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Federal Department of the Environment,
Transport, Energy and Communications DETEC

**Federal Office of Civil Aviation FOCA**
Innovation and Digitalisation

# FOCA GM

## Operation Manual

BVLOS drone operations over sparsely populated areas

Version 1 - 01.03.2021

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| Scope | Guidance for the elaboration of an OM for BVLOS operations |
| Applies to | BVLOS drone operations over sparsely populated areas |
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| Business object | 311.340-30 |
| Prepared by | Alexander Lindner / Nathanel Apter ID |
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## Table of Contents

# 0 Introduction

All Guidance Material (GM) is intended to assist the organisation/operator in administrative matters. The administrative requirements and processes will facilitate liaising with the Federal Office of Civil Aviation (FOCA). It is to be considered a tool for the organisation/operator in order to ease processes of obtaining required authorisations issued by the FOCA. Using the GM will be conducive to establishing compliance with FOCA requirements and will lead through the respective certification or variation process in regard to administrative tasks.

## 0.1 Terms and conditions

The use of the male **gender** should be understood to include male and female persons.

The most frequent **abbreviations** used by the **EASA** are listed here: easa.europa.eu/abbreviations.

When used throughout the GM, terms such as ‘shall’, ‘must’, ‘will’, ‘may’, ‘should’, ‘could’, etc. have the meaning defined in the English Style Guide of the European Commission.

## 0.2 Legal references

Art. 17 para. 1 and Art. 18 of the Ordinance on Special Category Aircraft (OSCA) .

## 0.3 Purpose of this GM

This GM aims at providing guidelines for the elaboration of an Operation Manual for BVLOS drone operations over sparsely populated areas. This GM is valid for operations of the specific category.

## 0.4 Scope

The BVLOS operations shall take place within the limitations defined in the form “Authorisation EVLOS Drone Operation”. The operations will be held over sparsely populated areas in uncontrolled airspace at very low levels in BVLOS with visual air risk mitigation using unmanned aircraft up to 3 metres in dimension.

## 0.5 Organisation / Operator responsibilities

The applicant bears overall responsibility for the operation. Specifically, the applicant must ensure compliance with all requirements of the standard application procedure as well as any other requirements associated with the authorisation. The applicant may name an employee and instruct the said employee to carry out the operation. Overall responsibility remains with the applicant.

# 1 Organisation overview

## 1.1 Responsibilities and associated duties

Describe the responsibilities and duties of the UAS operator and personnel, describe all positions and people involved.

## 1.2 Safety

Describe how safety is integrated in the organisation. What Safety Management System (SMS) is in place?

## 1.3 Training of staff involved in operations

Describe the training to qualify all staff involved in operations.

## 1.4 Maintenance

Describe maintenance instructions and procedures.

# 2 Operations

## 2.1 Standard operating procedures

Describe the standard operating procedures (SOP) applicable to all operations for which an approval is requested.

Further guidance on the content of checklists can be found here:

https://www.bazl.admin.ch/dam/bazl/fr/dokumente/Gut_zu_wissen/Drohnen_und_Flugmodelle/guidance_material_onsora_oso8_pre_and_postflight_inspections.pdf.download.pdf/Guidance%20Material%20on%20SORA%20OSO%208%20Pre-%20and%20Postflight%20Inspections.pdf

The limitations of the external systems used to support UAS safe operations are defined in an operation manual.

Note: In order to help a proper identification of the procedures related to deterioration of external systems supporting the UAS operation, it is recommended to:

- identify the 'external systems' supporting the operation;
- describe the deterioration modes of these 'external systems' which would prevent maintaining a safe operation of the UAS (e.g. complete loss of GNSS, drift of the GNSS, latency issues, …);
- describe the means put in place to detect the deterioration modes of the external systems/facilities;
- describe the procedure(s) in place once a deterioration mode of one of the external systems/facilities is detected (e.g. activaion of the Emergency Recovery Capability, switch to a manual control…).

### 2.1.1 Normal procedures

Normal procedures should cover at a minimum the following points:

(1) Operation preparation and planning, including the assessment of:
   a. the area of operation and surrounding area, including the terrain and potential obstacles, potential overflown people groups, potential overfly of critical infrastructure …
      Note: A risk assessment of critical infrastructure should be performed in cooperation with the responsible organisation for the infrastructure, as they are most knowledgeable about the threats.
   b. surrounding airspace, including:
      i. the proximity of restricted zones and potential activities by other airspace user; Includes the assessment of the Daily Airspace Bulletin (DABS):https://www.skybriefing.com/;
      ii. check the compliance between visibility and planned range for AOs;
      iii. assess the potential terrain obstruction for AOs;
      iv. confirm there are no gaps between the zones covered by each of the AOs.
   c. environmental conditions (how to determine the adequacy of the planned UAS operation within defined environmental conditions);
   d. the required remote crew members and their responsibilities;
   e. the required communication procedures among remote crew members and with external parties when needed (e.g. ATC);
   f. the UAS and any other technical means to be used in the operation, including the assessment of their suitability and their fitness (e.g. airworthy condition) and compliance with required performance (e.g. required C2 link performance) for a safe conduct of the intended operation.
   g. compliance with any specific requirement from the relevant authorities in the intended area of operations, including those related to security, privacy, environmental protection, use of RF spectrum, etc.

(2) Pre-flight inspection procedures, which shall be:

a. performed by the remote flight crew to ensure the UAS is in a condition for safe operation and conforms to the operation manual, and
b. documented (at least as part of the manufacturer's instructions and requirements).

(3) Launch & (normal) recovery procedures.
(4) (Normal) In-flight procedures (including those to ensure that the UA remains within the "flight geography" volume).
(5) Post-flight (after recovery) procedures (including the corresponding inspections).
(6) Detection procedures of potentially conflicting aircraft by Remote Pilot and potential Airspace Observers.

### 2.1.2 Contingency procedures

Contingency procedures should at a minimum contain:

(1) Procedures to cope with the UA entering the 'containment' area.
(2) Procedures to cope with adverse operating conditions (e.g. what to do in case ice is encountered during the operation, when the operation is not approved for icy conditions)
(3) Procedures to cope with the deterioration of external systems supporting the operation.
(4) De-confliction scheme, i.e. the criteria that will be applied for the decision to avoid incoming traffic. In cases where the detection is performed by UA AOs, the phraseology to be used should be described.
(5) Avoidance manoeuvres may rely on performing a rapid descent to a safe altitude, or an immediate rapid landing (when a cleared landing space can be verified prior to descent).

### 2.1.3 Emergency procedures

Emergency procedures to cope with emergency situations (where there is a loss of control of the operation that cannot be recovered), including at a minimum:

(1) Procedures to avoid or, at least minimise, harm to third parties in the air or on the ground. With regard to the air risk, an avoidance strategy to minimise the collision risk with another airspace user (in particular, an aircraft with people on board) shall be included.
(2) Procedures for the emergency recovery of the UA (e.g. land immediately, termination of the flight with FTS or controlled crash/splash …).

### 2.1.4 Emergency response plan (ERP)

The ERP addresses situations involving:

- injured people;
- fire or explosion of a battery;
- fly-away cases.

# 3 Training

## 3.1 Remote crew

Brief description of the processes and procedures that the operator uses to develop and maintain the necessary competence for all staff involved in operations. Provide a reference to the applicable training program(s) for all staff involved in operations. This might simply be a reference to the program as required by regulation or, if the operator has developed a specific program, a reference to the operator's training program.

Description of the processes and procedures that the operator uses to recruit and qualify all staff involved in operations. In particular, there should be a description of the licensing and rating requirements for remote operators (if any) or, if a license is not required, how their qualification is carried out.

Describe which processes and procedures the operator uses to ensure that the remote operators (if any) or other operational staff acquire and maintain the required currency to execute the various types of duties.

Describe the crew training to avoid misunderstandings when communicating and to provide support and monitoring.

# 4 UAS description

Describe in detail the physical characteristics of the aircraft (mass, center-of-mass, dimensions, etc.). Include photos, diagrams and schematics whenever necessary to support the description of the UA.

## 4.1 Aircraft performance characteristics

Describe the performance of the aircraft within the proposed flight envelope.

Specifically, address at a minimum the following items:

a) maximum altitude;
b) maximum endurance;
c) maximum range;
d) maximum rate of climb;
e) maximum rate of descent,
f) maximum bank angle;
g) nominal cruising speed;
h) maximum cruising speed
i) never exceed airspeed.

## 4.2 Propulsion system

Describe the motors, ESCs and propellers and their ability to provide reliable and sufficient power to take off, climb, and maintain flight at expected mission altitudes.

a) Provide a high-level description of the electrical distribution architecture. Include items such as regulators, switches, buses, and converters, as necessary.
b) What type of motor is used?
c) How many motors are installed?
d) If a limited life power source such as batteries is used, what is the useful life of the power source during normal and emergency conditions? How was this determined?
e) How is information on battery status and remaining battery capacity provided to the operator (if one is in the loop) or watchdog system?
f) If available, describe the source(s) of backup power in the event of loss of the primary power source.
    - What systems are powered during backup power operation?
    - Is there any automatic or manual load shedding?
    - How much operational time does the backup power source provide? Include the assumptions used to make this determination.
g) How is the propulsion system performance monitored?
h) What status indicators and alerts (such as warning, caution and advisory) messages are provided to the operator?
i) How does the unmanned aircraft respond, and what safeguards are in place to mitigate the risk of propulsion system loss for each of the following?
    - low battery
    - failed signal input from the control station
    - motor controller failure

## 4.3 Payloads

Describe the payload equipment on-board the aircraft. Describe all payload configurations that significantly change weight and balance, electrical loads, or flight dynamics.

# 5 UAS control segment

Provide an overall system architecture diagram of the avionics architecture. Include the location of all air data sensors, antennas, radios, and navigation equipment. Describe any redundant system, if available.

### 5.1.1 Navigation

a) How does the UAS determine its location?

b) How does it navigate to its intended destination?

c) Describe the procedures to test the altimeter navigation system (position, altitude)?

d) How does the system identify and respond to a loss of the primary means of navigation?

e) Is there a backup means of navigation?

f) How does the system respond to a loss of the secondary means of navigation, if available?

### 5.1.2 Autopilot

a) How was the autopilot system developed? Which industry or regulatory standards were used in the development process?

b) Is the autopilot a commercial off-the-shelf (COTS) product? If so, name the type/manufacturer and provide the criteria that was used in selecting the COTS autopilot?

c) Describe the procedures used to install the autopilot. How is correct installation verified? Reference any documents or procedures provided by the manufacturer and/or developed by your organisation.

d) A management of the control software versions shall be available.

e) Does the autopilot employ input limit parameters to keep the aircraft within defined limits (structural, performance, flight envelope, etc.)? If so, what are these limits? How were these limits defined and validated?

### 5.1.3 Control station

a) Describe or diagram the CS configuration. Include screen shots of the control station displays.

b) How accurately can the operator determine the attitude, altitude (or height) and position of the UA?

c) What critical commands are safeguarded from inadvertent activation and how is that achieved (for example, is there a two-step process to command ‘kill-engine’)? What kind of inadvertent input could the operator enter to cause an undesirable outcome (for example, accidentally hitting the ‘kill engine’ command in flight)?

d) What are the provisions taken against a CS display or interface lock-up?

e) What alerts (such as warning, caution, and advisory) does the system provide to the operator (for example, low fuel or battery, failure of critical systems, operation out of control)?

f) Describe the means of power to the CS, and redundancies if any.

g) What are the procedures in place in case of CS loss of primary and secondary power (if any)?

### 5.1.4 Command and control link segment

Provide a detailed control system architecture diagram that includes informational or data flows and subsystem performance. Include values for data rates and latencies, if known. Describe the control link(s) connecting the UA the CS and any other ground systems or infrastructures, if applicable.

Specifically address the following items:

a) What spectrum will be used for the control link? What is the maximum power spectrum?

b) Is there a radio signal strength and/or health indicator or similar display to the operator? How is the signal strength and health value determined, and what are the threshold values that represent a critically degraded signal?

c) What design characteristics or procedures are in place to prevent or mitigate the loss of the datalink due to the following?

- RF or other interference
- flight beyond communications range
- antenna masking (during turns and/or at high attitude angles)
- loss of UA functionality
- atmospheric attenuation including precipitation

### 5.1.5 C2 link degradation and/or loss

a) What are the procedures in case of C2 link degradation?

b) How is the status of the C2 link displayed to the operator?

c) What are the conditions to trigger the C2 link loss procedure?

d) What are the measures in case of loss of the C2 link (lost link)?

## 5.2 Safety features

Describe the emergency recovery capability to prevent third party risk (incoming air traffic or people entering the ground control area). This typically consists of:

a) A flight termination system (FTS), procedure or function that aims to immediately end the flight, or,

b) An Automatic Recovery System (ARS) that is implemented through UAS crew command or by the on-board systems. This may include automatic preprogramed course of action to reach a predefined and unpopulated forced landing area.