

ANNEX B – Control Station Handover Process

1 Scope

This annex describes the concept of operations (ConOps) for the handover of control of a UAS in-flight from one ground station to another. The document includes considerations for simple operations such as VLOS operations in Category A and Category B where pilots executing the handover are participating in the same operation concurrently. The ICAO RPASP is developing handover procedures and considerations to address more complex international IFR operations, including BVLOS and transfer of control between pilots employed by different companies. A control station (CS) is a series of components used to control and manage the flight and operations of a UAS. It may include flight-control mechanisms, radio links, operational displays, and alerting systems.

2 Assumptions

The following assumptions are made in the ConOps described below.

- 1) All control stations used in the operation will have installed and operational all equipment required to conduct the operation;
- 2) All control stations used in the operation will be compatible with the UA(s) used in the operation;
- 3) The design and manufacture of Control Stations will be commensurate with the risk of the operation;
- 4) The designer and/or manufacturer has specified technical procedures for the handover of a Control Station;
- 5) All operational personnel will have completed required training for their respective role in the operation; and
- 6) The operation has been planned according to its relative risk and will be executed using well developed procedures and processes which have considered designer and/or manufacturer specified operational handover requirements/recommendations as well as the operational environment.

Note 1: This document does not address more complex operations and considerations for BVLOS operations, including international IFR operations. These considerations include: a) handover between pilots employed by different companies, b) handover with degraded or inoperative RPAS equipment, c) considerations for changing operational conditions (weather, airfield status, routing, etc.), d) transfer of operational control information to ATM and other authorities, and other considerations that the ICAO RPASP is addressing.

2.1 Categorization

Operations are to be categorized as described by JARUS in Doc-09: JARUS UAS Operational Categorization as one of Category A, B, or C depending on the risk level of the operation. It is expected a control station will be present regardless the category of operation.

Category A: In general the risk assessment and procedures have been developed by the authority and codified in operational regulations for Category A. In developing these regulations, consideration of UAS limitations operating in this category should be taken into account when

defining when and where handovers may occur to assure that the operation remains within the Category A risk envelope.

Category B: Procedures will be defined by the operator in adherence with SORA OSOs with consideration of designer(s)/manufacturer(s) specified procedures.

Category C: Procedures will be defined by the operator(s) based on the certified handover requirements developed by the designer(s), applicable ICAO SARPs and guidance and requirements approved by the certifying authority. The control station(s) used must be listed on the Type Certificate Data Sheet of the certified UAS.

Note 2: For complex operations (i.e. BVLOS operations in Category B and Category C, please refer to the handover procedures and guidance provided by ICAO. These ICAO standards and guidance will address more complex considerations such as changing control between operators during flight, transferring control of RPAS with degraded or inoperative systems, informing ATM and airspace authorities and coordinating changes in standard or contingency flight routing.

2.2 Type of Control Stations

A control station may take many forms from a hand-held radio-controller with the pilot providing positive control of the UA control surfaces to a fully immersive cockpit simulations with high levels of automated control and oversight. A control station may be operated from any location (e.g. ground station, other aircraft) though the location at which the control station is placed should be aligned with the type and scope of operation.

2.3 Airspace

As operations may occur within any airspace (depending on operation type) a control station should be equipped with the capabilities required to operate the UA within the operational airspaces defined in the ConOps (e.g. Air Traffic Control communications equipment, Detect and Avoid equipment).

2.4 Operations

The operational requirements for control stations will be commensurate with the risk posed by the particular operation including a degraded or inoperative system (A, B, or C).

3 Concept of Operations for Control Station Handovers

As part of the development of the ConOps for a particular operation, the operator must identify both geographic and temporal requirements for control station handovers (e.g. where and when a handover will take place). It is expected that handovers will generally occur as a planned event to enable continuous operation of a UAS, though it is recognized that emergency situations may develop during an operation which would require an unplanned handover. Whether the handover is planned or not (emergency), it should be prepared.

As part of the planning process, the operator will have developed both standard and emergency operational procedures for executing the handover process. The procedures should consider at minimum:

- Installation and serviceability of the control stations;
- Operational limitations of the UAS;

- Work-loads of operational personnel during phases of flight;
- Operational limitations;
- Coordination with airspace users and air traffic controllers, as applicable; and
- Operational contingencies in the event of failures.

The general concept of operation for handovers, involving Category A and simple Category B operations follows a simple progression:

- 0) Proceed to handover briefing;
- 1) Establish communications between the current Pilot-in-Command of the UAS and the new Pilot-in-command of the UAS;
- 2) Establish communications between the new Pilot-in-Command and other involved actors (e.g. Visual Observers, ATM or UTM if required for the operation)
- 3) Transfer control of the aircraft from the current Pilot-in-Command to the new Pilot-in-Command per designer/manufacturer technical instructions and operator standard procedures (e.g. checklists); and
- 4) Confirm the new Pilot-in-Command has control of the UAS and is operational.

For complex operations, each portion of this procedure may have multiple phases to account for changing operational conditions and the operational needs of operators, ATC, and other authorities. ICAO SARPs and guidance for handovers should be used for these more complex operations, including international IFR operations.

4 Additional Considerations

Design of the C2 Link: As part of developing technical procedures for control station handover (see Assumption 4 above), the designer/manufacturer needs to take into account the design of the C2 Link systems (e.g. “make-before-break”, “break-before-make”) and their potential failure modes in order to ensure an orderly handover.

UAS System Configuration: UAS may have multiple configurations with respect to the logical separation of system functions (e.g. UA Owner Operator, CS as a Service, C2 Link as a Service) which need to be considered when developing the procedures (see Assumption 6 above) to support the handover of control.