAIU if a person is fatally or seriously injured or if the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component.

The AAIU is aware of occasions where UA operators did not notify the AAIU of reportable occurrences under S.I. No. 460 of 2009, or occurrences were reported several days later after the wreckage of the UA had been moved. The Investigation is of the opinion that the difference in definitions could contribute to confusion amongst operators about which occurrences are reportable to the AAIU, particularly because S.I. No. 24 of 2023 also states:

> *'In the case of an accident or serious incident, the operator of the UAS shall immediately notify the UAS Division of the Authority, an Garda Síochána, and in accordance with the Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009, the Air Accident Investigation Unit.'*

The IAA informed the Investigation that S.I. No. 24 of 2023 will be superseded by an updated S.I. which will directly reference the definitions of accident and serious incident in Regulation (EU) 996/2010 and consequently will also align with the definitions of accident and serious incident contained in SI No. 460 of 2009, and ICAO Annex 13. Considering this planned update, no Safety Recommendation is made to the IAA.

3. CONCLUSIONS

3.1 Findings

1. The Operator held a Specific Category Line of Sight (LOS) authorisation from the IAA to carry out a delivery service in the Balbriggan area.
2. When the order was received a Visual Observer travelled to the delivery location to assess it for suitability.
3. In this occurrence, the Visual Observer moved the delivery location to a new location which was then approved by the Mission Controller.
4. The roof of an apartment building adjacent to the delivery location appeared as a flat grassy surface on the 2D mapping tool used by the Operator.
5. The UA descended to below the height of the roofline of the adjacent apartment building.
6. The UA impacted the wall of the adjacent building.
7. The UA's flight termination system was initiated, which included the deployment of an emergency parachute.
8. The UA did not have a collision avoidance system.
9. The height of the UA was below the minimum effective deployment height for the parachute and the parachute failed to fully inflate.
10. The UA impacted the ground close to the apartment building and sustained substantial damage.
11. The definition of '*Accident*' included in SI No. 24 of 2023 is substantially different to the established definition included in ICAO Annex 13, Regulation (EU) 996/2010 and SI No. 460 of 2009 and could contribute to confusion amongst operators about what occurrences are required to be reported to the AAIU.

3.2 Probable Cause

Turbulent air in the vicinity of a building, while the UA was unintentionally below the roofline, caused the UA to impact the building.

3.3 Contributory Cause

In the 2D mapping tool that was used by the Mission controller and Remote Pilot, the roof of the building resembled a ground-level surface.

4. SAFETY RECOMMENDATIONS

The Investigation does not sustain any Safety Recommendations.

- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

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