

Guidelines to ATCOs regarding very-low-level drone operations near controlled airports.

Introduction

The objective of this discussion and guidance material is to promote and uphold a high standard of knowledge and professional efficiency among Air Traffic Controllers. This document is for: distribution to IFATCA Member Associations and ATCOs; as guidance for IFATCAs' representatives; and for public dissemination. The guidance material focusses on drones operating very-low-level (e.g. not above 400 ft AGL) near controlled airports, generally within controlled airspace, and either VLOS¹ or BVLOS².

This guidance material complements the IFALPA/IFATCA Drone Sighting Guidelines published 29 August 2018³. It also aligns with IFATCA's policy statements on the operational use of unmanned aircraft.

Problem statement: The number of drone sightings by pilots and ATCOs and related airprox reports continues to rise. There have been numerous cases of airspace and aerodrome closures due to drones in the vicinity. Many countries do not yet have standard procedures to deal with drone sightings near aerodromes or violations of controlled airspace. Additionally, ATCOs are being asked to assess requests by drone operators for access to ICAO airspace when the rules of the air do not support such access nor provide separation minima for ATC to apply between drones and conventionally piloted (manned) aircraft (CPA). IFATCA policy: *ATCOs shall not be held liable for incidents or accidents resulting from the operations of RPAS that are not in compliance with ICAO requirements, in non-segregated airspace*⁷.

General notes

1. The scope of ICAO's work is currently limited to: '*certificated RPAS operating internationally within controlled airspace under instrument flight rules (IFR) in non-segregated airspace and at aerodromes in the 2031 onward timeframe*⁴'. ICAO will expand this scope where evidence indicates unanticipated needs resulting from market growth, technology advances or other unforeseen conditions. ICAO does not consider: fully autonomous aircraft and operations; visual line-of-sight; very low altitude airspace operations (although ICAO has an advisory group: UAS-AG); very high altitude operations; the carriage of persons; non-international operations; as well as droneports, optionally piloted aircraft and scenarios where one pilot operates several flights concurrently.
2. The four main requirements for Unmanned Aircraft System (UAS)-ATM integration⁵ are:
 - The integration of UAS shall not imply a significant impact on current users of the airspace;*
 - UAS shall comply with the existing and future regulations and procedures laid out for manned*

¹ Visual line of sight, often described as within 500 m of the drone operator/pilot.

² Beyond visual line of sight: outside the VLOS area; where the operator/pilot can no longer provide separation visually.

³ <http://www.ifatca.org/wp-content/uploads/2018/09/18ATSBL01-Drone-Sighting-Guidelines.pdf>.

⁴ ICAO Remotely Piloted Aircraft System (RPAS) Concept Of Operations (CONOPS) For International IFR Operations, p. 3.

⁵ EASA Eurocontrol UAS ATM Integration Operational Concept.

aviation;

-UAS integration shall not compromise existing aviation safety levels nor increase risk more than an equivalent increase in manned aviation would.

-UAS operations shall be conducted in the same way as those of manned aircraft and shall be seen as equivalent by ATC and other airspace users.

3. As of early 2019, Standards and Recommended Practices (SARPs) do not cover the following areas, therefore, the following information is provided by IFATCA to assist MAs and ATCOs in decision-making processes in these areas.
4. During VLOS, the Remote Pilot (RP) maintains direct unaided visual contact with the drone to maintain separation and avoid collisions/hazards. As yet, no reliable airborne nor ground based detect and avoid technology exists to install on small drones, so avoiding other airspace users (cooperative and non-cooperative drones or conventionally piloted aircraft) and airspace hazards (as well as other risks from obstacles, terrain, weather, birds) in BVLOS is problematic.
5. The operation of drones relies predominantly on either C2⁶ links or pre-programmed automation. When this link is sporadic or fails, i.e. a 'lost' C2 link, a fully autonomous flight results whereby the operator/pilot cannot interact with the drone. Also, as adequate contingency or emergency procedures are not yet established, integration in non-segregated airspace is not currently an option. *IFATCA is opposed to the operations of any autonomous aircraft in non-segregated airspace⁷.*
6. Eventually, an accurate picture of the consequences of a drone colliding with a CPA will be available through damage assessments and other ongoing work. Until these are complete and proven to be accurate, it is assumed the outcome of a mid-air-collision with a drone will be either Hazardous (Value A) or Catastrophic (Value B) as per the ICAO Doc. 9859: Safety Management Manual⁸, possibly penetrating the cockpit or impacting with a helicopter's rotor. Any collision should be avoided and this responsibility presently lies with the RP. It is generally accepted that drones under 250 gms are harmless. Training and simulation events for both pilots and ATCOs in coping with such scenarios is highly recommended.
7. Drones entering controlled airspace and operating near controlled airports, change the level of safety risk. This triggers a need to measure, understand and assess the change⁹. For example, IFR flights provided with an ATC control service in controlled airspace have an expectation of full separation from other airspace users. This includes helicopter landing sites, water runways, etc. with no control tower. This expectation of full separation can be misleading as there could now be numerous drones operating in the vicinity of the landing site, either known or unknown to ATC; separated, segregated or not, as the case may be. An overall safety and risk assessment for all hazards so far identified with regard to RPAS operations addresses this change.
8. Drones that may be operating legally under the regulations of several States' (e.g. not above 400 ft AGL, marginally outside exclusion zones) may potentially still be in near proximity to CPA operations, i.e. the approach path, or the departure path for IFR flights. These no-drone-zones may generally protect large numbers of IFR flights such as those via the ILS. However, not all traffic is perfectly aligned with

⁶ Command and Control links between the Remote Pilot (station) and the airborne craft.

⁷ IFATCA Policy Statement: POLSTAT, Technical and Professional Manual 2018.

⁸ It is also clear that drone strikes cannot be classified in a manner similar to the approach with bird strikes.

⁹ ESARR 4 - Risk Assessment and Mitigation in ATM. And <http://skybrary.aero/bookshelf/books/1721.pdf> .

the ILS, or a standard departure path. Reducing the collision risk requires accurate flight surveillance data and airspace assessments tailored to individual aerodromes. This then improves the process by addressing risk to CPA flights outside the instrument flight paths.

9. Other technology deemed to support robust mitigations to the safety risk of drones operating in controlled airspace needs continued attention. Continued research is essential in the area of drone-detection systems (civil use technology for countering drones), geo-fencing, electronic conspicuity, and drone registration, among other topics. IFATCA policy: *IFATCA urges the development and implementation of technology to prevent airspace infringements by Unmanned Aircraft*⁷.
10. Wake turbulence and downwash: drones, which are much lighter than most CPA, are particularly vulnerable. Wake turbulence is a very real hazard for drones and can trigger an unrecoverable attitude, loss of propulsion, loss of lift, or instability, which could subsequently lead to a ground collision or a deviation from the 'authorized' flight path. The response times by the RP in upset recovery are exacerbated (delayed) by latency in corrective control instructions through C2 links.
11. Safety approach: the vast majority of drones are uncertified, operate without airworthiness approvals, the historical safety data is unavailable, and operators are often not from aviation backgrounds. Drones are unable to interact with other airspace users (e.g. ACAS is not designed for drones¹⁰). their performance is significantly different from CPA, and they have no vision from the cockpit. Therefore contemporary approaches to safety risk management have appeared that address risk by limiting operational parameters, such as the JARUS instigated Specific Operations Risk Assessment (SORA). Albeit robust, these philosophies are moving from infancy to operational implementation and their efficacy is as yet unproven.
12. Communicators with RPs: MAs have reported that for some drone operator's, the operation of VHF transceivers is unreliable, for example, background noise from wind and the din from nearby cars, the RP's location on the ground distant from ATC VHF radio farms affecting radio line of sight (RLOS) limiting communication. Traditionally, ATCOs don't rely on mobile phones as a primary means of communicating with airspace users, whereas this is often the only option for even urgent communications with RPs, whereas it does not have the reliability required to support airspace Required Communication Performance and therefore separation minima, etc.
13. The validity of reports of sightings of drones from pilots, the public, etc. needs to be scrutinized. Individual estimations of size, location and distance may vary depending on many factors, or may even be false.
14. The management of flights at very-low-levels (commonly not above 400 ft AGL) is planned to be through UTM¹¹ or U-Space. In response to the vast number of flights expected, these services will often be fully automated and will have interfaces with ATC and ATM systems. Early UTM systems will require segregated airspace as ICAO classification of airspace (i.e. class A to E) is not appropriate. There is also broad industry acceptance that the airspace below 400 ft is free of CPA, and therefore entirely available to drone users and that the lowest VFR altitude of 500 ft as per Annex 2 provides a natural buffer. When considering emergency helicopters, MIL training, gliding, visual flights, etc., this is, of course, incorrect; and, additionally, a 100 ft buffer is not suitable. Further discussion is available in IFATCA's White Paper: *Operational Use of Unmanned Aircraft (including Remotely Piloted Aircraft Systems)*¹².

¹⁰ ACAS XU for RPAS will not be operational for some time.

¹¹ Unmanned Aircraft Systems Traffic Management, referred to in Europe as U-Space.

¹² Planned for publication in Q2 2019.

15. MAs have reported the inclusion of an ATCO service as a safety risk mitigation to permit otherwise unacceptable risk in various operational scenarios (such as BVLOS, no Detect and Avoid/DAA) as an alternative means of complying with rules of the air. Care should be taken when ATC might be asked to:
- track the drone on surveillance during lost C2 link. Knowledge of the actual position is more important when there is no pilot on board;
 - provide traffic information to the operator/RP on surveillance observed traffic;
 - provide traffic information to CPA about drones;
 - replace the 'rules of the air need' for a full detect and avoid collision avoidance from non-cooperative traffic [i.e. due to a violation of CTA, or an aircraft with an SSR failure/no Mode C].
16. Several Member States have tailored drone operating areas within controlled airspace (example: the FAA LAANC¹³). There is still the possibility that drones might fly-away (lost C2 link), conflicting with other traffic, and procedures for minimising the impact of such scenarios must be considered (such as recording the maximum possible flight endurance notated by the RP at the beginning of every drone sortie, so that the aerodrome can be reopened after propulsion has expired and the risk no longer exists). Alternatively, conventional aircraft may inadvertently violate the airspace containing the grids where drones are operating.
17. Remotely piloted drones with passengers (i.e. urban air mobility) are excluded from this guidance. The consequences of drone flight into terrain is less than for CPA with no people on board, whereas this is not the case for automated taxis and similar concepts with people on board.

Unmanned Traffic Management (UTM), U-Space

Drone flights can be provided with various parts of an Unmanned Traffic Management (UTM) service or U-Space service, assuming the operations are fully contained within segregated airspace. UTM needs an agreed definition, and the interface between ATM and UTM then needs to be defined. The industry norm is that automation will provide this service. However, ATCOs can also be asked to provide a UTM (such as approval; segregation: drone to drone; separation: drone to CPA; FIS; emergency response; sequencing and merging into/out of droneports) in present airspace or future airspace (let's envisage a new Class U). This is an area which is being focused on by IFATCA and further information and guidance will be disseminated as it reaches maturity.

Drones wanting to operate near controlled airports, generally within controlled airspace

The following are in addition to the general notes above.

Generally, drones are completely different from conventional aviation – except in a purely legal sense that they fly – which complicates their treatment under ICAO SARPs and Member States' regulations. According to IFATCA policy: *All Remotely Piloted Aircraft Systems (RPAS) operations in non-segregated airspace must be in full compliance with ICAO requirements²*. The most conservative approach would be to prevent Very Low Level (VLL) drones from operating within controlled airspace. This would probably lead to more illegal operations and criticism of ATC.

A common approach by Member States is to establish zones (segregation) within controlled airspace where the risk of collision with CPA is deemed low enough due to a range of responsibilities being deferred to ATCOs. Responsibilities range from applying ICAO separation minima; segregating from CPA based on local instructions; or passing traffic on drone activities to pilots of CPA. Some procedures, however, provide ATCOs with no knowledge of drone activity, merely an awareness that drone zones exist and may be used.

Drone pilots wishing to operate within no-drone-zones, will probably be required to ask permission from the airport's

¹³ LAANC: Low Altitude Authorization and Notification Capability.

Air Traffic Control. From experience in other Member Associations, such requests quickly absorb resources and are often not considered to be priority work. Dedicated (staffed) sections have been established elsewhere, usually comprising of members of the CAA and ANSP, to negotiate the means of either complying with regulations or applying exemptions so that ATC can legitimately approve drone operations in controlled airspace. Without clear procedures, different ATCOs may either reject or approve a similar request based on personal knowledge, previous good or bad experiences, operation's schedule and ATCO education. A clear strategy with guidance in the procedure for applying for permission (authorisation and then approval), agreements with each operator (procedures during a fly-away or loss of control event, during an unexpected change in the traffic picture requiring the drone operation to cease immediately, etc.), is essential.

Approving operations The assessment process of examining requests for drones to operate in CTA - when unable to fully comply with IFR or VFR, and rules of the air for the relevant airspace - must either follow ICAO SARPs (not yet in existence) or be administered via the application of the SMS through workshops, for example with appropriate stakeholders, followed by regulatory support and training of ATCOs. IFATCA policy: *Standardized procedures, training and guidance material shall be provided before integrating RPAS into the Civil Aviation System*⁷.

In future, we may witness areas where drones have near-exclusive access to low-level airspace (e.g. below 1500 feet) and CPA need approval to enter. It is unknown what vertical division would be most suitable to address segregation and the need for new wake turbulence separation minima for drones and RPAS (as there are no 'very light' WT categories, and also the latency of response time to a WT event will be different).

Controlling ('plugged in') ATCOs should not be involved in the approval process for drone operations requesting permission to operate VLL in controlled airspace, as it may distract from primary duties. This is known to be occurring already in several States.

The future direction of change in ATM may see the introduction of new airspace categories, such as Class U airspace. And new flight categorisations (extensions of VFR or IFR) such as the proposed Eurocontrol Low level Flight Rules (LFR) and High level Flight Rules (HFR)¹⁴, or discussions elsewhere proposing Basic Flight Rules (BFR) and Managed Flight Rules (MFR).

Another question necessitating further research is to decide the value of displaying position information from VLL drone operations on ATM surveillance display equipment, i.e. the CWP. This area of research will also be monitored by IFATCA.

Unapproved drones near controlled airports, generally within controlled airspace

Violations of CTA, sightings from pilots, public or drone detection systems, flyaway events (due to a loss of control) are all examples of unapproved drones in controlled airspace. IFATCA policy: *Contingency procedures and controller training shall be provided for the management of infringements by Unmanned Aircraft*⁷.

There are pros and cons to many of the considerations for the ATCOs controlling the airspace. Is there a procedure for providing hazard alerts to CPA on unapproved drone operations? Should the Controlling ATCO vector/reroute CPA away from unapproved drone operations? It is possible the vector may unknowingly place the CPA closer to the drone's trajectory as its position is most probably not displayed on the CWP and it is unlikely the CPA pilots will sight and avoid the drone. To maintain safety, the ATCOs controlling the airspace may need to close the airspace. Re-opening the airspace can only proceed through an appropriate safety risk driven process.

Suggestions to ATCOs and Member Associations of IFATCA:

Be involved with or even initiate safety risk assessment workshops prior to situations where ATCOs plugged in

¹⁴ <https://www.eurocontrol.int/sites/default/files/publication/files/uas-atm-integration-operational-concept-v1.0-release%2020181128.pdf>, p. 24.

operationally are asked to decide on having drones within their airspace, vector CPA clear of an area where an illegal operation has been reported, or to reopen the airspace. While international standards and transparent contingency or emergency procedures are lacking, all parties should be aware of every procedure prior to each and every UAS operation in non-segregated airspace.

Remember, the regulations may not support drone operations. Ensure the validity of the rules you are given.

Report and action all drone sightings. Consider also the guidance in this document when it is necessary to close airspace/airports to preserve safety and also for the process of reopening airspace.

Consider/plan your emergency response in reaction to a mid-air collision between a drone and a CPA.

Be cautious if essential communication with the RP is via a hand-held VHF transceiver or mobile cell phone.

IFATCA is working to assist and advise in the development of safe and orderly systems of Air Traffic Control; to ensure the professional voice of its members is represented while protecting and safeguarding the interests of the Air Traffic Control profession; and that we promote safety, efficiency and regularity in International Air Navigation.

The benefits realised from drone operations are significant and valuable to humanity. Safely fostering drone activities is a worthwhile method, balanced with the efficient interoperable operation of the ATM system.

Excerpt from the: Drone Sighting GUIDELINES

SPEED	Expect pilots to request a speed reduction <i>[when they are able to]</i> .
INFORM	Expect pilots to inform ATC immediately and pass as much accurate information as possible about the drone sighting: Location; Altitude; Lateral and vertical separation; Was it moving or stationary? Size, shape, appearance (e.g. quadcopter, camera underneath, colour, etc.). Inform supervisors, neighbouring sectors and pilots on and joining the frequency.
DELAY	Manage airspace and consider possible delays/diversions as a result.
AVOIDANCE	Pilots may request alternative routings or radar vectors if deemed necessary. Consider the safety of the operation and avoid the area if deemed necessary.
REPORT	File the appropriate safety report as established with your ANSP/aviation authority.
REMEMBER	In the event of imminent threat to the aircraft, nothing prevents pilots from declaring an emergency, taking avoidance action, etc.

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