香港特別行政區政府
民航處
Civil Aviation Department
The Government of the Hong Kong Special Administrative Region

Small Unmanned Aircraft Advisory Circular No. AC-013

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Permission for Small Unmanned Aircraft Beyond Visual Line of Sight Operations within the Context of Regulatory Sandbox

1. Background

1.1 The Small Unmanned Aircraft Order ("SUA Order"), Chapter 448G of the Laws of Hong Kong, took full effect on 1 December 2022. Under the SUA Order, small unmanned aircraft ("SUA") operations are regulated under a risk-based approach and be classified according to the weight of the SUA and the operational risk level.

1.2 Section 15 of the SUA Order stipulates that a SUA must be operated in compliance with all operating requirements applicable to the aircraft, unless the SUA is operated for the flight in accordance with a permission granted by the Director-General of Civil Aviation under section 37 of the SUA Order. In accordance with Section 16(1)(b) of the SUA Order, one of the operating requirements is that the remote pilot shall maintain the visual line of sight with the aircraft in a specified way[1] at all times during the flight.

1.3 This document sets out the requirements for a permission to operate SUA within the context of regulatory sandbox in circumstances where the above-mentioned operating requirement relating to visual line of sight cannot be met. Such operations shall enable the applicant/SUA operator ("operator") to safely collect and analyse data and results, acquire experience, build confidence, and develop capabilities through testing within the context of regulatory sandbox. This progressive approach allows the operator to gain proficiency before attempting beyond visual line of sight operations of SUA with higher risks.

[1] The way in which a visual line of sight is to be maintained is specified in the Gazette Notice issued under section 17(2) of the SUA Order.

2. Definition

2.1 **Automatic Operation** means an operation during which a SUA operates according to pre-determined flight routes before starting the flight. For this type of operation, it is essential for the remote pilot to take control of the SUA to intervene in unforeseen events for which the SUA has not been programmed.

2.2 **Autonomous Operation** means an operation during which a SUA operates without the remote pilot being able to intervene. The SUA is able to conduct a safe flight without the intervention of a remote pilot. It does so with the help of artificial intelligence, enabling it to cope with all kinds of unforeseen and unpredictable emergency scenarios.

2.3 **Detect and Avoid ("DAA")** means the capability to see, sense or detect conflicting traffic or other hazards, and take appropriate action.

2.4 **Flight Critical System ("FCS")** means a system, the failure of which could have a catastrophic effect on the SUA and/or affects the SUA ability to sustain its flight. Examples of flight critical system include flight control system (consisted of sensors, computers and all other elements of the SUA necessary to control the altitude, speed and trajectory of the SUA), propulsion system and navigation system.

2.5 **Involved Person** and **Uninvolved Person**

2.5.1 **Involved Person** means a person who takes part in or is well aware of the SUA operation, understands the risk, and is aware of the instructions and safety precautions in regard to the SUA operation. In practical terms, this means that an involved person must:

- be clearly notified about and aware of the SUA operations;
- understand the risks involved;
- have reasonable safeguards introduced for them by the venue manager or the SUA operating crew during SUA operation;
- be expected to follow the directions and safety precautions provided.

2.5.2 **Uninvolved Person** means any person other than involved person.

2.5.3 **Involved Vehicle/ Vessel/ Structure** and **Uninvolved Vehicle/ Vessel/ Structure** shall be construed accordingly.

2.6 **Visual Line of Sight and Beyond Visual Line of Sight**

2.6.1 A **Visual Line of Sight ("VLOS")** is direct and unaided (other than by way of corrective lenses and sunglasses) visual contact with the SUA and the

surrounding airspace in which the SUA is operating. VLOS can be maintained by: -

a) the remote pilot of the SUA, and/or
b) a visual observer ("VO"), chosen by the remote pilot, who is at the same location as the remote pilot, has good eyesight and is capable of communicating timely and effectively with the remote pilot of the SUA to avoid collision.

2.6.2 **Beyond Visual Line of Sight ("BVLOS")** means operation of a SUA where the remote pilot or visual observer is unable to maintain a visual line of sight of the SUA.

3. Applicability

3.1 To ensure aviation and public safety, remote pilot shall endeavour to operate in compliance with all operating requirements applicable to the SUA as specified under section 15 of the SUA Order at all times during the flight. This includes maintaining VLOS with the SUA. However, for regulatory sandbox which aims to foster innovation and facilitate the testing of various potential application involving SUA, the Civil Aviation Department ("CAD") understands that there are operational circumstances (such as drone delivery, inspection of infrastructure located at relatively inaccessible areas, etc.) where the requirement relating to VLOS and even Extended Visual Line of Sight ("EVLOS")[2] may not be met. In special circumstances involving SUA operations within the context of regulatory sandbox where the VLOS or EVLOS requirement cannot be met, the SUA may be required to operate in BVLOS.

3.2 Applicants may follow the requirements as set out in this document to apply for conducting BVLOS operations within the context of regulatory sandbox. Each application will be considered on its own merits by the Working Group on Developing Low Altitude Economy based on the pre-defined assessment criteria. The Working Group on Developing Low Altitude Economy reserves the right to determine the suitability and implementation priority of the applications within the context of regulatory sandbox.

3.3 Apart from the requirements prescribed in this document, an applicant shall also include, in its Operations Manual (See Appendix A for guidance), various supporting information / documentation specific to the BVLOS operations as part of the application. A flight plan, a test plan and a risk assessment identifying hazards specific to the BVLOS operations and the corresponding risk mitigating measures (See Appendix B for guidance) shall also be submitted.

[2] For requirements for permission to operate a SUA in EVLOS, please refer to AC-004 available from CAD website (https://www.cad.gov.hk/english/sua_new.html).

4. Operators

4.1 Applications to conduct BVLOS operations by operators with a proven track record on safety and with support of reliable systems or equipment will be accorded higher priority. In addition, the operator shall take appropriate measures to address privacy and other relevant concerns (e.g. permission from land owners or other stakeholders where necessary) before the BVLOS operations. Relevant information is available on PCPD's website with the following link:

https://www.pcpd.org.hk/english/resources_centre/publications/files/GN_CCTV_Drones_e.pdf

4.2 In addition to the compliance with all applicable Government's requirements, the operator shall fulfil the applicable requirements set out in this document, including the following criteria and provide the relevant details in its application:

a) Experience in BVLOS Operations: -

(i) The operator must be a holder of an Advanced Operations Permission issued by the CAD[3]; or

(ii) The operator must possess prior relevant experience in safely operating SUA to conduct the proposed BVLOS operations, with the approval by major civil aviation regulatory authorities to conduct such operations; and

b) Local Nexus – The operator must demonstrate its local nexus (such as be registered in Hong Kong under the Business Registration Ordinance (Cap. 310)); and

c) Potential for a viable and sustainable application – The operator must demonstrate strong potential for a viable and sustainable application of its proposed BVLOS operations.

4.3 Regarding the operational and safety aspects, before the BVLOS operations, the operator shall: -

a) Develop appropriate policies and procedures for the operations, considering its specific requirements and scale of operations (including the areas over which the SUA is operated and any additional system or equipment demonstrating enhanced

[3] The application of an operator without specific BVLOS experience may still be considered, provided that the operator can demonstrate its competence to conduct the BVLOS operations and its proposed BVLOS operations are commensurate with its level of experience.

safety assurance particularly when sustained flights (if justified) over uninvolved people, vehicles, vessels or structures are anticipated);

b) Establish the minimum number of remote pilot and supporting crew to ensure sufficient manpower for the safe operations. Each remote pilot and crew member shall be fully aware of their roles and responsibilities as well as the operational procedures, including emergency procedures;

c) Ensure that the remote pilot and supporting crew are competent to perform their tasks and in sound physical and mental condition that will enable the safe operations of the SUA;

d) Consider how to enable containment of SUA. As the main determinant of risk is dependent on the area of operations, the operator shall ensure that the SUA will be confined within the operating areas and/or flight routes pre-defined for the regulatory sandbox at all times during the flight;

e) Identify all possible risks and demonstrate an acceptable level of safety, through system redundancies, reliability testing and/or operational procedures;

f) Conduct a comprehensive safety risk assessment and establish mitigating strategy with reference to the specific equipment, personnel competency, types of operations, and environmental conditions of each operation. In identifying the risks of the intended BVLOS operations, the operator shall assess the severity and probability of two main risks associated with the operations (i.e. air risk and ground risk);

g) Comply with the applicable requirements for radio equipment and the use of radio frequency spectrum;

h) Develop appropriate security procedures to protect the SUA against unlawful interference; and unauthorised access to the take-off / landing sites, SUA staging areas and other preparation areas;

i) Develop specific test cases to cover normal operations and emergency scenarios for the purpose of demonstrating the robustness of the BVLOS operations; and

j) Include, in its Operations Manual (See Appendix A for guidance), various supporting information / documentation specific to the BVLOS operations, and submit a flight plan, a test plan and a risk assessment identifying hazards specific to the BVLOS operations and the corresponding risk mitigating measures (See Appendix B for guidance).

4.4 It shall be the responsibility of the SUA responsible person and remote pilots to comply with all applicable regulatory requirements, put in place appropriate safety precautions and risk mitigating measures for the BVLOS operations, as well as to follow relevant requirements and/or guidelines set out by any authorities, Government Departments, land owners or other stakeholders where necessary to ensure the safe operations of the SUA at all times.

4.5 Subject to the risks and complexity of the proposed operations, the CAD may require the applicant to perform a flight demonstration for assessing its capabilities in delivering the proposed operations safely.

4.6 Throughout the BVLOS operations, the operator shall collect and analyse the relevant data and results, which will be submitted to the Working Group on Developing Low Altitude Economy for the purpose of validating whether the applications are viable and can meet the relevant safety, stability and reliability requirements.

5. Operating Areas and/or Flight Routes

5.1 Unless operational justifications with evidence can be provided to the satisfaction of the CAD to minimise air risk associated with the BVLOS operations, the intended operating areas and/or flight routes shall be away from aviation activities, in particular, the SUA shall not be operated:

a) outside the operating areas and/or flight routes pre-defined for the regulatory sandbox;
b) in Restricted Flying Zones ("RFZ") established under the SUA Order, and Prohibited Area / Restricted Area / Danger Area as published in the Hong Kong Aeronautical Information Publication ("HKAIP");
c) within 500 m from aerial sporting area such as flying sites for paragliding activities;
d) within 1 km from Aerodrome Traffic Zone as shown on local flying chart;
e) within 500 m from helipad (unless relevant permission has been obtained); and
f) in a way that will affect operations of aircraft to/from the Hong Kong International Airport ("HKIA") and low-flying aircraft / helicopters of the Government Flying Service ("GFS").

5.2 Unless operational justifications with evidence can be provided to the satisfaction of the CAD to minimise ground risk associated with the BVLOS operations, operating areas and/or flight routes that will pose higher risks to people and properties on the ground shall be avoided, in particular, the SUA shall not overfly: -

a) congested areas, highways, railways or strategic routes; and
b) areas where uninvolved people, vehicles, vessels or structures are likely to be present (e.g. piers, roads).

5.3 The SUA shall be entirely confined within the operating areas and/or flight routes pre-defined for the regulatory sandbox. This can be achieved either through technologies or operational limitation. There shall be effective means to ensure that the SUA will not fly beyond the intended operating areas and/or flight routes (such as through the use of geo-fence, waypoint operation, etc.), and maintain situational awareness of the SUA and its surroundings in the air and on ground.

5.4 When planning the intended operating areas and/or flight routes (for normal operations and emergency scenarios), the accuracy of the SUA's FCS, navigation system, DAA system adopted (or other alternative means of compliance), latency of telecommunication technology adopted, etc. shall be taken into consideration.

5.5 The operator shall ensure the adequacy of mobile radio and Global Navigation Satellite System ("GNSS") signal strength, coverage and integrity for Command and Control Link ("C2 link") throughout the intended operating areas and/or flight routes including the emergency landing sites.

5.6 For SUA operations using public mobile networks, the operator is reminded that according to OFCA's requirements, the operator shall coordinate with the relevant mobile network operator(s) to ensure mobile network coverage along the intended operating areas and/or flight routes. If a private radiocommunications network is adopted, the operator shall demonstrate its capability in terms of network infrastructure and radio coverage and its usage in compliance with the licensing requirements established by and to the satisfaction of OFCA. Relevant information is available on OFCA's website with the following link:

https://www.ofca.gov.hk/en/consumer_focus/guide/help_for_consumers/information_on_radio_applications/unmanned_aircraft_systems_drones/index.html

5.7 The operator shall avoid conducting operations in areas with strong signal interference, and in locations in close proximity to high-rise buildings or locations with rugged terrain where signal coverage may be affected by signal blockage or reflections. Appropriate assessment shall be conducted before the operations to ascertain the signal strength and levels of interference at the operating areas and/or flight routes.

5.8 All landing sites, including emergency landing sites, shall allow the recovery of the SUA in an expeditious manner with adequate safety considerations. The emergency landing sites shall be located within the flight limits of the SUA and at a safe distance from areas with high level of ground risk.

6. Operating Requirements

6.1 Unless relevant permission has been obtained, the applicable operating requirements under section 16 of the SUA Order, including but not limited to operating the SUA only in daylight hours, maintaining the flying altitude at 300 ft Above Ground Level or below, etc. shall be observed. More information about the requirements is available in the Safety Requirements Document ("SRD") published by the CAD.

6.2 The operator shall ensure that the SUA can cover the proposed route distance before commencing any SUA operation, having regard to the operating range declared by the manufacturer.

6.3 SUA's maximum speed shall be considered with reference to DAA system adopted (or other alternative means of compliance), wind resistant capability, latency of telecommunication technology adopted, SUA's reaction to emergency scenarios, impact energy taking into account the weight of the SUA, etc. Under normal circumstances

during the flight, the speed of the SUA shall allow sufficient response time to emergency, taking into account DAA system adopted (or other alternative means of compliance).

6.4 Before the SUA operations, the remote pilot shall ensure that the prevailing weather conditions are suitable for the BVLOS operations with reference to weather forecast. Under normal circumstances, the BVLOS operations shall not be conducted unless the following weather criteria is fulfilled: -

a) 5 km visibility
b) 1,000 ft vertically clear of cloud base
c) not within 5 km of thunderstorms
d) other weather conditions (e.g. wind speed and precipitation) within technical specifications by the SUA manufacturer

6.5 Prior to and during the operations, the meteorological conditions within the operating areas and/or flight routes shall be closely monitored. If the meteorological conditions deteriorate beyond the levels the SUA is designed for, the remote pilot shall cease the operations immediately.

6.6 The SUA shall not carry any dangerous goods[4] during flight, unless a relevant permission has been obtained.

6.7 Autonomous operation is not allowed. The remote pilot shall be able to maintain control of the SUA during normal operations, except in cases of emergency scenarios where the SUA is pre-programmed for certain course of action. For instance, returning to home position in case of loss of C2 link.

6.8 Subject to the risks and complexity of the proposed operations, the CAD may require the applicant to keep the SUA in VLOS during the take-off and landing of the SUA, unless the landing of the SUA is the result of an emergency flight termination.

6.9 For operations over water / sea, the SUA shall not normally exceed the altitude of 300 ft Above Mean Sea Level unless permission has been obtained from relevant authorities.

6.10 For operations involving carriage of payload, the operator shall ensure that the mechanism of payload release will prevent accidental dropping.

7. Remote Pilot

7.1 The remote pilot shall maintain reasonable control and manoeuvrability of the SUA under all anticipated operating conditions, ensuring flight safety. The SUA shall remain

[4] According to the SUA Order (Cap. 448G), dangerous goods means any of the goods or substances under section 3 of the Dangerous Goods Ordinance (Cap. 295).

in a predictable flight condition, avoiding any tendencies to deviate from the intended operating areas and/or flight routes throughout the BVLOS operations.

7.2 The remote pilot shall have the authority to cancel or delay any or all flight operations under the following conditions:

a) the safety of persons is jeopardised;
b) property on the ground is jeopardised;
c) other airspace users are in jeopardy; or
d) there is a violation of the conditions of the advanced operations permission or other relevant permission.

7.3 The remote pilot shall be made aware of SUA system failures and/or unsafe conditions that will affect the risk level of the BVLOS operations, including but not limited to the following: -

a) Degradation to the SUA's flight performance such that the SUA is unable to maintain its flight route or current location;
b) Failure of any of the SUA's FCS;
c) Loss of capability to maintain situational awareness of airspace traffic, terrain, obstacles and/or weather;
d) Loss of communication;
e) Loss of power.

In response to the above-mentioned system failures and/or unsafe conditions, the remote pilot shall be able to perform emergency recovery and implement the relevant corrective actions as stipulated in the operations manual.

7.4 The remote pilot shall:

a) not perform any duties under the influence of psychoactive substances or alcohol, or when they are unfit to perform their tasks due to injury, fatigue, medication, sickness or other causes;
b) be familiar with the manufacturer's instructions provided by the manufacturer of the SUA, the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), the surveillance system (if applicable);
c) ensure that the SUA is in a safe condition to complete the intended flight safely;
d) obtain updated information relevant to the intended operations about any geographical zones, environment or condition of the intended operating areas and/or flight routes before the operations;
e) verify that the means to terminate the flight as well as the programmable operating parameters of the SUA are operational before the operations;
f) notify relevant parties such as Air Traffic Control ("ATC") and GFS as appropriate prior to operations; and

g) conduct a thorough site safety survey and risk assessment before the operations with records retained.

8. Training and Qualification

8.1 For operations at sparsely populated areas where uninvolved people, vehicles, vessels or structures are unlikely to be present, the remote pilot shall possess adequate experience in SUA operations including those on the type / model of SUA to be used for the BVLOS operations. In addition, the remote pilot shall hold a valid remote pilot certificate and be assigned a corresponding Advanced Rating issued under the SUA Order. Subject to the risks and complexity of the proposed operations, higher experience levels or proof of qualifications may be required, such as holding a valid remote pilot certificate for BVLOS operations issued by major civil aviation regulatory authorities.

8.2 For operations at areas where uninvolved people, vehicles, vessels or structures are likely to be present, the remote pilot shall possess adequate experience in SUA operations including those on the type / model of SUA to be used for the BVLOS operations. In addition, the remote pilot shall be assigned a cooresponding Advanced Rating issued under the SUA Order and hold a valid remote pilot certificate for BVLOS operations issued by major civil aviation regulatory authorities. Subject to the risks and complexity of the proposed operations, higher experience levels may be required.

8.3 The remote pilot shall be at least 18 years of age.

8.4 All supporting crew and involved person shall be trained / briefed specifically for BVLOS operations and the emergency procedures. The operator shall keep and maintain updated record of all the relevant qualifications and training courses completed by the remote pilot, supporting crew and other relevant personnel essential to the BVLOS operations and by the maintenance staff for at least two (2) years after those persons have ceased to be employed by the organisation or have changed position within the organisation.

9. SUA

9.1 The SUA shall be registered and labelled as required under section 11 of the SUA Order.

9.2 The weight of the SUA including payload shall not exceed 150 kg at all times during the flight. In determining the weight of a SUA, everything installed in, carried by or attached to the aircraft is to be taken into account.

9.3 The SUA shall be designed to minimise system degradation and/or failures that, at minimum, address the following: -

a) Loss of power to the SUA, FCS or other safety systems;

b) Loss of SUA's ability to navigate within allowable operating parameters;
c) Loss of or poor communication (including radio interference);
d) Loss of or poor reception of GNSS signals (including radio interference or spoofing); and
e) Other failure conditions which may lead to accident / incident.

Relevant information on GPS spoofing is available on the following link:

https://ops.group/dashboard/wp-content/uploads/2024/09/GPS-Spoofing-Final-Report-OPSGROUP-WG-OG24.pdf

9.4 The SUA design shall be integrated with emergency recovery capability which shall consist of a flight termination system, procedure or function that allows the remote pilot to terminate the flight as soon as practicable; and/or an emergency recovery procedure that is implemented through the surveillance system (if applicable), the SUA controlling system (including ground station, remote controller, flight controlling software, etc.) or SUA (including automatic pre-programmed course of action to reach a pre-determined emergency landing site).

9.5 To enhance detectability and conspicuity of SUA during BVLOS operations, the SUA shall be equipped with appropriate navigation lighting as well as strobe or anti-collision light system. In addition, the SUA shall be painted with high visibility colour / contrast paint scheme.

9.6 For operations at areas where uninvolved people, vehicles, vessels or structures are likely to be present, the operator shall adopt measures to reduce the energy generated by the impact of the SUA on the ground in case of accident / incident (such as equipping the SUA with an effective parachute system). The operator shall ensure that the measures adopted are effective and will not increase new risks. Remote pilot and supporting crew shall be briefed and trained for the relevant operating procedures, which shall be documented in the operations manual as appropriate. The operator shall provide specific training and assessment for personnel responsible for installation and maintenance of the measures.

10. System Requirements

10.1 The SUA shall be equipped with the necessary safety systems capable of performing the functions specified in section 13 of the SUA Order, i.e. flight log and geo-awareness functions. The information recorded by safety system shall be kept for six months and that information related to any advanced operation shall be accessible in Hong Kong.

10.2 All critical components in the SUA such as FCS and the associated systems ensuring the safety of operations, shall be designed and installed such that they will perform as intended under the operating and environmental conditions for which it is designed for.

For all other equipment/components, shall they become unserviceable, shall not reduce the level of safety and shall not adversely affect the proper functioning of all critical components.

10.3 Appropriate SUA controlling system (including ground station, remote controller, flight controlling software, etc.) with appropriate data recording capability and redundancy shall be in place.

10.4 To enhance airspace situational awareness, the operations shall be supported by technologies for electronic detection (or other alternative means of compliance) of the SUA and also air traffic in the proximity of the operating areas and/or flight routes (e.g. ADS-B IN, web-based real-time tracking services).

10.5 All geospatial and map data necessary for navigation, including for the purpose of supporting situational awareness and DAA system adopted (or other alternative means of compliance), must be updated in a timely manner. All geospatial and map data must be accurate to a level sufficient for the safe operations of the SUA (to include ground fixtures and temporarily erected structures if necessary).

10.6 For navigation systems that utilize an external reference source (such as Global Positioning System ("GPS")) as the primary means of ensuring navigation performance, the operator shall specify the following information in the operations manual:

a) Navigation sensor accuracy (to include both normal and degraded modes); and
b) Any operational procedures that must be performed by the remote pilot to compensate for the degraded navigation.

10.7 For all SUA attitudes and orientations relative to the signal source within the design envelope, the SUA antenna margin shall be consistent to maintain an adequate level of communication link quality of service for safe operations.

10.8 The C2 link shall be designed to be protected against electrostatic, lightning (if applicable) and electromagnetic emission (EME) hazards.

10.9 <u>For operations at areas where uninvolved people, vehicles, vessels or structures are likely to be present:</u>

10.9.1 The remote pilot shall be able to monitor the SUA and its surrounding geographical environment during the BVLOS operations, via electronic means, such that the remote pilot is able to monitor the SUA's flight route and intervene the operations immediately in case of emergency. To enhance safety, a surveillance system (or other alternative means of compliance) with proven performance shall be in place. The surveillance system shall be capable of the following functions during the flight (including but not limited to): -

a) Enabling the SUA to effectively detect and avoid other aircraft, obstacles (structures, buildings, terrains, buoys, etc.) and moving objects (vessels, vehicles, birds, kites, balloons, etc.) in the proximity of the operating areas and/or flight routes (or other alternative means of compliance);
b) Indicating the geographical location, flying altitude, etc. of the SUA as well as the collision avoidance information and/or alerts in real-time (or other alternative means of compliance); and
c) Continuous monitoring of air traffic information in the proximity of the operating areas and/or flight routes (or other alternative means of compliance).

10.9.2 The operations manual shall include details regarding procedures for handling separation provisions and DAA system adopted (or other alternative means of compliance). If the remote pilot's intervention is required to avoid obstacles, procedures shall account for the time needed for detection, transmission, and decision-making to maintain safe separation between the SUA and the obstacle.

11. Human-Machine Interface

11.1 The human-machine interface of the SUA and the associated systems shall be clear and concise, and the interface design shall not easily cause fatigue, confusion, or misinterpretation. The operator shall assess the risks caused by human factors in the human-machine interface and determine whether the human machine interface is appropriate for the BVLOS operations.

11.2 Information of the SUA shall be displayed to the remote pilot and relevant supporting crew in a clear and unambiguous manner during all phases of flight, at an update rate consistent with safe operations, and not pose unnecessary workload on the remote pilot and relevant supporting crew. Information to be displayed shall include, but not be limited, to the following: -

a) SUA performance indicators and health status (e.g. altitude, speed, heading, position, battery level, propulsion system data, C2 link signal strength, GNSS reception, etc.);
b) Mode of control (e.g. automatic operation or manual control);
c) SUA system warning and failure messages for alerting remote pilot of any failures or any corrective actions required, or as a warning to prevent deviation from the intended operating areas and/or flight routes.

12. Maintenance

12.1 Maintenance of the SUA shall be performed in accordance with the established instructions so that the SUA is maintained in an airworthy condition. Maintenance includes the accomplishment of scheduled and unscheduled servicing and inspection tasks to ensure continuing airworthiness of the SUA and good health of the battery. There shall be a system of assessment to support the continuing airworthiness of SUA and provide a continuous analysis of the effectiveness of the maintenance programme in use.

12.2 Furthermore, the operator shall:

a) Ensure that the SUA maintenance instructions that are defined by the operator are included in the operations manual and cover at least the SUA manufacturer's instructions and requirements when applicable;
b) Ensure that maintenance staff follow the SUA maintenance instructions when performing maintenance;
c) Keep for at least two (2) years and maintain up to date a record of the maintenance activities conducted on the SUA; and
d) Establish and maintain up to date a list of the maintenance staff employed by the operator to carry out maintenance activities.

12.3 Maintenance of the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), surveillance system (if applicable), etc. shall be performed in accordance with the established instructions so that they are maintained in a serviceable condition. Maintenance includes the accomplishment of scheduled and unscheduled servicing and inspection tasks to ensure continuing serviceability of the above-mentioned systems. There shall be a system of assessment to support the continuing serviceability of the above-mentioned systems and provide a continuous analysis of the effectiveness of the maintenance programme in use.

12.4 Furthermore, the operator shall:

a) Ensure that the above-mentioned systems' maintenance instructions that are defined by the operator are included in the operations manual and cover at least the above-mentioned systems' manufacturer's instructions and requirements when applicable;
b) Ensure that maintenance staff follow the above-mentioned systems' maintenance instructions when performing maintenance;
c) Keep for at least two (2) years and maintain up to date a record of the maintenance activities conducted on the above-mentioned systems; and
d) Establish and maintain up to date a list of the maintenance staff employed by the operator to carry out maintenance activities.

13. External Services

13.1 If a service provider is engaged by the operator, the operator shall ensure that the level of performance for any externally provided service that is necessary for the safety of the flight is adequate for the intended operations. The operator shall define and allocate the roles and responsibilities between the operator and the service provider, if applicable.

13.2 If the operation relies on any external services, such as LTE (4G / 5G), internet services etc., the operator shall demonstrate that the performance and availability of the service is adequate for the intended operations. The operations manual shall document how potential degradation or loss of services could impact flight safety and detail the mitigating strategies to manage such situations. If the provision of the external service requires specific contracts or arrangements to be entered into, roles and responsibilities between the operator and the external service provider shall be defined.

14. Emergency Procedures

14.1 The operator and remote pilot shall determine suitable responses and fail-safe mechanism for emergency scenarios. There shall be proven and well documented emergency procedures including but not limited to the following scenarios: -

a) Inoperative motors / blades;
b) Intermittent / degraded / permanent loss of C2 link;
c) Partial or total failure of FCS, SUA controlling system (including ground station, remote controller, flight controlling software, etc.), surveillance system (if applicable), etc.;
d) Navigation system failures, e.g. degradation or total loss of GNSS, sensors/ cameras;
e) Flight planning failures that could result in a loss of containment, i.e. incorrect setting of waypoints / Return-To-Home ("RTH") functions;
f) Flyaway, motor failures, other malfunctions, and other emergency scenarios that may arise specific to the proposed operations;
g) Fire; or
h) Low battery, etc.

14.2 Demonstration of SUA's reaction to emergency scenarios (e.g. sudden appearance of other flying objects, loss of or poor communication, loss of or poor reception of GNSS signals, RTH operations, battery failure) shall be arranged prior to the intended operations upon the requests from the CAD.

15 Adverse Space Weather Conditions

15.1 Adverse space weather conditions (e.g. ionospheric scintillation) can affect the functionality of SUA navigation system hence disrupt the safe operations of the SUA.

Components of the SUA navigation system such as GNSS, the Real Time Kinematic ("RTK") positioning system, etc. are particularly prone to the effect of adverse space weather conditions. To mitigate the risks associated with adverse space weather conditions, the operator shall adopt the following mitigating measures: -

a) Before the SUA operations, the operator shall check space weather forecasts and regularly monitor space weather reports and alerts issued by reputable space weather prediction agencies and/or organisations. The operator shall pay particular attention to ionospheric scintillation forecasts and geomagnetic storm warnings, and consider postponing the operations if severe space weather conditions are predicted. During the SUA operations, the operator shall continuously monitor RTK signal quality parameters and set up automated alerts for when these parameters fall below pre-determined thresholds;

b) The operator shall develop flight plans and emergency procedures that account for potential operational disruptions due to adverse space weather conditions. For instance, pre-determined emergency landing sites along the flight route, automatic pre-programmed course of action to return to home position or land safely if RTK signal quality degrades beyond acceptable levels, etc.;

c) The operator shall perform regular calibration and maintenance on the SUA navigation system to ensure that it is operating accurately and reliably. This includes checking the integrity of the RTK antenna, cables, and other components, as well as updating the relevant firmware and software to the latest versions;

d) The operator shall consider using alternative navigation techniques, such as visual-based navigation, as a backup to the GNSS / RTK positioning system;

e) The operator shall provide comprehensive training to remote pilots and supporting crew on space weather effects and mitigation strategies. In addition, the operator shall conduct regular drills simulating RTK failures due to space weather. This will help ensure that operating personnel are familiar with the system's capabilities and limitations, as well as any potential space weather hazards that could impact the SUA operations.

16 Insurance

1.1.1 A policy of insurance shall be in force during advanced SUA operations for the third-party liability (for bodily injury and/or death) arising out of or caused by the SUA operations. The minimum coverage of:

(a) HKD 10,000,000 (i.e. HKD 10 million) for advanced operation involving a Cat A/B SUA;

(b) HKD 15,000,000 (i.e. HKD 15 million) for operation involving a Cat C SUA that **weighs not more than 75 kg**; or

(c) HKD 20,000,000 (i.e. HKD 20 million) for operation involving a Category C SUA that **weighs more than 75 kg**

17 Records

17.1 The operator shall record and store operational information, including information related to the flights and associated systems (operational data, crew coordination, meteorological conditions, etc.), SUA and/or systems failures, inspections, repairs and maintenance, personnel training, assessments, shift handover records, accident / incidents, etc. The above-mentioned information shall be provided to the CAD upon request.

17.2 Unless otherwise specified, all records shall be maintained for at least two (2) years. They shall be kept in either paper form or in electronic format or a combination of both and shall be made available to the CAD for inspection upon request.

18 Enquiries

18.1 This document will be subject to review and update from time to time in the light of the advancement of technology and increasing popular use of SUA in different professional applications. It shall also be noted that the safety requirements provided above are not meant to be exhaustive. It shall be the responsibility of the SUA responsible person and remote pilots to comply with all applicable regulatory requirements, put in place appropriate safety precautions and risk mitigating measures for the subject SUA operations, as well as to follow the requirements and guidelines set out by any authorities, Government Departments, land owners or other stakeholders where necessary to ensure the safe operations of the SUA at all times.

18.2 This document shall be read in conjunction with the SUA Order, SRD and other SUA related documents published by the CAD.

18.3 For enquiries, please contact the Unmanned Aircraft Office of the CAD at sua@cad.gov.hk.

19 Notes

19.1 This AC supersedes the version dated 24 April 2025.

Appendix A – Guidance Notes for Operations Manual for Small Unmanned Aircraft Beyond Visual Line of Sight Operations within the Context of Regulatory Sandbox

Table A.1 provides an outline of the areas and details (specific descriptions/ policies/ procedures) that shall be included in an Operations Manual (OM) for conducting BVLOS operations. While the following outline or list of topics are not intended to be exhaustive or prescriptive, and may be adjusted as necessary to suit the particular arrangements of an individual operator, the applicant shall give similar considerations in the OM.

A sample OM for SUA advanced operations is also available on the CAD website (https://www.cad.gov.hk/english/sua_new.html) for reference.

Table A.1 – Outline of an OM for BVLOS operations within the context of Regulatory Sandbox

Part A – Organisational Procedures		
1	**Introduction & Applicability**	
1.1	Contents	Brief list of OM contents.
1.2	Compliance statement and applicability	State the applicability of this OM to whom and when (flight demonstrations / test flights / training flights / actual SUA operations) the contents within this OM must be adhered to.
1.3	Definitions	Include any common acronyms, if necessary.
1.4	Document control and amendment process	To ensure the OM remains in date that different versions are not being used. Amendments shall be sent to the CAD. Suggest including a version number and date on the cover of the OM.
1.5	Type(s) and descriptions of BVLOS operations to be conducted	State the type(s) and provide descriptions of BVLOS operations to be conducted with pointers to the relevant sections of the OM for specific procedures / required information.
1.6	Policy of the retention of a list of SUA and personnel involved in BVLOS operations	Explain the policy of how such lists are maintained.
2	**Organisation**	
2.1	Structure of organisation and management lines	Organogram with brief description.
2.2	Key personnel and responsibilities	(i) State the accountable person for the operation. (ii) Specify the responsibilities of each key

		position, such as operations manager, technical manager, remote pilot, supporting crew and communication engineer(s). Note: The duties and responsibilities of the remote pilot and supporting crew to assist in carrying out the BVLOS operations safely shall be detailed in the OM. e.g. During the BVLOS operations, the remote pilot shall continuously know and determine the position, altitude, attitude and movement of his/ her SUA and ensure that it remains in the intended operating areas and/or flight routes without exceeding the performance capabilities of the command and control link.
2.3	Competency of the remote pilot(s)	(i) Detail the qualification / experience / training requirements for the remote pilot(s). (ii) Justify the remote pilot(s) assigned (or to be assigned) for the operations are competent, with the proof of competency including qualifications and experience supplemented in the Appendix. Note: The Remote Pilot shall be competent for the BVLOS operations to be conducted. He/ she is required to complete satisfactorily internal training and assessment relevant to the duties and responsibilities and maintain currency by test flights, training flights and/ or actual SUA operations. The training programme for Remote Pilot and supporting crew shall be documented in the OM.
2.4	Responsibilities and duties of supporting crew	List the composition of the supporting crew, which shall include roles to ensure that the operations can be carried out safely, such as checking of SUA controlling system (including ground station, remote controller, flight controlling software, etc.), surveillance system (if applicable), SUA battery level, navigation system, positioning system, etc.
2.5	Competency of the supporting crew	Detail any qualification, experience or training requirements for each of the supporting crew.

		Note: The supporting crew shall be competent for the BVLOS operations to be conducted. He/ she is required to complete satisfactorily internal training and assessment relevant to the duties and responsibilities and maintain currency by test flights, training flights and/ or actual SUA operations. The training programme for Remote Pilot and supporting crew shall be documented in the OM.
3	**Overview of the SUA and communication protocol**	
3.1	Brief technical description of the SUA	(i) Specify the SUA model to be used for the BVLOS operations and the basic technical features, including the size, take-off weight (payload inclusive), maximum flying altitude, speed and maximum operating time. (ii) Full technical specifications can be supplemented in the Appendix or a separate technical manual.
3.2	Command and control (C2) Link	(i) State the primary C2 link network, its frequency and maximum working distance. (ii) State how a C2 link between the SUA, the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), and the surveillance system (if applicable) is established and maintained. (iii)Describe the technical mitigations to prevent the loss of the C2 link. Such as the use of secondary independent C2 link as redundancy.
3.3	C2 link signal latency	Describe the proof that the signal latency timing within the C2 link falls within the tolerable limit.
3.4	Navigation and positioning system	(i) Describe the navigation and positioning system. (ii) State the minimum number of satellites required for the operations. (iii) Explain the communication lines between the GNSS satellites, the SUA, the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), the

		surveillance system (if applicable) and the additional base station (if applicable). (iv) Describe the fallback design in case the GNSS signal to the SUA is lost / weak.
3.5	Collision avoidance and movement (or alternative means of compliance)	Explain the collision avoidance and movement coordination technologies for the SUA within the group.
3.6	Geo-fencing	Describe how the geo-fence will be set and maintained to retain the SUA within the intended operating areas and/or flight routes.
3.7	Fail-safe mechanism	Explain the fail-safe mechanism which shall include flight termination function that could stop the operation in case of an emergency.
3.8	Operating limitations and conditions	(i) State the operating conditions, including operating under BVLOS conditions and the weather (wind, precipitation, temperature) limits. The maximum allowable operating conditions must be based on information from the manufacturer. (ii) Explain how the weather will be monitored prior to and during the operations.
3.9	Means of Communications	(i) The operator shall detail the communication methods that will be used with other airspace users and/or the Air Traffic Control (if applicable), to monitor airspace, and to communicate with supporting crew if required. The operator shall also detail the process to ensure that the Remote Pilot is contactable in the operating areas and/or flight routes and that communication coverage is satisfactory. (ii) The Remote Pilot shall consider adequate means of real-time communication between supporting crew and involved person when conducting operations, including any procedures that need to be implemented. The Remote Pilot shall also consider back up communication methods in case the primary means of communication fails. (iii)Communication protocols between the

		Remote Pilot and supporting crew to communicate collision avoidance information and corresponding commands.
4	**Operational Control**	
4.1	Monitoring of SUA operation	(i) Describe how the various operating parameters will be monitored by the Remote Pilot. This shall include (but not be limited to) flight altitude, latitude & longitude, GNSS / RTK equipage, battery level, geo-fencing, C2 link between each SUA, the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), and the surveillance system (if applicable). (ii) Maintain a good lookout at all times and avoid collision with other aircraft (both manned and unmanned).
4.2	Requirements on the area of operations	Detail the requirements on the area of operations.
4.3	Safety System	Describe the details of any safety system that will assist the remote pilot to carry out the BVLOS operations safely.
4.4	Surveillance System (if applicable)	Describe how the system (or other alternative means of compliance) shall operate: (i) Enabling the SUA to effectively detect and avoid other aircraft, obstacles (structures, buildings, terrains, buoys, etc.) and moving objects (vessels, vehicles, birds, kites, balloons, etc.) in the proximity of the operating areas and/or flight routes; (ii) Indicating the geographical location, flying altitude, etc. of the SUA as well as the collision avoidance information and/or alerts in real-time; (iii) Continuous monitoring of air traffic information in the proximity of the operating areas and/or flight routes; (iv) Alerting airspace users in the proximity of the operating areas and/or flight routes of the SUA operations in real-time; (v) Communicate continuously and

		effectively with the Remote Pilot and provide sufficient collision avoidance information to the Remote Pilot; and (vi) Inform the Remote Pilot when the SUA is approaching its maximum operating range limits. (vii) If a surveillance system is in place, the surveillance system shall be able to: - • Locate the SUA; • Determine the SUA's attitude, altitude and direction of flight; • Monitor the airspace for other air traffic or hazards; and • Determine if the SUA become a hazard to any other aircraft, person or property. (viii) If the surveillance system fails, or the SUA becomes a hazard to any other aircraft, person or property, the remote pilot shall immediately respond in accordance with established emergency procedures to ensure the safety of operations. The relevant emergency procedures shall be documented in the OM.
4.4	Management of cordon-off area	Describe how the cordoning measures are maintained and the access control is exercised.
4.5	Personnel and equipment Redundancy	Describe the arrangement for backup remote pilot(s), SUA controlling system (including ground station, remote controller, flight controlling software, etc.) and surveillance system (if applicable) as redundancy.
4.6	C2 Link	Explain how potential radio frequency interference is assessed prior to and during the operations.
4.7	GNSS signal	Explain how the number of satellites is monitored before and during the operations.
4.8	Crew health	A statement and any guidance to ensure that the crew are appropriately fit before conducting any operations.
4.9	Go / no-go criteria	(i) Define the go / no-go criteria for the operations.

		(ii) State who is responsible to make the decision and when the decision must be made (i.e. how many minutes prior to the operations).
4.10	Emergency abort criteria	(i) State the emergency abort criteria which, if reached, would lead to an immediate and safe termination of the operations. (ii) State who is responsible to make real-time decision to abort the operations.
4.11	Records	(i) State the requirements for records of aircraft S/N, and flight log. (ii) Records shall be retained for a period of at least 2 years after the date of event. (iii) All the forms / checklists involved shall be attached in the Appendix. Note: All records shall be properly kept and updated by the operator, and shall be made available in a legible format to the CAD upon request.
Part B - Operating Procedures		
1	**Flight planning / preparation**	
1.1	On-site survey and assessment	(i) Before the operations, the operator shall conduct comprehensive flight planning (including daylight reconnaissance and site safety survey) prior to the operations to ensure compliance with all applicable statutory requirements, e.g. the flight routes are so planned that the operations will not be conducted in a congested area and within a restricted flying zone unless otherwise justified. Any hazards, restrictions and obstacles shall be identified, addressed and recorded. (ii) The operator shall ensure the functioning and performance of SUA controlling system (including ground station, remote controller, flight controlling software, etc.), surveillance system (if applicable), etc. at all times during the operations. (iii) The operator shall brief all supporting crew and involved person, to ensure that they are fully aware of their responsibilities, the operational tasks and the associated risks.

		(iv) The operator shall detail how the site will be set up for BVLOS operations. The followings shall also be identified: (i) if the operation would fall into the Restricted Flying Zone (RFZ); (ii) any other aircraft operations or other airspace users within the operating site; (iii) any potential hazards to the operations due to activities nearby, such as live firing, fuel tank, high tension cables, high-intensity radio transmissions; (iv) any obstructions to the operations and radio frequency transmission (wires, masts, buildings etc); (v) public access affected; (vi) mobile network signal coverage and capacity (Note: coordinate with OFCA if required); (vii) the takeoff, landing and recovery areas (if any) are sufficiently illuminated to ensure safe operations of the SUA.
1.2	Safety risk management	Describe how the risks specific to the operations shall be identified and mitigated to an acceptable level. **Note: A safety risk assessment report must be submitted with the application (see Appendix B).**
1.3	Liaison with other Government Bureaux / Department	State whether any additional permission / licence / authorisation from other Government Bureaux / Departments is required and the timeline to obtain such permission / licence / authorisation.
1.4	Cordoning measures	Explain how the cordon line(s) shall be marked and the assess to the cordon-off area shall be controlled to ensure no unauthorised entry into the operating area.
2	**Pre-flight check**	
2.1	Operating area	(i) No potential hazards or obstructions to the operations. (ii) The takeoff, landing and recovery areas (if any) are sufficiently illuminated to ensure safe operations of the SUA.
2.2	Cordoning / security measures	The cordoning arrangement adheres to that

		depicted in the flight plan and the OM.
2.3	Weather checks	The operating conditions are fulfilled.
2.4	Equipment readiness	The batteries in the SUA, the SUA controlling system (including ground station, remote controller, flight controlling software, etc.), the surveillance system (if applicable), etc. are properly charged / serviceable.
2.5	Loading of equipment	All components and payload are secured.
2.6	SUA Conditions	(i) Assembled in accordance with the manufacturer's instructions. (ii) Propellers and propeller guards (if applicable) are properly assembled and secured.
2.7	C2 Link, SUA positioning system and calibration	(i) C2 link are established, and network (including 4G or 5G network where applicable) is with sufficient strength. (ii) GNSS signals are received with the required number of satellites tracked.
2.8	Geo-fencing	Geo-fencing boundary is set in accordance with the flight plan.
2.9	Return-to-home position / maximum altitude	Return-to-home position and maximum altitude of operations are correctly set.
2.10	Pre-flight Checklist	(i) All the check items must be recorded in the pre-flight checklist, with the signatory of the authorised person. (ii) The go / no-go criteria and decision is documented.
3	**Normal operating procedures**	
3.1	Staging	These procedures may be contained in the operations manual and shall cover all necessary matters including safety. Critical information shall be specified. This shall include the minimum number of satellites tracked and the minimum battery level required before and during the operations. For example, the operations shall be terminated if the number of satellites tracked dropped below the minimum number, or battery level dropped below the minimum level, etc.
3.2	Take-off	
3.3	In flight	
3.4	Landing	
3.5	Shutdown	

		During the BVLOS operations, the remote pilot shall continuously know and determine the position, altitude, attitude and movement of his/ her SUA and ensure that it remains in the intended operating areas and/or flight routes without exceeding the performance capabilities of the command and control link.
4	**Emergency procedures**	
4.1	Emergency procedures for different scenarios	The emergency procedures in response to situations (including but not limited to the following) shall be specified: (i) Inoperative motors / blades; (ii) Intermittent / degraded / permanent loss of C2 link; (iii) Partial or total failure of FCS, SUA controlling system (including ground station, remote controller, flight controlling software, etc.), surveillance system (if applicable), etc.; (iv) Navigation system failures, e.g. degradation or total loss of GNSS, sensors/ cameras; (v) Flight planning failures that could result in a loss of containment, i.e. incorrect setting of waypoints / Return-To-Home ("RTH") functions; (vi) Flyaway, motor failures, other malfunctions, and other emergency scenarios that may arise specific to the proposed operations; (vii) Fire; (viii) Low battery, etc. **Note: Must include the procedures for remote pilot to override the normal operating system.**
5	**Quality Assurance**	
5.1	Quality Assurance policy	Describe how appropriate quality assurance actions shall be performed for ensuring continuous compliance of applicable regulatory requirements stipulated in the SUA Order, Safety Requirements Document, various Advisory Circulars, conditions of the permission and other documents published by the CAD.

5.2	Training policy and programme	Detail the training policy and programme for key personnel and supporting crew.
5.3	Oversight Activities by the CAD	State that the operator shall provide all necessary support for the oversight activities conducted by the CAD, including but not limited to announced and unannounced inspection, audit, document check and any other appropriate activities; and support subsequent root cause identification, proposal and implementation of corrective action(s) with the aim to prevent reoccurrence of any deficiency.
6	**Accident / incident reporting and investigation**	
6.1	Accident or incident reporting timeframe	State the following reporting sequence: (i) Notify Police by phone immediately and an email notification to the CAD at sua@cad.gov.hk, if the operations have caused any damage to property or injury to person; (ii) Within 24 hours of any incident or accident (whether or not there was damage to third party property or injury), provide full details of the circumstances in writing to the CAD by email to sua@cad.gov.hk. (iii) Within 3 calendar days, provide additional details and/or investigation findings by email to sua@cad.gov.hk.
6.2	Investigation policy	Include the responsible person for conducting the investigation. The root cause must be identified.
Part C – Appendices		
1	Qualification of remote pilot(s)	Enclose evidence of qualification.
2	SUA technical specifications	Full technical specifications of the SUA.
3	Forms and records	Include, but not be limited to, the followings: (i) On-site survey and assessment record; (ii) Pre-flight checklist; (iii) Post-flight checklist. Note: All records shall be properly kept and updated by the operator, and shall be made available in a legible format to the CAD upon request.

Appendix B – Guidance Notes for Safety Risk Assessment for Small Unmanned Aircraft Beyond Visual Line of Sight Operations within the Context of Regulatory Sandbox

The applicant shall identify risks specific to the proposed BVLOS operations and propose effective risk mitigating measures so that the risks are mitigated to an acceptable level. The following is an example of basic safety risk assessment for BVLOS operations and some anticipated risks to be addressed. Applicant shall note that the list is not exhaustive. Any other risks associated with the proposed operation shall be identified and addressed. Subject to acceptance by the CAD, the applicant may adopt other risk assessment methodologies such as the Specific Operations Risk Assessment (SORA).

Risk No.	Identified Hazard	Associated Risk (What & How)	Existing Mitigation	Current Risk Rating	Further Mitigation	Revised Risk Rating
1.	*Loss of communication with the SUA*	*The SUA cannot be effectively controlled and may collide with other aircraft, person or property*	*The path of flight is programmed in advance such that the SUA may continue the flight if GNSS signal is in place*	*4C*	*A surveillance system is in place to track the position of the SUA and flight parameters*	*2C*
2.	*Loss of or poor GNSS signal*					
3.	*Accidental drop of payload during flight*					
4.	*SUA flyaway*					
5.	*Communication between remote pilot and supporting crew fails*					
6.	*Adverse space weather conditions*					

– END –