AC 101-2-5 (Rev 0)
8 September 2026

Civil Aviation Authority of Singapore

Advisory Circular

APPLICATION FOR UNMANNED AIRCRAFT LIGHT SHOW OPERATIONS

GENERAL
Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 11 of the Air Navigation Act 1966 (ANA), to show that compliance with a statutory requirement has been achieved. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE
This Advisory Circular provides guidance to an Operator Permit (OP) holder intending to apply for permits to conduct unmanned aircraft (UA) light show operations in Singapore. It sets out the application requirements, safety documentation expectations, and permit process to ensure safe operations.

APPLICABILITY
This AC is applicable for an OP holder intending to apply for permits to conduct UA light show operations.

RELATED REGULATIONS
This AC relates specifically to Part 2 of Air Navigation (101 – Unmanned Aircraft Operations) Regulations 2019 (“ANR-101”).

RELATED ADVISORY CIRCULARS
- AC 101-2-1 Permits for Unmanned Aircraft Operations
- AC101-2A-1 Centralised Flight Management System

CANCELLATION
This AC is the first on the subject.

EFFECTIVE DATE
This AC is effective from 8 September 2026.

OTHER REFERENCES

Joint Authorities for Rulemaking on Unmanned Systems (JARUS) guidelines on Specific Operations Risk Assessment (SORA) V2.5 and pre-defined risk assessment (PDRA-08) for swarming operations.

1 INTRODUCTION

1.1 Unmanned aircraft (UA) light shows offer an innovative form of public entertainment with infinite creative possibilities by leveraging advances in digital and unmanned aircraft systems technologies.

1.2 This AC provides guidance for permit(s) application and sets out the safety requirements and operational considerations to ensure aviation and public safety.

2 DEFINITION

2.1 Unless the context otherwise requires, the following terms have the meanings set out below:

(a) **Light show** means an operation of 2 or more unmanned aircraft which are each equipped with lights (such as light emitting diodes); and flying in coordinated patterns to create visual effects in the air (as reproduced from the First Schedule of ANR-101).

(b) **Involved person** means a person, as identified by the operator, who understands the operations and the risks involved in the UA operation and can reasonably be expected to follow directions and safety precautions given by the operator or UA pilot(s), in order to avoid unplanned interactions with the UA.

Uninvolved person means anyone who is not an involved person.

Note: A spectator attending a UA light show is generally considered to be an 'uninvolved person', even if he/she is aware that a light show is taking place.

An example: When conducting a UA light show at a large-scale public event such as the National Day Parade, New Year's Eve celebrations, or a music festival, spectators are not considered conversant with UA operations on the basis that they are informed of the light show through any means, such as: (1) A public address system, (2) A statement on the ticket, (3) In advance by email or text message, or (4) Signage at the event venue. These types of communication channels do not satisfy the requirements for involved person.

(c) **Safety crew** means trained persons responsible for monitoring the operation and initiating emergency procedures.

3 PERMIT REQUIREMENTS

3.1 An operator who conducts UA light show operations will be required to hold:

(a) A UA Operator Permit (OP)

Note: As part of the OP application, the operator is required to apply for a waiver from CFMS tracker requirements under Regulation 19D(1) and/or 19D(2) of ANR-101. This waiver, once granted at the OP stage, will cover all subsequent UA light show AP applications. Do note that active use of the FlyItSafe application is still required unless separately waived.

(b) A Class 1 Activity Permit (AP1) for the conduct of UA light show

Note: A single AP1 covering both rehearsal(s) and actual show(s) may be granted. The applicant should indicate the dates and times of the rehearsal(s) and/or actual show(s) in the application. For repeat applications involving a similar show conducted at other locations, the applicant may consider submitting existing flight test reports or documentation from previous rehearsals or actual shows as a means of demonstrating that all identified risks can be adequately mitigated.

3.2 An applicant should refer to AC 101-2-1 and the CAAS website for guidance on the process to apply for OP and AP1 Permits. The applicant needs to identify potential high-risk elements and demonstrate that the light show can be conducted safely. This may be demonstrated through the robustness of the operational procedures, UA airworthiness, and suitability of the environment at a scale representative of the intended show(s). The following information should be included within the application:

Technical and Operational Information

(a) Technical specifications of each UA type to be used, including:

(i) UA model, dimensions, and weight
(ii) Ground control station and system functionalities
(iii) Flight performance characteristics (maximum speed, endurance, altitude capability)
(iv) Navigation and positioning systems
(v) Communication systems and frequencies
(vi) Safety features (geofencing, return-to-home, flight termination systems)
(vii) Lighting systems and power specifications
(viii) Any additional equipment or deviations from the manufacturer's original specifications that may affect flight safety or performance

(b) Illustration of operations, detailing how the light show will be carried out and deployed

(i) Calculation of the ground risk buffer (refer to Paragraph 4.6 for guidance)
(ii) Flight Plan including maps and diagrams detailing all safety zones described in Paragraph 4 (refer to Appendix 1 for guidance)
(iii) Take-off and landing zones
(iv) Equipment set-up areas and control stations

(c) The visual content to be displayed during the light show

(d) Containment breach procedures, detailing:

(i) Detection method for boundary violations
(ii) Immediate response action
(iii) Communication protocols with safety crew and authorities
(iv) Procedures for securing the affected area
(v) Conditions to hold or terminate flight

(e) Weather and wind monitoring procedures, including:

(i) Wind speed and gusts
(ii) Visibility and cloud ceiling
(iii) Precipitation

(f) Safety crew deployment plan, detailing:

(i) Number and positioning of safety crew
(ii) Roles and responsibilities of each crew
(iii) Communication methods and equipment
(iv) Coordination procedures during normal and emergency operations

(g) Site and Access Control

(i) Physical barriers (e.g fencing, cordons, barriers) and their locations
(ii) Signage placement and content
(iv) Security crew positioning and responsibilities
(v) Entry and exit point management
(vi) Procedures to prevent unauthorized access during operations

<u>Safety Systems and Procedures</u>

(h) Emergency Procedures

An operator is to identify all failure scenarios that would necessitate emergency handling or termination of the show and establish corresponding contingency procedures for each. Such scenarios include:

(i) Single UA failure (e.g. navigation system failure, GPS signal loss or degradation)
(ii) Multiple UA or fleet-wide failures (e.g. ground control station failures, communication link loss)
(iii) Adverse weather or environmental conditions

For each scenario, the procedures should detail the response actions, decision-making criteria, and roles of involved personnel.

(i) Management of involved persons

(i) Procedures and means to identify an involved person within the controlled ground area

(ii) Safety plan for involved persons detailing briefing procedures, training requirements, safety mitigation measures, safeguards and supervision arrangements to ensure that every 'involved person'–

a. Understands the risks involved in that UA operation; and
b. Understands and be able to carry out safeguards during that UA operation, as instructed by the operator to ensure safety is maintained during operations.

(j) Flight termination protocols, specifying:

(i) Conditions and criteria that would necessitate an emergency termination of flight (e.g. UA malfunction, adverse weather, or containment breach)
(ii) Geofencing parameters and activation thresholds
(iii) Automated flight termination system capabilities and triggers
(iv) Manual pilot intervention procedures and authority

Administrative Requirements (where appropriate)

(k) Details of event organiser or sponsor

(l) Written consent from property owners and relevant authorities with jurisdiction over the site

(m) For a UA light show at Marina Bay, the Padang and other locations within the Central Area, an approval from the Urban Redevelopment Authority (URA) would be needed and more information is available on URA drone show application webpage.

(n) Given the risks involved, applicants are advised to consider obtaining insurance coverage for their operations

3.3 Application Timeline and Fees

The fee for applying a UA OP for the purpose of conducting UA light show is as stated In AC 101-2-1. The application of a Class 1 AP (each activity or block of different dates/times of the same activity) for the purpose of conducting the UA light show will incur an application fee of $500. A repeat or variation of the activity (without any change in the unmanned aircraft or type of unmanned aircraft or place of operation of that aircraft) will incur an application fee of $425.

Due to the complexity and risk of operations, a permit application should be submitted no later than three months before the intended date of the first activity. Approval of an application is subject to safety and security assessments. There will be no refunds regardless of the outcome of the application.

4 DETERMINATION OF SAFETY DISTANCE AND CONTAINMENT

4.1 The operator of a UA light show should establish clear safety zones to ensure proper containment of the operation and protection of uninvolved persons.

4.2 All safety zones should be identified, documented, and contained within a controlled ground area where access is restricted to involved persons only. **Figure 1** illustrates the relationship between these zones.

4.3 The four safety zones are (1) Flight geography, (2) Contingency volume, (3) Ground risk buffer and (4) Controlled ground area.

Figure 1: Safety zones and their relationship

4.4 Flight Geography

The flight geography defines the three-dimensional airspace where UA operations take place.

The operator should clearly define and document this area, accounting for:

(a) Maximum horizontal boundaries of all planned formations and flight paths

(b) Maximum operational altitude

(c) Take-off and landing zones

(d) Transition corridors between formations

The flight geography should account for all phases of flight including take-off, show choreography, transitions and landing.

4.5 Contingency volume

This volume encompasses the flight geography and serves as the primary containment boundary where automated safety systems such as geofencing and flight termination systems are typically activated if a boundary breach occurs to prevent further excursions. This volume should consider:

(a) Navigation system errors: This includes GPS accuracy specifications, local and environmental factors affecting GPS performance and the impact of multiple UA operations.

(b) Flight technical errors: This includes UA position keeping accuracy, and effects of wind on station-keeping.

(c) System latencies: This includes command and control delay, position reporting delay and emergency command and flight termination execution time.

When a UA reaches the boundary of the contingency volume:

(a) Geofencing systems should be activated to prevent further excursion (when applicable)

(b) Flight termination protocols should be initiated if containment cannot be maintained (when applicable)

The operator should note the following:

(a) Geofencing parameters and activation thresholds

(b) Flight termination criteria and procedures

(c) Alert systems for boundary violations

4.6 Ground risk buffer

The ground risk buffer is a safety zone that surrounds the projected footprint of both the flight geography and the contingency volume. It is intended to account for the final impact point of a UA in the event of a total system failure or uncontrolled descent.

The ground risk buffer should be calculated from the outer edge of the contingency volume and sized to ensure that any descending UA remains within a contained and secured area. The operator should ensure that the ground risk buffer remains fully within the boundaries of the controlled ground area.

In sizing the ground risk buffer, the operator should take into consideration:

(a) Altitude of operation

(b) Vertical fall time T = $\sqrt{\frac{2y}{g}}$ where y is the altitude of the UA and g is acceleration due to gravity ≈ 9.81m/s^2

(c) Lateral drift distance, which depends on the UA's horizontal velocity at the moment of failure and the ambient wind speed during descent

Note: An example of ground risk buffer calculation is provided in Appendix 2.

4.7 Controlled ground area

The controlled ground area should cover the surface area of all the above zones (flight geography, contingency volume, and ground risk buffer) and be secured to prevent

access by any uninvolved person. In defining this area, the operator may leverage on existing infrastructure such as existing fence lines and gates. This area should have:

(a) Physical controls: Cordon-off mechanism such as permanent or temporary fencing, warning signs at appropriate intervals, clearly marked entry and exit points and emergency access points.

(b) Access management: Deployment of security crew, entry point registration and identification systems for involved person.

5 CONSIDERATION FOR OPERATING SITES AND SITE SUITABILITY

5.1 The fundamental principle for UA light shows site selection is the ability to establish complete control over the operational area whilst ensuring the safety of people, property, and critical infrastructure. In the worst-case scenario where a UA loses power and fall, the established safety zones ensure that the UA falls within the controlled ground area.

The operator should assess the area, properties, and structures within the controlled ground area for potential damage that may result from any falling UAs.

5.2 A suitable site should therefore satisfy three core requirements:

(a) Sufficient space to contain all safety zones within a controlled ground area

(b) Ability to restrict access to involved persons only

(c) Free from elements within the controlled ground area that would create unacceptable consequences if impacted

These requirements, along with operational considerations, are detailed in the following sections.

5.3 Spatial Requirements

The site should provide sufficient space to accommodate:

(a) The entire flight geography, contingency volume, ground risk buffer and the controlled ground area as defined in Section 4.

(b) Equipment setup areas and control stations

(c) Safety crew positioning areas

5.4 Access Control

The site should enable establishment of effective access control measures including:

(a) Clear signage indicating restricted access, operational hazards, and ‘involved persons only’ zones

(b) Physical barriers (e.g. fencing, cordons, barriers) around the controlled ground area perimeter

(c) Controlled entry and exit points with security personnel

(d) Procedures to prevent unauthorized access throughout operations

Note: Only involved persons should be allowed within the controlled ground area during the UA light show operation. Involved persons are operators, safety crew, and authorized individuals who understand the operational risks and have agreed to participate.

5.5 Elements within the Controlled Ground Area

The controlled ground area should not contain:

(a) Any uninvolved person who has not consented to the operation

(b) Property where owner consent has not been obtained

(c) Hazardous facilities (fuel storage, explosive materials, fireworks etc.)

(d) Critical infrastructure (power stations, telecommunications hub etc.)

(e) Heritage structures or culturally sensitive sites

(f) Public roads, paths, or thoroughfares where access cannot be controlled

Note: The ground risk buffer calculation in Section 4 ensures that falling UAs remain within the controlled ground area. However, what they impact matters. Hazardous materials could trigger secondary incidents; critical infrastructure damage could disrupt essential services; heritage site damage could result in irreplaceable cultural loss. Site selection should therefore consider both containment and the consequences of impact within the contained area.

5.6 Site Selection Guidance

Based on the considerations above, the following guidance applies to site selection:

General Suitable Sites

Water bodies, open fields, parks, and open land are generally suitable for UA light show operations. In the event of a UA falling within these areas, the impact is unlikely to cause significant damage or trigger secondary hazards as compared to when operating over structures and properties.

APPENDIX 1 DEVELOPMENT OF FLIGHT PLAN – SAFETY ZONES

When submitting a flight plan for UA light show, it is good practice to clearly demarcate the following in a true-to-scale drawing:

1 All four safety zones clearly marked with distance markers

2 Take-off and landing zones clearly marked with distance markers

3 Location of UA pilot(s), safety crew(s), security crew(s) and any other ground crew

4 Controlled ground area entry/exit points, and audience area

5 Any other areas of interest, such as (but not limited to) areas where fireworks will be stored, heritage structures or heritage trees, shopping malls, mass rapid transit (MRT) stations and roads

An example of the flight plan is as follows:

Note: The operator may choose to include more than one diagram if greater resolution is required to fully illustrate the operational plans.

APPENDIX 2 CALCULATION OF THE GROUND RISK BUFFER

In calculating a suitable ground risk buffer, the operator may do so using the following method.

Parameters to be defined

a = maximum altitude of operation measured from lowest ground level (in metres)

b = horizontal velocity of the UA (in m/s)

c = ambient wind speed (in m/s)

Note: For the ambient wind speed, this value should be supported by historical or measured wind data in the region. Once a wind speed value is defined, the operation should not be permitted to take place if conditions exceed the defined wind speed.

Calculation method

Using the kinematics free fall equation, first calculate the time (t) for the UA to fall from maximum altitude:

$$t = \sqrt{\frac{2a}{g}}$$

where g = 9.81 m/s² (gravitational acceleration)

The **minimum ground risk buffer value** can then be computed as:

$$ground\ risk\ buffer\ = (b + c) \times \sqrt{\frac{2a}{g}}$$