Accommodation Validation Plan for MALE type RPAS IFR operation in General Air Traffic (airspace class A-C)

CONSOLIDATION OF SCENARIOS
SAFETY CASE ANALYSIS
DEMO/TEST FLIGHT CONCEPT OF OPERATIONS

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Document History

Issue	Date	Reason For Change
01	04/10/2021	Initial Delivery
02	24/11/2021	Taking into account the remarks and comments made by the EDA and the SCG members

This validation plan, first deliverable of the study is the result of the consolidation of the scenarios studied during the previous phase of the study, which have been refined to take into account the progress of regulatory work underway in the various organizations, and in particular the documents recently published by the EDA and EASA.

It complements the safety study and accurately describes the mission scenario, which will be performed during the demonstration flight, the aspects that will actually be observed/evaluated and what can be expected from the flight.

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1. INTRODUCTION

1.1. Document Purpose

This study takes place in a suite of works initiated by EDA in response to Member States' willingness to make progresses toward the integration of MALE type RPAS in non-segregated Airspace.

In 2018, EDA ordered a study entitled « accommodation of large RPAS scenarios and safety case ». A report published in February 2019, defined standard scenarios and associated tailored risk assessment (safety case) of this kind of operation. Some real time simulations were used to validate the safety cases. The result was an enhanced aviation safety case assessment methodology for RPAS, helping to cover, through various scenarios stemming from the generic one, relevant threats and aviation hazard analysis, which may occur when accommodating a RPAS MALE into the European airspace, alongside manned aviation.

Following the presentation of those simulations result, during an EDA SES Military Aviation Board (ESMAB) policy meeting in January 2019, France offered the possibility to perform a real flight, including a cross border portion.

France's offer aims at facilitating the validation of the methodology defined by the initial accommodation study, and testing use cases developed in the "Guidelines for the Accommodation of Military IFR MALE-type RPAS under GAT Airspace classes A-C".

This MALE-type RPAS accommodation validation study aims at performing real test/ demo Flight in order to validate scenarios for MALE RPAS accommodation during a portion of their flight performed in non-segregated airspace.

The approach adopted for this study consists, after taking into account the results of the previous study, in refining the scenarios, then completing the safety case analysis, taking into account in particular, with regard to the air-to-air risk, the impact of the introduction of male drones in nominal operation as well as the air-to-ground risk.

One of the challenges is to identify the points that can actually be validated through the test/demo flights during the portions of the mission performed in non-segregated Airspace, following GAT IFR. The procedures to be applied in the event of deteriorating operating conditions, adverse weather condition or failure will be studied, analysed and submitted for approval to the civil aviation supervisory authorities, but cannot really be tested during these flights.

It should be noted that this experimentation takes into account the specificities of the organisation of air traffic management in France and Spain, which may or may not be extended to other member states. Some variations may nationally be applied if, for example, military-civil coordination is organized in a different way.

The document is organized into Five sections the content of which is described below:

- Section 1 introduces the study and its place in the whole set of work related to RPAS operation conducted by EDA, as well as the activities related to RPAS operation carried out by international bodies.
- Section 2 reminds a set of concepts and definitions, particularly those used in the previous study and the agreed safety case assessment methodology.
- Section 3 reminds the agreed safety case methodology and provides refinements and complements.
- Section 4 describes the real flights to be performed with their generic elements which are constitutive of accommodation scenarios :
    - A template for a generic CONOPS
    - The refined scenario for the test/demo flights
    - the expected outcomes of the flight tests
    - the methods and processes used to collect and analyse the data (reporting methodology)

- Section 5 lists the texts and documents, all the work done is based on.
- Finally, the annexes provide terminology and definitions, MQ9 descriptions, and the concept of operation, which has been developed by French and Spanish, civil and military ANSP authorities.

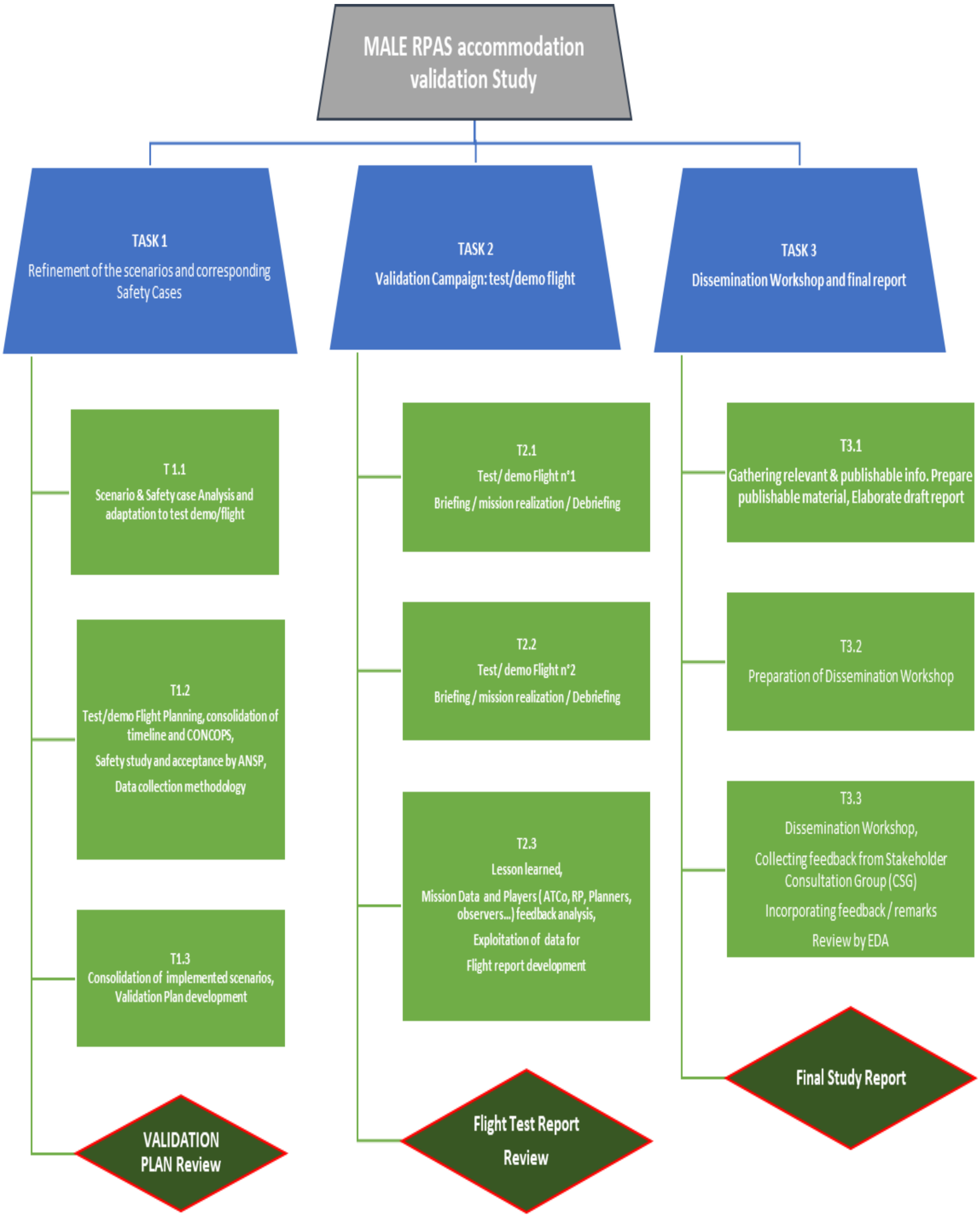

Fig. 1: Work Breakdown Structure of the MALE RPAS accommodation validation study

1.2. Background information

Military MALE RPAS are operational and used in operations since decades. Until now, this operational asset was a scarce capacity, mainly used by European forces in overseas operations. Today, this capacity is getting a growing importance and the projections for the near future show that there will be a growing demand from the European states for accommodating MALE type aircraft within the European sky. The European fleets will comprise legacy systems (Reapers, Heron TP, Watchkeepers,…) as well as new comers (Euromale,…) In the meantime, civilian sector is closely looking at the developments of this new activity and could, in the coming years, develop an industrial base to support the associated capacity.

ICAO

The growing importance of unmanned air vehicles is not confined to military operators. ICAO is taking on board the questions raised by the introduction of those new capacities and has proposed a phased approach to manage in an orderly worldwide manner this evolution. It is of high importance that the changes are done coherently with other technical and organizational developments, affecting manned aviation.

In that spirit, European stakeholders have decided to adopt the pace proposed by ICAO. This pace is reflected in the Blocks scheme 1.as described as follow:

- **Block1 [2019-2024]:** RPAS Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace. Implementation of basic procedures for operating RPA in non-segregated airspace including detect and avoid.
- **Block2 [2025- 2030] :** RPAS RPA Integration into Traffic
    - Implements refined operational procedures that cover lost link (including a unique squawk code for lost C2 link) as well as enhanced detect and avoid technology.
- **Block3 [> 2031 -…]:** RPAS RPA Transparent Management
    - RPA operate on the aerodrome surface and in non-segregated airspace just like any other aircraft. Dependent on ACAS-TCAS resolution

European Union

In Europe, many stakeholders have also taken up this subject. Expected development of the ICAO Aviation System Block Upgrades (ASBU) is implemented in Europe through the SESAR[2] programme. This Program is a joint initiative funded by the EU, which involves EASA, Eurocontrol and Industry and aims at improving ATM performance by modernising and harmonising systems through the definition, development, validation and deployment of innovative technological and operational solutions.

In 2003, EUROCONTROL in its manual for airspace planning[3] already mentioned the specificities of Unmanned newcomers in the European airspace of which an extract is quoted below:

" *2.6.1 General Requirements*

2.6.1.1 Test and Acceptance Flights for both civil and military purposes require special handling, but represent a relatively small airspace user community. The use of Uninhabited Aerial Vehicles (UAVs), formerly developed for military operations and recreation (model flying), has recently been extended to various civil aerial applications as a more cost effective solution than the use of conventional aircraft or helicopters.

2.6.1.2 No uniform regulatory framework for UAVs exists today, but it could be assumed that the Test Flights & UAVs community seeks mainly:

- *accommodation of their operations, based on shared use of airspace, with sometimes a need for special handling, rather than on strict segregation;*
- *possibility of operating in the "Upper" Airspace;*
- *definition of standards for additional equipment capabilities so that UAVs can be designed to achieve compatibility with the airspace they are expected to operate in."*

[1] Source: ICAO 9854 Global Air Traffic Management Operational Concept

[2] Single European Sky ATM Research

[3] Ref: EUROCONTROL MANUAL FOR AIRSPACE PLANNING COMMON GUIDELINES (issue 2003); § 2.6 TEST FLIGHTS & UAV OPERATIONS REQUIREMENTS

Those assumptions are still valid, and a regulatory framework partially exists today for Unmanned Air Vehicles.

JARUS works

JARUS[4], is a group of experts gathering regulatory expertise from all around the world and includes, at present, 61 countries, as well as the European Aviation Safety Agency (EASA) and EUROCONTROL. Resulting from its work, EASA issued a series of recommendations related to RPAS operations[5].

"The proposed regulatory framework is operation-centric, proportionate, risk- and performance-based, and establishes three categories of unmanned aircraft (UA) operations as follows:

- ***'open'*** *(low risk) is a UAS operation category that, considering the risks involved, does not require a prior authorisation by the competent authority before the operation takes place;*
- ***'specific'*** *(medium risk) is a UAS operation category that, considering the risks involved, requires an authorisation by the competent authority before the operation takes place and takes into account the mitigation measures identified in an operational risk assessment, except for certain standard scenarios where a declaration by the operator is sufficient;*
- ***'certified'*** *(high risk) is a UAS operation category that, considering the risks involved, requires the certification of the UAS, a licensed remote pilot and an operator approved by the competent authority, in order to ensure an appropriate level of safety.*

"

Each of these categories has its own characteristics on which safety case analysis and the resulting regulations are based. Military MALE-Type RPAS should fall into the third category (certified), for which regulations have not yet been developed but EASA is currently working on it.

Recently in November 2019, EDA and EASA have published a document entitled "ACCOMMODATION OF MILITARY IFR MALE TYPE RPAS UNDER GAT AIRSPACE CLASSES A-C" that provides agreed guidelines recommended to all member states, which intent to facilitate the accommodation of their military MALE-type RPAS into GAT.

1.3. Context of the Study and its place in the Follow-up of previous work

Everyone agrees on the need for a full integration of MALE-Type RPAS in ATM following GAT rules. However, this will require the development of new equipment and technologies that have not reached maturity and Member States have expressed their willingness to endeavour a stepping approach for Accommodation of RPAS, until full integration can be achieved.

One of the objectives of this study is to harmonise at European level the provisions aimed at facilitating the Accommodation of MALE-Type RPAS into non-segregated airspace in ATM and to determine the measures and limits to be implemented so that the safety of both other airspace users and overflown populations is not compromised.

One main development, which influences our study, is the adoption of a holistic approach of safety, described in the Safety Reference Material (SRM) [6] methodology developed by EUROCONTROL, within SESAR program.

Recently, EU Commission[7] laid down common requirements for providers of air traffic management/air navigation services and for other air traffic management network functions and their oversight. It also defined, in its Part-ATS, specific requirements for providers of air traffic services and especially requirements for safety risk management when a significant change occurs. Introduction of MALE RPAS in non-segregated airspace must be considered as a significant change. This justifies the necessity of carrying out a Safety risk study.

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[4] Joint Authorities for rulemaking on Unmanned Systems

[5] EASA Rule making task RMT 02-30 « Regulatory framework to accommodate unmanned aircraft systems in the European aviation system » (2018)

[6] SESAR Safety Reference Material

[7] Ref: COMMISSION IMPLEMENTING REGULATION (EU) 2017/373, dated 1 March 2017

Recent EU Commission implementing regulation[8] has formally defined categories for UAS operations and associated performing conditions quoted bellow:

"

- ***a)*** *UAS operations in the "open" category shall not be subject to any prior operational authorisation, nor to an operational declaration by the UAS operator before the operation takes place;*
- ***b)*** *UAS operations in the "specific" category shall require an operational authorisation issued by the competent authority pursuant to Article 12 or an authorisation received in accordance with Article 16, or, under circumstances defined in Article 5(5), a declaration to be made by a UAS operator;*
- ***c)*** *UAS operations in the "certified" category shall require the certification of the UAS pursuant to Delegated Regulation (EU) 2019/945 and the certification of the operator and, where applicable, the licensing of the remote pilot.*

"

Military MALE-type RPAS, the subject of this study, should eventually fall in category (c). However, until the regulations on category (c) have been developed and approved, they could be considered as certified under specific conditions that entail defined operational limitations.

The same Commission Implementing regulation further describes the above mentioned « specific » category which should « cover other types of operations presenting a higher risk and for which a thorough risk assessment should be conducted to indicate which requirements are necessary to keep the operation safe. ». For the present "accommodation validation study", specified scenarios and associated safety case study will be developed with the intent of bringing evidence that the flights are performed with a sufficient level of safety.

The related EU Implementing Regulation (EU) 2017/373 of 1st March 2017 lays down common requirement for providers of air traffic management/ air navigation services and other traffic management network functions and their oversight..

EASA recent works

In spring 2021, EASA has issued a document of interest:

Terms of reference for Rule Making Task RMT.0230

"Introduction of a regulatory framework for the operation of unmanned aircraft systems and for urban air mobility in the European Union aviation system" ISSUE 3 — 22.4.2021

This document addresses a different category of UASs which are not MALE RPAS and are operated in the low layers of Airspace. It does not therefore apply to MALE RPAS, the subject of our study. However, the approach and methodology chosen to cover all the aspects of the problem and reference to standard scenarios, in particular, , are interesting for the continuation of our study.

*« To simplify the authorisation process for operations in the 'specific' category, two standard scenarios were developed and adopted in the form of an Appendix to Regulation (EU) 2019/947. More standard scenarios may be developed in the future based on requests from MSs. In addition, EASA developed several predefined risk assessments (PDRAs) in the form of AMC to the above regulation. Also in this case, more scenarios may be developed in the future at the request of MSs. Standard scenarios and PDRAs are covered by RMT.0729 and RMT.0730 respectively, except for the first PDRA that was included in Annex I to ED Decision 2019/021/*R *(RMT.0230). »*

[8] Ref: COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019

NATO

Our Study focuses on accommodating military RPAS into non-segregated airspaces under GAT (controlled by civilian ANSPs). To a certain extend, NATO and associated manpower can be considered as both a source of inspiration as well as a strong dissemination tool.

Through it's RPAS Readiness Initiative, R2I NATO has the ambition to develop an enduring strategy to promote acceptance and operational effectiveness of NATO remotely piloted aircraft systems by delivering harmonisation, standardisation readiness and coherence.

RPAS from NATO Class III (above 600kg) constitute the immediate priority and scope for R2i and includes the requirement for civil military co-ordination. Last but not least, NATO intends to promote acceptance of military RPAS operations by nations through supporting engagement between military and civilian regulatory agencies at State level, in accordance with the principles and procedures established by ICAO, and through a supporting programme of education, outreach and technical support.

Clarification of the use of the terms "accommodation"

It is appropriate here to return to the notion of "accommodation", which corresponds to a transitory phase perfectly defined by ICAO as "the condition when an RPAS can operate along with some level of adaptation or support that compensates for its inability to comply within existing operational constructs".

Bringing additional precision, European RPAS steering group, mandated by European Commission mentions in its roadmap:

"*'Accommodation' means limited RPAS access to non-segregated airspace via special procedures and mitigations. These include permits to fly, restricted airworthiness certification processes and the use of airspace to segregate RPAS operations from manned operations. Such operations are considered on a case-by case basis to ensure that today's non-standardized RPAS performance and operational features do not adversely affect safety or efficiency. As RPAS research, rulemaking, and policy developments enable an increase in integrated operations, the need for accommodation will decline significantly*."

It should be noted that MALE-type RPAS are already regularly operated within the European Union Airspace in segregated areas. This means that we are not developing a new concept from scratch, but rather verifying that through accommodation process, existing MALEs can fly routinely in non-segregated airspace in safe conditions. To this end, it is highly recommended to follow a holistic approach, which encompasses normal condition of operations as well as abnormal and faulty conditions.

We therefore propose to take up the methodology developed in the previous study and to complement it with a safety case analysis covering the "normal conditions" MALE-type RPAS operations and related impacts on ATM. We shall then endeavour establishing links with SRM[9], using Implementation scenarios, developed from an original Generic MALE RPAS Accommodation scenario.

1.4. Rationale, Scope and objectives of the study

Until now, MALE RPAS have been flying in segregated airspace but it is of a growing evidence that transit portions of the flights poses problems both for military and civil ANSPs as well as for remote crews.

Segregation limits FUAS[10] and increases the weight of necessary coordination. Furthermore, flying in segregated areas (corridors) presents a number of disadvantages, including the lack of flexibility in the conduct of the flight, which can even have negative consequences on flight safety.

As a first step, common agreed and safe scenarios could be developed, taking into account only the En-Route phase of a mission performed by a RPAS. The take-off and landing phases of the flight, occurring in military facilities can

[9] SESAR Safety Reference Material
[10] FUAS : Flexible Use of Airspace

be set apart at that stage, waiting, among others issues, technical and regulatory progresses. The portion of flight covered by the study is represented in blue in the figure below.

To facilitate validation, it has been decided to carry out a comprehensive experimentation, with a transnational use of the asset, though a mission including a cross-border flight. The operational mission portion of the flight, being in a segregated Airspace, is excluded.

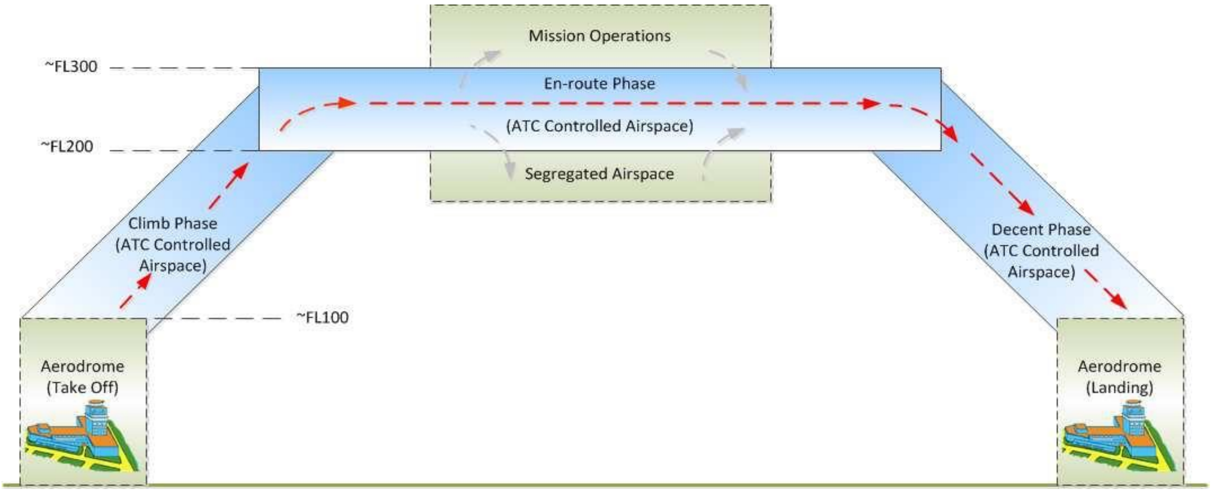


Fig 2: Scope of the study

The objectives of this study are to observe and evaluate, as far as possible, how the introduction of a MALE-Type RPAS in General Air Traffic under IFR will affect ATM during a live flight.

The study will focus on specific part of the flight, such as "hand-over" between ACC while the RPA switch from one sector to another, adherence to the flight plan, reaction and compliance with clearances and ATCOs instructions. Abnormal as well as faulty conditions shall be considered and covered by specific routine with contingency and emergency procedures developed and assessed during the preparation of the flight.

Special circumstances, which laid down delays in our study.

In conducting this study, we faced several challenges:

1) COVID 19 - health crisis
2) Evolution of the EU regulation for safety studies related to experiment (EU) 2017/373)
3) Different perception between the two Member states involved in the experiment regarding coordination between civil and military organizations for air traffic management. This lack of harmonization at the EU level finally proved to be the main difficulty to overcome.

COVID crisis was not the major constraint that we faced. Of course, such a major event may force to adapt the working processes, but the modern communication systems allow a flexibility without mobility.

This study is based on experience and observations of the civil and military appropriation of the accommodation measures. At the same time, regulations are evolving rapidly, forcing nations to integrate new regulatory elements into their practices. Thus, Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 lays down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight. This new regulation affects the way of carrying out safety study and all the processes and associated documentation, when introducing new operations.

In addition, the Spanish partners encountered difficulties in meeting the study prerequisites regarding the objective of operating a MALE RPAS in non-segregated Airspace under GAT.

Each country has its specific characteristics in the way it manages the airspace. There is not, within Europe, yet a unified landscape in the civil-military coordination and prerogatives. This entailed significant delays when dealing with a cross border experimental flight as required in our study.

In the meantime, some EU Member States are in the process of acquiring RPAS at different levels of technological development. Taking into account the evolution of the regulation in accordance with those technical improvement, these upgraded versions of RPAS, implement Detect And Avoid systems.

However, it seems more than advisable to set some common accommodation rules for operating legacy and recent RPAS, which will fly for decades if we consider the rhythm of renewal applicable to military assets.

Finally yet importantly, if all Member States agree with the interest of operating their MALE UAS in non-segregated airspace, not all of them give the same level of prioritization to this project.

All the above elements caused some delays in dealing with the preparation of these demonstration/experimental flights.

In this regards an agreement on a principle does not mean an agreement on a prioritization. This study will bring a concrete element to motivate a necessary sense of solidarity among EU MSs and give to the accommodation process the adequate priority.

We also observed that the longest part of the work to reach an agreement on the concepts of operation is the necessary confidence building among national actors and changes in the regulations to characterize it.

As long as there is no unified European landscape on civil-military relationships for airspace management, we can expect to always encounter this type of difficulty for the realization of cross-border MALE RPAS experimentation.

2. CONCEPTS, DEFINITIONS, REMINDER ON THE SAFETY CASE ASSESSMENT METHODOLOGY

The following section contains a reminder of the main concepts and definitions, as well as a description of the safety case assessment methodology developed and used in the previous study.

2.1. Overview

For achieving the analysis, the previous study developed a holistic Air System Safety Case assessment, identifying three "functional pillars" that interact with the "new operation", which consist of "operating a MALE RPAS in non-segregated Airspace": ATM, Equipment and Organisation. The goal of the "Air System Safety Case" is to assess the "*Claim*" that it will be safe to fly a MALE-Type RPAS within the context of the implementation scenario. This *"Claim"* is supported through a risk analysis using the Bow Tie Methodology. The introduction of a new Air System into the ATM may be considered as presenting a potential danger.

The Bow Tie method introduces the concepts of "Hazard", "Top Event", "Threats" and "Consequences".

In the Bow-Tie Method, the term "Hazard" refers to the activity whose associated risk, which,, if left unaddressed, can potentially present a hazard by triggering an unwanted event.

For the present study, the "Hazard" can be summarized by: "Flying MALE RPAS in non-segregated Airspace in GAT" ant the "Claim" is that, thanks to the associated accommodation measures taken to mitigate the risk, this activity is safe. The claim is "Fying a MALE RPAS in non-segregated airspace in GAT is safe subject to appropriate accommodation measures."

Each identified "Hazard", is presented in a yellow hatched black rectangle and characterised by one or more 'Top Level Events" (TLE), presented in red & orange circles in Figure 3 below.

A TLE may be caused by one or more "Threats" (blue rectangle) placed on the left of the graph. When a TLE occurs, it may lead to one or more "Consequences" (red rectangle) placed on the right of the graph. Thus, the relationships of a TLE are identified by reading the graph from left to right. A single TLE can have several causes and several consequences.

Each "Threat" may be prevented by putting a "preventive barrier" placed between the Threat and the TLE. Each "Consequence" may be mitigated by putting "recovery Barriers" (grey and white vertical rectangles) placed between the TLE and the Consequences.

Threat barriers may also be dependent upon some other action or threat also known as an "Escalation Factor" that are shown in yellow rectangles on the diagram. Similarly, each mitigation barrier may lead to a further "Escalation Factor" or Consequence and these are shown in the vertical yellow rectangles below.

Threats were identified across all three pillars of the Accommodation Safety case: Equipment (something might malfunction); Organisation (someone might make an error while operating the Aircraft or during a maintenance operation on the system) and ATM (an ATCo might expect unrealistic behaviour or performance characteristic from an RPA if not properly aware or briefed).

The illustration bellow summarizes the Bowtie methodology:

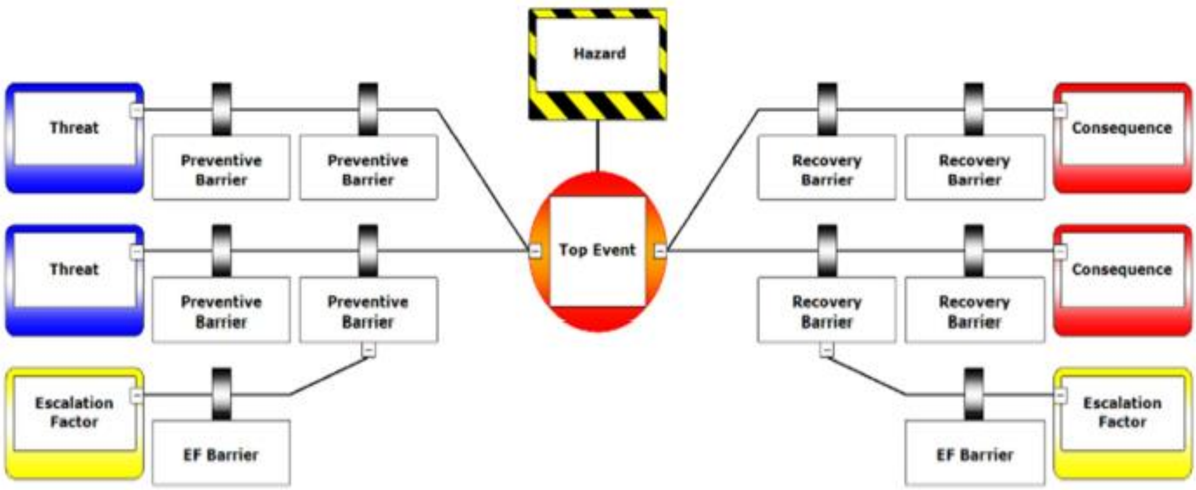


Figure 3 - Bow Tie

2.2. Detailed Risk Assessment

The BOW Tie methodology intends to provide Arguments and Evidences that support the "Claim". The Bow Tie Diagrams include threats that could cause the Top Level Event (TLE) to occur, which in turn may lead to a Hazard. Similarly, identified barriers (or controls) serve to mitigate and protect against the threats, which could result in an increased Risk to Life (RtL). Consequences are also identified to understand the level of RtL, which could result from the Hazard "flying MALE RPAS in non-segregated Airspace under GAT".

The Bow Ties are then analysed using a semi-quantitative analysis approach whereby Layers of Protection Analysis (LOPA) techniques are used for analysing and assessing Barriers & Controls. LOPA uses an order of magnitude approach to evaluate the adequacy of existing or proposed layers of protection against known hazards.

The previous study addresses MALE-Type RPAS accommodation into European skies and considers the RtL associated with the following "unwanted events" that require accommodation measure for mitigating these risks:

- ***Airborne Risk to Life:***
  - Loss of separation with other airspace users leading to mid-air collision, this includes cleared airspace boundary proximity violation.

- ***Ground Risk to Life:***
    - Equipment failure leading to uncontrolled descent into terrain
    - Equipment failure leading to falling debris
    - Mid-air collision (as above)

It was assumed that the RP manoeuvres his RPA through remote command and control (C2), following instructions received from an ATCO, leading to the following assumptions:

- ATC detects and vectors all aircraft in controlled airspace (non-permissive Airspace class only);
- RPA operations will require a "person in-the-loop" to ensure "appropriate" avoidance manoeuvres are authorised and implemented taking into account emergent rules of the air and other considerations such as weather, airspace structures and proximate traffic. Work continues to develop "appropriate" manoeuvres for RPAS in a similar manner to extant TCAS standards that exist for manned aviation; however, it is essential that a harmonised approach is agreed.
- DAA[11] was not included in the team SIRENS simulations as it is considered that, for accommodation of few RPAS into controlled airspace, the ATM organisation Standard Operating Procedures (SOP's) are capable of providing appropriate separation assurance with manned aircraft. However, to facilitate progression from accommodation of few RPAS to full integration of multiple RPAS in controlled airspace, the introduction of a certified and capable DAA system will be necessary.

2.3. Threats and Barriers identified by the previous study

Further Threats analysis conducted in the previous study led to identifying one or more possible actions to mitigate the consequences of these threats for the Top Level Events. The Threats and associated mitigation measures led to elements that were included in the simulations, hence in the Implementation Scenarios.

All identified events were considered and analysed but only a few were actually simulated:

- Loss of communication between the remote crew and ATC
- Link Loss
- Loss of separation between the RPAS and other Traffic

These simulated events will not be played during flights, but will be considered and related procedures, established on risk reduction measures, are developed in the CONOPS and will be applicable whenever necessary

The other events were not simulated, either because the consequence analysis had already been validated by a previous study, or because it was outside the scope of the study (e. g. conflict trajectory with the RPAS, due to non-compliance with control instructions by another manned aircraft)

Thus, thanks to the use of the Bow Tie methodology, the team SIRENS identified a number of events, each individually associated with a set of "threats" (causes) and "consequences" and their mitigation.

The previous study focused mainly on degraded and failures modes, which is logical because the simulation allows to test these risky scenarios and to evaluate, to a certain extent, the level of risk as well as the effectiveness of the measures.

[11] DAA: Detect and Avoid

3. APPROACH FOR THE ACCOMMODATION VALIDATION THROUGH THE LIVE DEMO FLIGHT.

3.1. COMPATIBILITY OF THIS STUDY WITH THE E-OCVM PROCESSES

The current MALE-type RPAS accommodation study is in line with the principles of the European Operational Concept Validation Methodology (e-OCVM).

Through the implementation of experimentations, we can consider reaching a level, equivalent to the V3 status, taking into account the particularity that the RPAS system is already routinely operated in segregated airspace. We can observe that we are indeed in the state described in the paragraph 8.4.1 "Integration and Validation of Operational Concept" quoted below:

"The operational concept is integrated into the target system and validated using realistic scenarios. Its interaction with all related concepts is analysed"

Here, the accommodation scenarios are tested in real live flight to bring evidence of feasibility of an accommodation for MALE RPAS in non-segregated airspace, in full respect for safety.

The list of planned deliverables is consistent with the recommendations:

- The annex III contains a detailed operational concept and the associated operational procedures for accommodating the MQ-9 in GAT
- The framework for a generic CONOPS template, covering the main issues to be addressed and adjustable to other types of MALE is proposed in section 4 of the present document.
- The final report of study will serve as a validation report.

DGA, has carried out the qualification and the certification process based on the standards in force for manned aircraft. This means that the following steps were completed:

- Assessment of logistical system architecture (Supply chain)
- Assessment of a technical system architecture (Maintenance plan, qualification of personnel, Configuration Management, Airworthiness….)
- Assessment of interoperability with some accommodation specifications

Subsequently, DGA, the French technical authority for State Aircraft, has issued a type certificate to the Reaper, the Holder of which is the Manufacturer General Atomic[12]. This UA, which was to be used mainly in theatres of operation, was not originally designed according to safety standards similar to those of civil military aviation.

Therefore, the Reaper type certificate provides for flight restrictions to avoid mid-air collisions (flight in segregated airspace) and depending on the density of population areas, with the duration of flight over dense areas being limited in time.

However, these overflight restrictions do apply to the Reaper when it is used for pilot training or education in the French sky. However, the employment authority (CEMA or CEMAA) may derogate from these restrictions to meet operational needs when required, such as threats on sensitive sites on national territory.

The transition phase is characterized by the scenario and associated accommodation processes.

The present study aims at validating this transition phase and, precisely, propose mitigation measures to overcome, under specific conditions, the restriction on flight in segregated airspace only. It includes a risk assessment, and

[12] REAPER type certificate: https://www.defense.gouv.fr/content/download/483267/7739057/file/20190923_NP_DGA-IP-ASA_liste_CT_drones.pdf

points out the possible benefits to the military and the civil airspace users, when operating MALE-RPAS in non-segregated airspace.

3.2. The Holistic approach in safety case analysis for MALE-RPAS accommodation

The team analysed the safety case from the previous study and noted, as did some experts in the field of General Air Traffic Safety, that only abnormal and faulty situations were considered (incident/accident, adverse weather conditions, failure of a critical subsystem, loss of C2 link, etc.).

However, the objective of this work is precisely to demonstrate that the safety of people and environment remains properly ensured, despite the differences observed between the requirements to be met by a manned aircraft to operate in general air traffic in a given class of airspace and the current capacity of the MALE-type RPAS newly inserted in GAT.

The aim is therefore to identify the safety impact that the insertion of an unmanned aerial vehicle can have when the system is operating at in normal condition and, when this impact is considered too high, to propose measures to reduce the risk to an acceptable level.

Abnormal situations and degraded modes (failure cases) are then examined following the same approach as illustrated by the figure below.

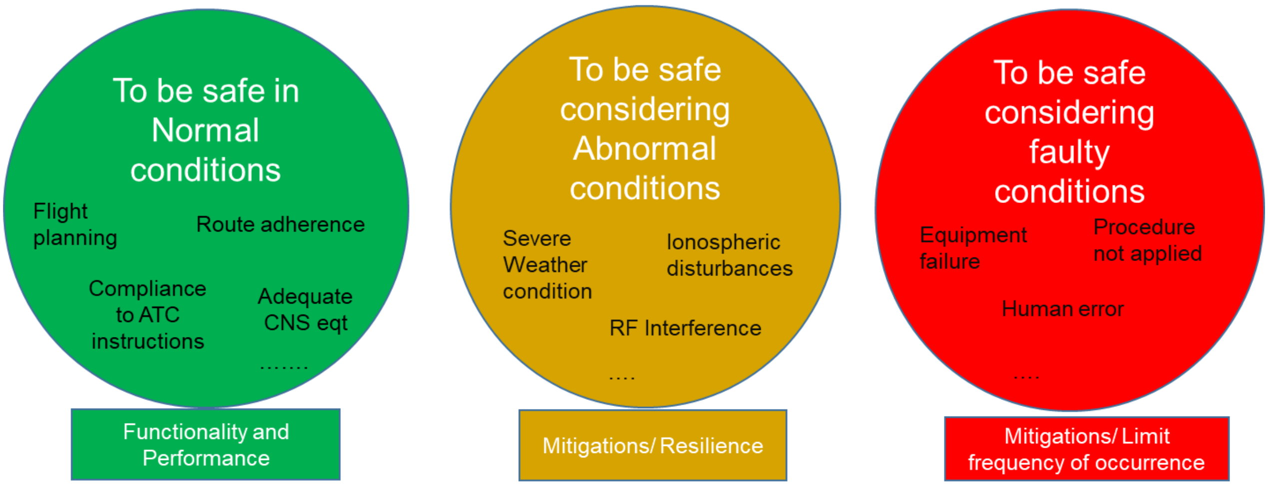


Fig 3: Excerpt from a EUROCONTROL presentation

DCI team then proceeded to an in-depth analysis of all the safety cases, the related "Top Level events" and their impacts on safety as discussed in the previous study, , in order to classify them according to two categories of criteria.

1) Conditions of operations:
    a. Normal conditions
    b. Abnormal/ degraded conditions
    c. Faulty conditions
2) Event category: Which area is impacted by these "new operations", depending on the nature of the event and its cause.
    a. Aircraft (A/C)
    b. Flight operations
    c. Aerodrome
    d. Airspace and Procedure design
    e. Air Information System (AIS)
    f. Air Traffic Flow Management (ATFCM)
    g. Air Traffic Services (ATS)
    h. CNS (Communications, Navigation, Surveillance)
    i. Weather conditions, forecast and observed (MET)

Moreover, for obvious safety reasons, it is not possible in live tests/demo flights accommodating an actual MALE-type RPAS in GAT alongside manned aircraft carrying hundreds of passengers, to simulate systems failures nor trigger abnormal conditions.

Nevertheless, these cases must be considered in the CONOPS and appropriate procedures must be developed and adequately reviewed and assessed in terms of feasibility and effectiveness (Contingency procedures).

The flights will only allow the assessment of the impact of the insertion of a vehicle with characteristics that could generate an additional workload on air traffic management and would potentially degrade safety.

By applying this approach to the case of MALE UA operations in non-segregated airspace according to the general air traffic rules, we distinguish three cases:

- flight in nominal conditions
- flight in abnormal conditions
- flight in faulted conditions

The table below shows the cases on which we have investigated a potential impact on the different layers of safety (strategic, tactical, collision avoidance), event categories/impact and operating conditions (normal, degraded, faulty).

	NORMAL	ABNORMAL	FAULTED
METEO	- Strategic - Tactical - Collision avoidance	- Tactical - Collision avoidance	- Tactical - Collision avoidance
CNS	- Strategic - Tactical - Collision avoidance	- Tactical - Collision avoidance	- Tactical - Collision avoidance

	NORMAL	ABNORMAL	FAULTED
ATS	- Strategic - Tactical - Collision avoidance	- Tactical - Collision avoidance	- Tactical - Collision avoidance
ATFCM	- Strategic	- Tactical - Collision avoidance	- Tactical - Collision avoidance
AIS	No impact for accommodation	No impact for accommodation	No impact for accommodation
AIRSPACE AND PROC. DESIGN	No impact for accommodation considering the Scope of the Study	No impact for accommodation considering the Scope of the Study	No impact for accommodation considering the Scope of the Study
AERODROME	Out of scope	Out of scope	Out of scope
Flight operations	- Strategic - Tactical - Collision avoidance	- Tactical - Collision avoidance	- Tactical - Collision avoidance
RPA	- Strategic - Tactical - Collision avoidance	- Tactical - Collision avoidance	- Tactical - Collision avoidance

Of course, for the present study, this approach should only cover the domain at stake, namely the IFR transit phase in non-segregated airspace. Ideally, the introduction of this new type of operation should have no impact on air traffic management and therefore on safety. Nevertheless, due to the particularities and performances of the RPAS system, it induces differences on flight plan adherence and compliance to ATCos instructions that will have an impact on air traffic management, which will require accommodation measures to reduce the induced level of risk.

It is also important to note that due to its specific nature, some positive complementary measures may offset or mitigate these impacts (Internet access, possibility to establish a fixed telephone line inside the Remote Cockpit...).

3.3. Analysis of the previous study and findings

In following paragraphs, we list what emerges from the safety case analysis of the previous study. The findings are as follow and detailed in the next sections:

- A Specific safety case must be developed to cover the "New ATM operation" in normal conditions with a new "Hazard": "Flying MALE-type RPAS in GAT alongside Manned Aviation". This "normal condition safety case is developed in section 3.3.1
- Section 3.3.2 provides comments and proposal on refinement on some safety cases:
  - The case of an IFF failure was not considered as a TLE but only as a "threat". Failure of IFF is not specific to the MALE RPAS, but its consequences are likely to be more difficult to manage, both for the remote crew and for the air traffic controller
  - The TLE 001 "Loss of separation with ground" (during emergency recovery) can be amended by adding new barriers that can actually reduce the risk level.

3.3.1. Impact of the "new operation" in normal conditions

To analyse the impact of the introduction of a new type of operation, we take as a basis for comparison, the performances and required capabilities of a single-turbine, manned aircraft of less than 5.7 tons certified for IFR flight.

For each of the event categories (MET, CNS …) defined above, we sum up here the analysis of the impact on Air Traffic Management due to the introduction of MALE-type RPAS, considered as a new type of operation, and its potential consequences on safety/level of risk.

- The first column of the table below gives the Event Category.
- In the Second column, we identify/ analyse the gaps between an equivalent manned aircraft and a MALE-type RPAS.
- The last column describes the proposed measures to reduce the risk to an acceptable level (ALARP[13]) considering the specific case of the MQ-9 REAPER.

Event category	Gaps Drone / equivalent Manned A/C and potential impact on ATM	Application to the case of MQ-9 and Measures to mitigate risk for the demo/test flight
METEO	No significant changes compared to manned aviation but more restrictive weather conditions and long duration flight, which implies increased vigilance of the crew: Weather forecast and observation to be monitored before the flight and regularly updated during the flight. Review and analysis of weather forecast and compliance with the condition set out in the flight manual.	Increase vigilance on weather conditions encountered during the mission enabled by accessing official MET website providing aeronautical MET information (observations & forecast) regularly refreshed and covering the entire area of interest. During the mission execution, this MET information enables the Remote Crew to anticipate change request on FL and/or route for avoiding unacceptable adverse weather condition. Should the appropriate weather condition not be met temporarily for landing on the home base, (Recovery proc.) the MQ-9 can eventually loiter until these conditions are met. This possibility must be taken into account in mission preparation, in particular for the calculation of the quantity of fuel on-board and the range in the area of operations.
CNS	***<u>Communications :</u>*** If two VHF radio available on board, no discrepancy. If the RPA is not equipped with two VHF radio sets, a direct telephone line must be available to each ATCos work position involved during the flight for enabling	This version of the MQ-9 is equipped with a single V/UFH radio set. Therefore: Any control position involved must be equipped with a direct tel. Line. Telephone numbers must be known by all parties and programmed (strategic layer).

[13] ALA
RP : as low as reasonably practicable

Event category	Gaps Drone / equivalent Manned A/C and potential impact on ATM	Application to the case of MQ-9 and Measures to mitigate risk for the demo/test flight
CNS	backup communication between the Crew and the ATCos (Loss of "party-line" when using this degraded mode of communication).	The tel. line should be systematically tested before the flight and, with the "winning" ATCo before each handover when switching to another ACC (tactical layer).
	Navigation : Navigation performance (in accordance with the requirements of the airspace used) Automatic landing capability (or not).	MQ-9 is equipped with 3 independent hybrid Navigation system. Performances are compliant. The lack of automatic landing capability in BRLOS[14] mode prevents any diversion: The MQ-9 must return to its departure aerodrome or reach an alternate equipped with a GCS[15] that allows control in RLOS[16] for recovery. Plan the possibility of a return to the home base, in degraded conditions (MET, loss of the SATCOM link, radio failure, IFF failure...). During the flight, the programmed "Emergency route" is permanently updated, to allow bringing the MQ-9 back within RLOS range of the GCS. (Consistent with the CONOPS).
	Surveillance : Transponder mode C, mode S... Presence or not of an equipment performing "detect-and-avoid" functionality	The MQ-9 is equipped with a transponder with mode C, which comply with strategic and tactical ATM requirements but do not fulfil collision avoidance requirement. The MQ-9 is cooperative: It can generate Traffic Alert and RA[17] manoeuvres on conflicting A/C if equipped with a TCAS system. The MQ-9 itself will not be alerted nor execute TCAS RA manoeuvres.

[14] Radio Beyond Line of Sight
[15] Ground Control Station, the ground assets that include the remote cockpit and allow the remote crew to control the RPA.
[16] Radio Line of Sight
[17] Resolution Advisory

<table>
<tr><th>Event category</th><th>Gaps Drone / equivalent Manned A/C and potential impact on ATM</th><th>Application to the case of MQ-9 and Measures to mitigate risk for the demo/test flight</th></tr>
<tr><td>ATS</td><td><u>Strategic Layer: flight plan</u>

The mission duration can be particularly long (up to more than 24 hours); air speed lower than most aircraft using the same airspace, circular navigation (return to the aerodrome of departure).

A mixed OAT/GAT flight plan may be used for such operation

<u>Tactical layer:</u>

The controller, in his control position, must be able to easily identify the presence of a UA and know its associated characteristics (communication latency, horizontal and vertical speed performance, specific behaviour and procedures in the event of a failure or in degraded conditions.

<u>Collision avoidance:</u> If no DAA functionalities, access restricted to controlled classes of Airspace.</td><td>All these characteristics can generate difficulties in the processing of flight plans, or even require manual processing. Special care must be taken when filing flight plans and planning the mission. A preliminary test shall be performed to check if the ATM Information System can properly handle the planned route.

The MQ-9 Reaper , as any current RPAS system, has no DAA capability. It should be noted that, as far as manned aircraft are concerned, the obligation to carry an ACAS/TCAS system is only compulsory for aircraft over 5.7 tons that can carry 19 passengers

Thus access of MALE-type UA is restricted to controlled airspace classes, where all aircraft are known and in radio-contact with ATC (Class A to C).</td></tr>
<tr><td>ATFCM</td><td>The performance of the MALE type UA may lead to integration difficulties depending on the traffic density in the related control sectors. (Flight slots).</td><td>The performances of the MQ-9 has been inserted into the French ATM system. They are comparable to that of a turboprop aircraft (i.e. C-160 Transall, ATR...).

However, to take into account flow management, flights are scheduled to avoid periods of heavy traffic (i.e. holidays periods)</td></tr>
</table>

Event category	Gaps Drone / equivalent Manned A/C and potential impact on ATM	Application to the case of MQ-9 and Measures to mitigate risk for the demo/test flight
AIS	Until the presence of UAs flying in GAT has become routine, it may be necessary to inform other users of the possible presence of a MALE UA in the airspace being frequented.	Since the route planned for the demo/test flights are the published airways and GAT, IFR rules will applied. Given the performances (horizontal velocity and vertical velocity), that differs little from that of a manned single turboprop aircraft, it is assumed that MQ-9 will be capable to adhere to flight plan and RP will be able to comply with ATC instruction. It was therefore not considered necessary to develop an AIP[18]
AIRSPACE AND PROC. DESIGN	No impact for accommodation	One of the objectives of the validation demo/test flight is to check that integrating RPAS in GAT doesn't require specific changes in Airspace & Procedure design
AERODROME	Out of scope	Out of scope
Flight operations	The aircraft's dependence on the SATCOM link introduces particularities (communication latency) and vulnerabilities (some manoeuvres may lead to a temporary loss of the link).	This is precisely one of the purposes of the demo/ test flights: – To observe the effect of these particularities on ATM for assessing the ability of ATCos to handle this "new operation" and estimating its impact on flight safety (both for other Airspace users and overflown population and ground assets).
RPAS	**SATCOM link criticality:** In BRLOS mode, a single SATCOM link. Encompasses ATC communications, Telemetry Command and Control, and Payload exploitation (Full motion Video). This introduces specific vulnerabilities of RPAS to EM interferences whether intentional or unintentional. In particular, solar activity forecast must be taken into	The MQ-9 will initially continue its route in accordance with the flight plan, while attempts are made to recover the link. If this recovery procedure failed, the drone follows the flight plan and after a predetermined time switches to the programmed emergency route to bring it back to the Home base, to regain optical range of

[18] Aeronautical Information Publication

Event category	Gaps Drone / equivalent Manned A/C and potential impact on ATM	Application to the case of MQ-9 and Measures to mitigate risk for the demo/test flight
RPAS	account while planning the mission, as well as weather forecast. ***Link loss in BRLOS.*** This brings us back to the case of a Radio failure. The MALE UA would automatically squawk the planned A7600 code. It will continue its flight according to a predetermined trajectory (therefore predictable for the controller) and ATC remain informed of the position thanks to SSR. The possibility of a diversion is only possible if the UA is equipped with an automatic landing function.	the GCS and switch from BRLOS to RLOS mode. The situation is quite similar to manned aviation. The pilot would proceed according to the flight plan and clearances. The ATC would ensure anti-collision by giving avoidance instructions to other users. The Reaper has no Autoland capabilities. No possibility of diverting the flight to an alternate airfield.
	Loss of Power The pilot has all the engine parameters information in the cabin that he can monitor in exactly the same way as manned aviation. It also has the same controls (throttle, variable pitch control of the propeller...) If necessary, it may initiate a procedure to restart the turbine in flight	If the attempts of re-ignition in flight fail, the batteries have sufficient reserve to maintain control of the MQ-9 for 120 min. and direct it to an uninhabited area, pre-determined for an emergency landing (flight termination area). As in Glider Flying, the RP must update the position of a possible crash zone throughout the flight, through the programmed "emergency route", which is updated during the execution of the mission and provided to ATC.

We note that for achieving this analysis, it is necessary to choose a category of manned aircraft whose characteristics (size, mass and performance...) are quite comparable to that of the MALE UA considered.

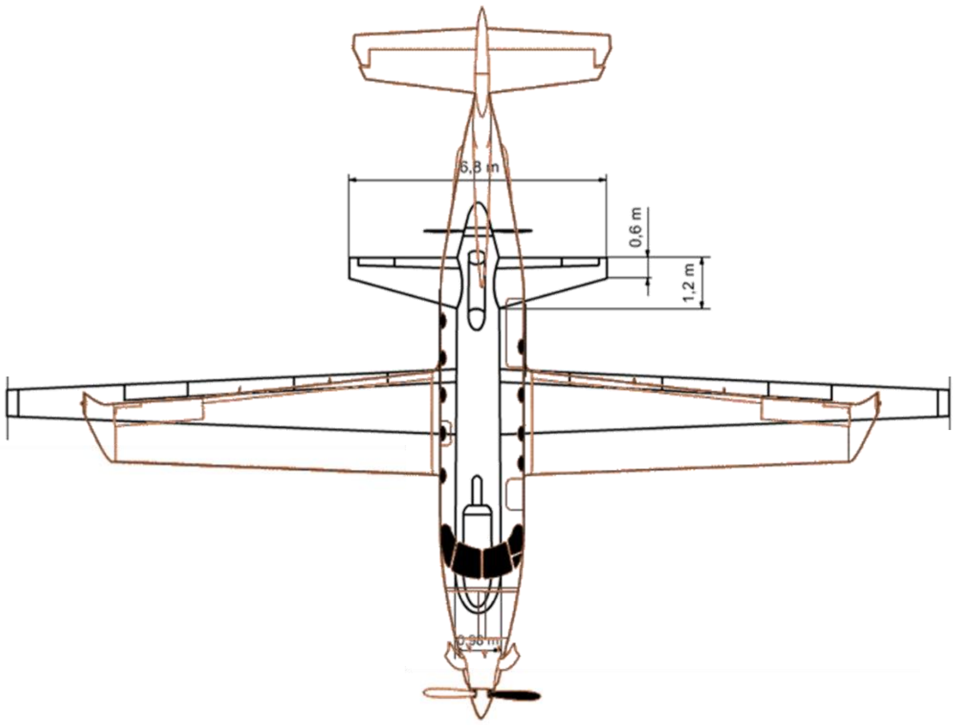


Fig 4: comparison between a MQ-9 Reaper and a Pilatus PC-12

Thus, if we considered comparing the MQ-9 to a single-turbine aircraft of less than 5.7 tonnes, other smaller MALE-type RPAS, such as the Watchkeeper or the Patroller, powered by a turbo-compressed piston engine, should rather be compared to a smaller and lighter manned general aviation aircraft (type Cessna 172. or Piper Malibu...).

Some MALE-type RPAS may have performances and capabilities which greatly differ from those of other aircraft using the same class of airspace. In that case, it could lead to an additional workload for ATCos and therefore could need implementation of additional mitigation measures.

Thus, if the method of analysis is generic, a specific analysis should be carried out for each MALE-type RPAS taking into account its actual characteristics.

3.3.2. Impact of Abnormal and faulty conditions

TLE 001- Loss of Separation with Ground (during Emergency Recovery)

The TLE 001 "Loss of separation with ground (during emergency recovery) can be amended by adding a line THT 001-7: Engine failing (Icing) and four barriers METEO, dealing with "weather condition forecast and observation" during mission preparation (pre-flight), and during mission execution. In both cases, the Remote Crew, thanks to available GCS secured Internet connection can easily get a refreshed outlook on weather condition (forecast and observation) covering the entire flight path from official governmental websites.

TLE 006- C2 Link Loss (A 7600)

Link loss will inevitably induce loss of communications. In that case, the UA will automatically squawk A-7600 and pursue the flight plan initially according to flight plan and after a predetermined time, switch to the programmed emergency route whose updates are systematically shared with ATC: predictable behaviour.

The loss of communication between ATC and RP can also be caused by other abnormal situation (on board equipment failure, error in frequency setting…etc.). In these cases, the RPAS remains controllable by the RP and the communication between Remote Crew and ATC can be recovered by using a direct telephone line.

But using the phone, instead of the radio, no longer allows other users to benefit from the communication network effect called "party-line", where all aircraft can listen to all verbal exchanges with the control centre while only one pilot can speak with the controller at any given moment. This does not allow the crews to monitor all the messages exchanged and so to collect more information about the traffic situation and to update their mental representation, which is a degraded /abnormal situation that should be addressed.

IFF issues (failure, squawk error…)

The IFF failure was not considered as a TLE in the previous study. However, following discussion with ATCos, and considering that, for the accommodation phase, MALE's operations in non-segregated Airspace will be restricted to Airspace Classes where all air traffic is known and controlled, the IFF failure is considered as a critical failure (Faulty conditions) requiring the implementation of an emergency procedure specific to RPAS. The failure of the IFF is a critical failure, like the manned aircraft, but its consequences can be more difficult to manage for the air traffic controller who no longer sees the mobile on his scope.

This event cannot be simulated in test/demo flight, but must be considered while elaborating the CONOPS. Although it cannot be validated during an actual IFR GAC flight (too risky for other users), this procedure must be the subject of a safety study, reviewed and approved by the supervisory authority.

3.3.3. Proposed refined scenario that cope with the scope of the studied flight profile

It should be further noted that the take-off, initial climb, initial approach and landing phases are not covered by this study and that, for planned flights, these phases will be carried out in segregated airspace, under the responsibility of aerodrome control The scenario played for the demo/ test flight will only cover the case "normal condition".

The portion of the flight which is of interest for us is the one that begins with a transfer between military and civilian control centres at the limit of segregated airspace, then climb to cruise level, then the cruise phase, in class A to C airspace.

The flight profile will includes several transfers between civilian control centres, as well as the initial descent before handover back from a Civilian ACC to a Military ACC in segregated airspace for landing.

We will also have to manage a transition from GAT to OAT, during the non-segregated part, for carrying out the operational part of the mission that will be achieved in a segregated airspace, under military control. And then another transition to resume the navigation under GAT when the operational mission is completed.

It is therefore appropriate to revise the bowties accordingly to exclude elements that are not relevant to this study.

4. SCOPE OF THE EXPERIMENT (TEST/DEMO FLIGHT)

The accommodation scenarios implemented are described in detail in a CONOPS document developed and shared with all the parties involved in carrying out the demo/ test flights.

Each CONOPS, at least during the accommodation phase, must take into account the specific characteristics of the MALE-type RPAS (performances, equipment).

Nevertheless, we propose in the following paragraph, a generic template for elaborating a CONOPS adapted to other types of RPAS; heavier with better capabilities, like the future EuroMale.

This document, among other critical information should provide a detailed description of the mission, which is the scenario that will be played. Such CONOPS should be shared between all involved parties and approved by their supervisory authorities prior implementation.

4.1. Template for a generic CONOPS

4.1.1. References:

- Generic scenario reference
- Evidence of the safety case study including certification references.
- LOA between the states concerned when cross border flight and Agreement between civil ANSP and military ANSP...

4.1.2. Context:

We are currently in the "accommodation" phase, which implies the need to follow a specific approach before each mission, in order to ensure operational and safety aspects related to the type of drone are covered appropriately: to be safe in normal conditions, abnormal conditions and faulty conditions.

4.1.3. Objectives of the document:

For first flights of a given type of machine, a description of the flight objectives allows all operators, civilian and military, to fully understand the key elements of the flight. In particular, we must find the operational procedures (covering nominal modes). I.e.: check the telephone line, contact the position before transferring from one sector to another...)

4.1.4. Operational procedures:

This section describes planned route and trajectories, with a specific focus on cross sectors and cross border elements and handover procedures. There is an interest in this part to make a clear link with the emergency procedures and the associated decision points.

Some special attention has to be paid and described for:

- Required qualification for the remote pilot
- the flight plans management;
- the AIP management;
- the coordination processes , especially telephone lines if any;
- the radio frequencies, especially for the first experimental flights;
- Some specific rules to be applied for the drone and which need to be stressed (spacing rules, IFF code…)
- For each specific phase of the flight, hand over procedures should be described.
- METEO: due to the sensitivity to weather conditions, a specific paragraph should describe the associated limitations. Minimum weather conditions.

4.1.5. Degraded modes:

A paragraph will detail the main degraded modes and in coherence with the safety case, we should find all the TLE that are identified. Some supplementary paragraphs can be added if deemed necessary.

- Radio failure
- Management of an unexpected trajectory of the UA
- Loss of the UA command link (Loss of C2 Link: LoL)
- UA engine failure
- UA GPS failure
- UA Electric failure
- UA IFF failure

4.1.6. Specific recommendations

This paragraph should provide a description of the specific measures implemented for preparing and executing the flight.

i.e.: specific training prior the flight or information to be provided, presence during an experimental flight, etc…

4.1.7. Annexes

ANNEX I : TELEPHONE NUMBERS

ANNEX II: PRESENTATION OF THE RPAS SYSTEM with a focus on the RPA performances

4.2. Description of scenario that will be "played" during the test flights

For the current validation study, we shall perform a real demo/test flight as described in the CONOPS provided in annex III. This section will focus on the main issues where significant effort should be brought to ensure a smooth integration of the drone in the non-segregated airspace.

We must keep in mind that until a Pan-European agreement has been reached on RPAS-MALE type operations in non-segregated airspace, planning cross-border operations, as any international cooperation issues, requires prior exchanges of information and agreements of all involved parties.

Although cooperation between the air forces of EU Member states is very active, resulting in many cross-border training missions, discussions between the ANSPs of the different participants may be difficult, due to radically different perception of the relationship between civilians and the military, regarding the use of airspace.

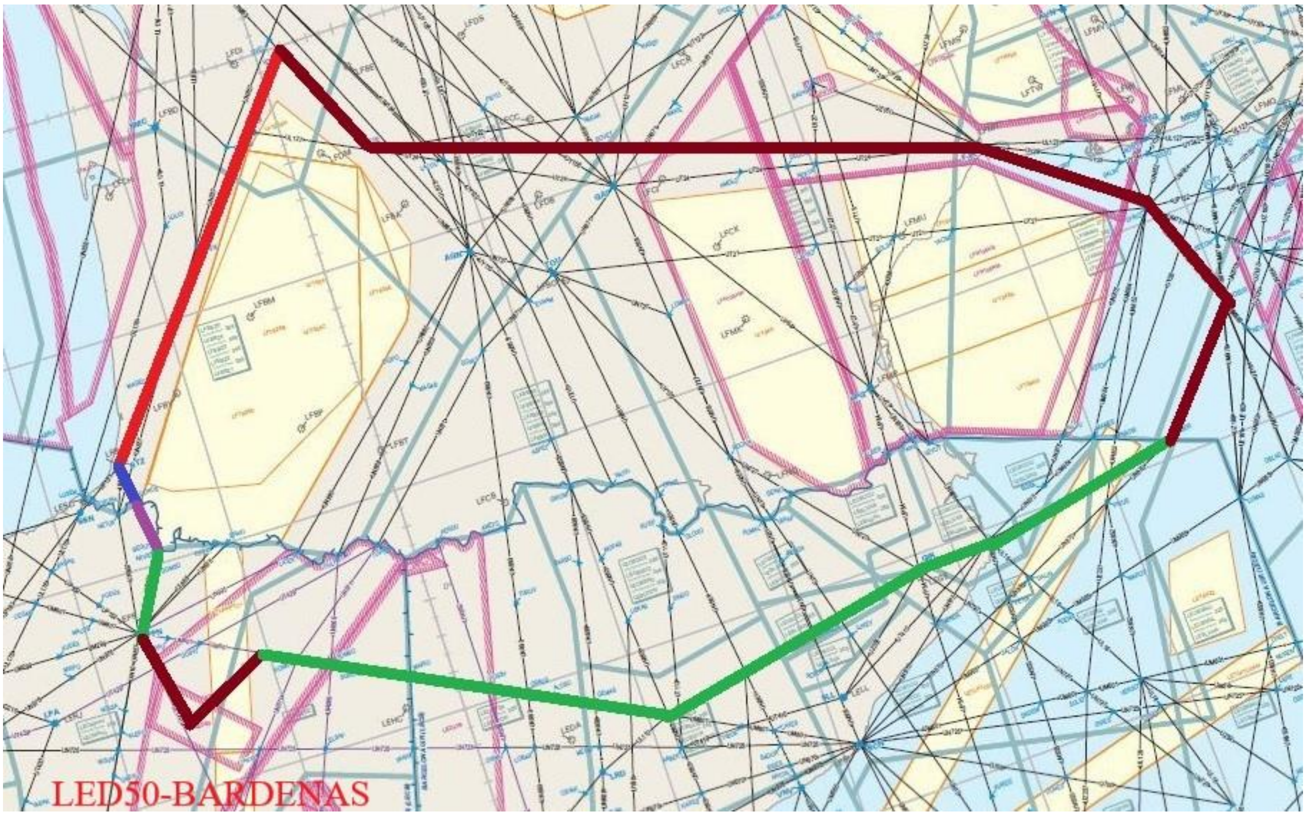
For the present study, the health crisis was part of the reason for delays in agreeing to the Concept of Operations, but this difference in perception of the relationship between civil and military control was an important cause of the delays. A compromise had to be reached: While the objective was to show the possibility of accommodating a MALE DRONE in general air traffic without having to create segregated areas (specific corridors), once in Spanish airspace, the drone will remain controlled by civilian controllers, but according to the operational traffic rules (OAT).

The planned demo/test flight will consist in carrying out a circular navigation as follows:

- Take-off from Cognac Air-base,
- climbing into the CTR and then transfer to the En-Route control centre (CRNA S/O),
- then transfer to the Spanish ACC,
- Transfer to the En-Route control centre (CRNA S/E) and return to Cognac Air-Base via the Mediterranean Sea..

This journey will involve several Flight level changes, and several transfer procedures from one control entity to another.

The diagram below illustrates the planned flight plan. The Annex III provides the detailed CONOPS of the planned flights.



From a more technical point of view, some important conditions for implementation that result from the application of the principles set out in the GENERIC CONOPS are as follows:

- Ensure that the conditions of the execution of the flight comply with the MQ-9 certification limitations.
- Take into account the population density of the overflown areas, prior determination of landing or crash areas....
- Put emphasis on the necessary detailed study of weather forecasts, solar activity and determination of flight slots, vigilance on short-term forecasts and observation during the flight (i.e. ensure that the MQ-9 can perform the mission with a special attention on the weather predictions for the whole flight)
- When necessary (in the case of a single radio on board): ensure availability of the fixed telephone line between the Remote Crew and the control positions of all the centres responsible for providing air traffic services.
    - Strategic layer : ensure that lines are in place and phone directories are appropriately shared and updated,
    - Tactical: check that lines are operative.
- File the flight plan and eventually perform a prior test with sufficient notice to allow the integration of the characteristics of the UA and the specificities of the mission, such as length and circular trip (strategic level of traffic flow management- impact on ATFCM).
- Estimate the need or not for issuing an AIP (to inform ATCos and other users of the presence of a drone…)

This list is not exhaustive and the analysis in the next phase will give more details on the content of the CONOPS and how it will be implemented for the actual demo/test flights.

4.3. Expected Outcomes and validation approach

For each event category (Aircraft, CNS, ATS... Environment), the impact on ATM of the identified MALE-RPAS capability gaps or specificities shall be evaluated and the effectiveness of the risk mitigation measures implemented be assessed.

After completing the flights, the aim is to evaluate the ability of such MALE-type RPAS to meet the essential safety criteria while flying in non-segregated Airspace (Class A to C), under normal conditions, namely:

1) flight plan adherence
2) Ability to comply/ follow Air Traffic Control instructions
3) Ability of ATCos to handle, alongside manned aviation, the specificities of a MALE-type RPAS (capabilities, performances, flight duration, increased sensitivity to adverse weather conditions, emergency procedures, contingency procedures…)

The annex V details the validation objectives and propose a criteria of success.

The main objective of the flights is to evaluate the acceptability of performing RPAS operations in GAT, with risk mitigation measures. Post flight analysis of observation data, in particular radio traffic at key moments of the mission (change of FL, reactions to the controller's instructions, etc.) collected during the flight will provide a more detailed assessment of acceptability.

4.4. Data collection and observation (reporting methodology)

4.4.1. Preamble

In the specific case of our study, in order to mitigate the consequences of the delay in dealing with border crossing issues, in May 2020, an experimental flight was conducted in French airspace by the French Air Force, controlled by civilians ATCO's in non-segregated airspace, both in lower and upper airspace and according to GAT rules, as required.

This flight contributed to validate the methods and observation tools for such a demonstration flight. It also provided concrete and useful elements for the present study.

4.4.2. Preparation phase

A summarised chronology of activities will be shared between all participants to provide key information about how the preparation phase was carried out and different steps of the elaboration of the CONOPS.

The CONOPS is the main reference document, which comes into force, once approved by all parties, military and civilian authorities and distributed to all participants.

Some other products, such as the flight plan, will be collected as well as context information for further analysis. Collecting and analysing data such as MET, Crew qualification, etc…, will allow estimating the environment quality. All documentation relevant to the purpose of the study will be gathered and shared with EDA, with permission of the owning authorities.

Most elements of this preparation phase are dealing with the strategic layer.

4.4.3. Mission execution

During the flights, which are performed in a real traffic environment, it will not be possible to « play » abnormal condition or emergency scenarios. The effort will focus on the main points of attention identified in the risk assessment "operation in normal conditions":

1) To make sure that a common understanding of the specificities of the MALE flight is developed, as described in the CONOPS;

2) To verify that all processes, materials, and sufficient knowledge are in place;
3) To check the capacity of the MALE drone to comply strictly with the expected flight plan.
4) To observe and report the differences that may occur in the management/handling of the MALE's flight and surrounding aircraft, if any.
5) To report, assess and compare results.
6) To assess contingency and emergency procedures (not played but briefed and discussed with all involved players).

For achieving this, observers will be posted during the flight in each civil ACC involved in the experimentation as well as in the remote cockpit, pending Pandemic situation and related sanitary limitation, mitigation measures will applied.

- To collect feedback from the participants (observers, ATCos, Crew…), a questionnaire will be distributed to them and briefed prior mission execution. In order to allow possible comparison with the results of the simulations phase, this questionnaire is directly inspired by the one used for the previous EDA study.
- Each observer will be provided with an observation grid to identify the key information required for further analysis.
    - Special attention will be brought on delays of reactions, compliance to the instructions given, and quality of the insertion of the MALE in GAT.
    - To complement the observations, replay access should be possible to the main elements of the flights, such as record of communications, visualisations, etc.

In addition, a hot debriefing gathering the observers and players feedback will follow each flight, pending Pandemic situation and related sanitary limitation, mitigation measures will applied.

This will be complemented by another debriefing based on the questionnaire, provided in annex, distributed to all actors.

5. LIST OF REFERENCES

#	Source organism	Title	Ref
1	EASA	European Plan for Aviation Safety (EPAS)	EASA RMP-EPAS 2017-2021
2	EASA	Introduction of a regulatory framework for the operation of drones	EASA NPA 2017-05
3	EDA	Service Contract for the provision of a study : "accommodation Validation" for MALE-Type RPAS operations	19.ISE.0P.159
4	EDA	MALE RPAS Accommodation Study- Task 1 Report- General Approach and Safety Assessment Method Definition	17.CPS.OP.017
5	EDA	MALE RPAS Accommodation Study- Task 2 - Simulation Readiness Report	17.CPS.OP.017
6	EDA	MALE RPAS Accommodation Study- D3-Simulation Campaign & Safety Case Assessment	17.CPS.OP.017
7	EDA	MALE RPAS Accommodation Study- Final Report	17.CPS.OP.017
8	EDA/EASA	Guidelines for the accommodation of military IFR MALE type RPAS under GAT Airspace classes A-C	Nov. 2019
9	EU Commission/ EUROCONTROL	E-OCVM Version 3.0	
10	EUROCONTROL	Specification for the use of Military Remotely Piloted Aircraft as Operational Air traffic outside segregated airspace	EUROCONTROL-SPEC-0102
11	ICAO	Remotely Piloted Aircraft System (RPAS) Concept of Operation (CONOPS) For International IFR Operations	March 2017
12	ICAO	Manual on Remotely Piloted Aircraft Systems (RPAS)	Doc 10019 AN/507
13	ICAO	Safety Management Manual (SMM)	Doc 9859 AN/474
14	ICAO	Global Air Traffic Management Operational Concept	Doc 9854 AN/458
15	ICAO	Procedure for Air Navigation Services- Air Traffic Management	Doc 4444
16	ICAO	Annex 10 - Aeronautical Telecommunications - Volume VI - Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link	July 2021
17	ICAO	Procedures for Air Navigation Services – Aircraft Operations	Doc 8173
18	JARUS	JARUS guidelines on Specific Operation Risk	JAR-DEL-WG6-D.04
19	NATO	STANAG 4671	
20	SESAR JU	Project CLAIRE Demonstration Report	Project RPAS.07
21	SESAR JU	SESAR Safety Reference Material (SRM)	D27/ edition 00.04.00
22	SESAR JU	European ATM Master Plan: Roadmap for the safe integration of drones into all classes of airspace	

ANNEXES

Annex I- Terminology and definitions

Acceptable risk	Acceptable risk defines the target risk for an ANSP as defined in their Risk Classification Scheme (RCS).Acceptable risk is more demanding than tolerable risk.
AIP	Aeronautical Information Publication. An AIP is defined by the International Civil Aviation Organization as a publication issued by or with the authority of a state and containing aeronautical information of a lasting character essential to air navigation.
AIS	Aeronautical Information Service
ANS Air Navigation Service(s)	Air traffic services; communication, navigation and surveillance services; meteorological services for air navigation and aeronautical information services.
ANSP	An "Air navigation service provider" (ANSP) shall be understood to include an organisation having applied for a certificate to provide such services.
Assumption	Statement, principle and/or premises offered without proof.
ALARP	As Low As Reasonably possible
AMC	Acceptable Mean of Compliance
ATC	Air Traffic Control / Controller
ATCO	Air Traffic Controller
ATI	Air Traffic Integration
ATFCM	Air Traffic Flow and Capacity Management
ATM	The aggregation of ground based (comprising variously ATS, ASM, and ATFM) and airborne functions required ensure the safe and efficient movement of aircraft during all appropriate phases of operations.
ATM functional system	ATM functional system' shall mean a combination of systems, procedures and human resources organised to perform a function within the context of ATM;
ATM System	ATM System is a part of ANS System composed of a Ground Based ATM component and an airborne ATM Component.
BLOS/BRBLO/BVLOS	Beyond Line of Sight / Beyond Radio Line of sight/ Beyond Visual Line of Sight
C2	Command and Control
CAE	Claim Argument Evidence
CLAIRE	Civil Airspace Integration of RPAS in EUROPE
CNS	Communication Navigation and Surveillance
DAA	Detect And Avoid

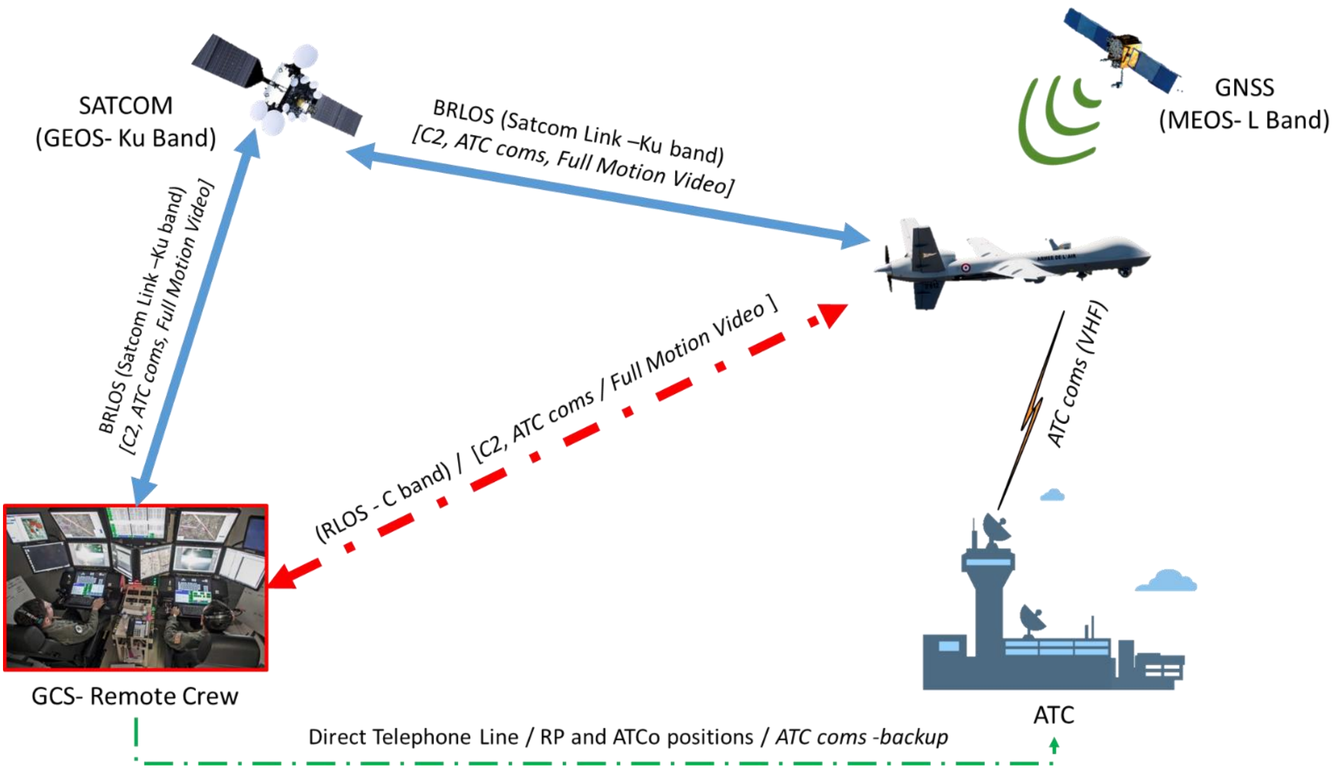
DGA	Direction Générale de l'Armement: General Directorate of Armament, The French Defense Procurement Agency which is responsible for acquisition of any military equipment
DGAC	Direction Générale de l'Aviation Civile: The French Civil Aviation Authority , attached to the Ministry of Transport
DIRCAM	Direction de la Circulation Aérienne Militaire: The French Military air Navigation service provider, attached to DSAé
DSAE	Direction de la Sécurité Aéronautiques de l'Etat : The State Aviation Safety Directorate, attached to the French Minister of the Armed Forces
DSNA	Direction des Services de la Navigation Aérienne : the French ANSP.
EASA	European Aviation Safety Agency
EATMP	EUROCONTROL's European Air Traffic Management Programme.
EC	European Commission
EDA	European Defense Agency
Environment of operations	The environment of operations consists of the physical and institutional characteristics of the airspace within which operations occur. The environment includes ATM services being provided, technologies used, airspace organisation, ambient conditions and people.
ESARR	EUROCONTROL Safety Regulatory Requirement
EU	European Union
EUROCAE	The European Organisation for Civil Aviation
FL	Flight Level: In aviation and aviation meteorology, flight level (FL) is an aircraft's altitude at standard air pressure, expressed in hundreds of feet. The air pressure is computed assuming an International Standard Atmosphere pressure of 1013.25 hPa (29.92 inHg) at sea level, and therefore is not necessarily the same as the aircraft's actual altitude, either above sea level or above ground level.
GCS	Ground Control Station The remote Cockpit./ Crew deck
Hazard	Any condition, event, or circumstance, which could induce an accident.
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules: Instrument flight rules (IFR) is one of two sets of regulations governing all aspects of civil aviation aircraft operations; the other is visual flight rules (VFR).

Incident	An occurrence, other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations.
ISR	Intelligence, Surveillance and Reconnaissance
JARUS	Joint Authorities for Rulemaking on Unmanned Systems.
LOPA	Layer Of Protection Analysis
LOS/RLOS	Line of Sight / Radio Line of Sight
MALE	Medium Altitude Long Endurance
Mitigation (or risk mitigation)	Steps taken to control or prevent a hazard from causing harm and reduce risk to a tolerable or acceptable level.
National Supervisory Authority (NSA)	The body or bodies nominated or established by EU Member States as their national authority pursuant to Article 4 of Regulation (EC) No. 549/2004.
Risk	The combination of the overall probability, or frequency of occurrence of a harmful effect induced by a hazard and the severity of that effect.
Risk Assessment	Assessment to establish that the achieved or perceived risk is acceptable or tolerable.
RP	Remote Pilot
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RtL	Risk to Life
Safety	Freedom from unacceptable risk.
Safety Assurance	All planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a system achieves acceptable or tolerable safety.
Safety Objective	Quantitative or qualitative statement that defines the maximum frequency or probability at which a hazard can be accepted to occur.
Safety Requirement	A risk mitigation means, defined from the risk mitigation strategy that achieves a particular safety objective. Safety requirements may take various forms, including organisational, operational, procedural, functional, performance, and interoperability requirements or environment characteristics.
SCG	Stakeholder Consultation Group
SERA	Standardized European Rules of Air
SESAR	Single European Sky ATM Research
Severity	Level of effect/consequences of hazards on the safety of operations, including the aircraft operations.

Severity Class	Gradation, ranging from 1 (most severe) to 5 (least severe), as an expression of the magnitude of the effects of hazards on operations, including the aircraft operations.
SQEP	Suitably Qualified & Experienced Personnel
SRM	SESAR Safety Reference Material
Target Level of Safety	A level of how far safety is to be pursued in a given context, assessed with reference to an acceptable or tolerable risk.
Tolerable risk	Tolerable risk defines the target risk for a National Regulator as defined in their Risk Classification Scheme (RCS).
UAS	Unmanned Aircraft System
UA	Unmanned Aircraft
Validation	Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. (ISO 8402)

Annex II - Male RPAS capabilities
Performances characteristics and Equipment

MQ-9 Reaper- System Overview:



The RLOS link is used only for Launch and Recovery of the UAV. During the Launch Phase, once the UA is airborne and check-list after take-off is completed, the Crew Switch on BRLOS and check that SATCOM link has the expected quality of service while it is still within optical range and it is possible to return on RLOS mode.

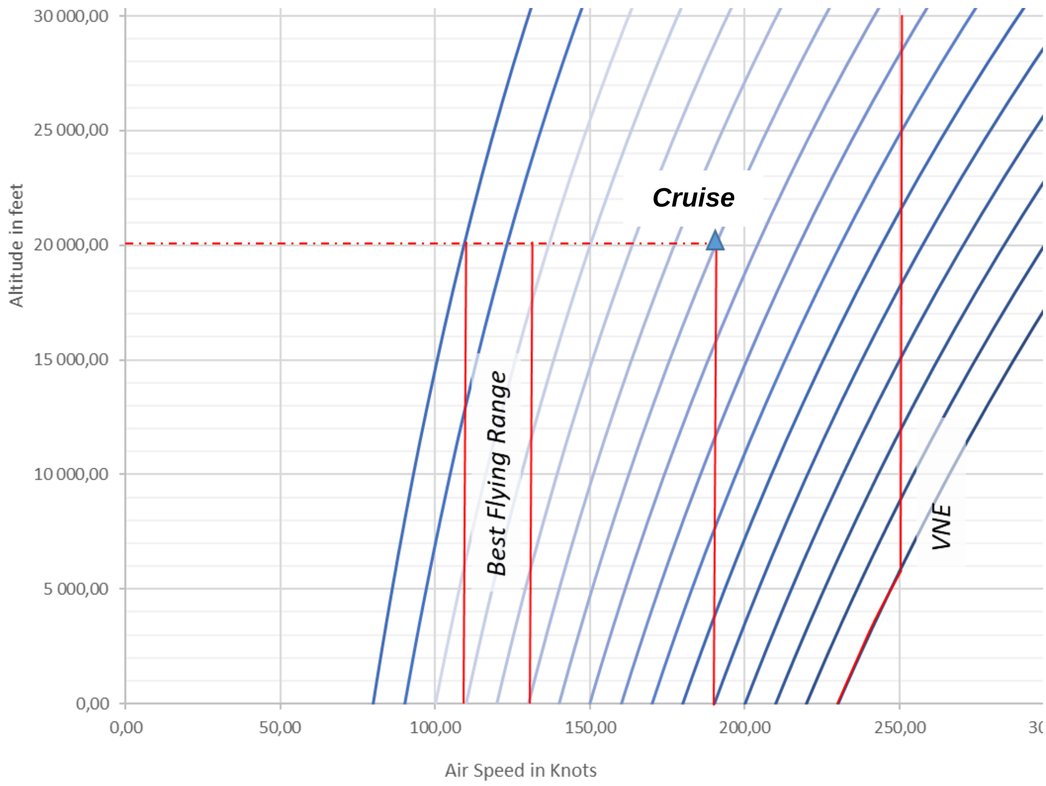
C2 Link Loss:

Should a C2 link Loss occur while the UA is airborne, It would first, continues according to the flight plan, then after a pre-determined period of time (determined in mission preparation), if attempts to re-establish the link fail, it adopts a pre-programmed and therefore predictable emergency route, both for the Remote crew and for the ATC. The IFF of the UA would initially switch automatically to A-7600 (coms failure). If the UA cannot reach the area where it is possible to regain control in RLOS for a safe landing, it then moves to a predetermined emergency landing/crash zone. In this case, the IFF would squawk the emergency code A-7700.

Its actual position reported to ATC through the Secondary Surveillance Radar (SSR).

Main characteristics:

Item	***Specifications***
Dimensions & Weight	- Wing Span: 20 m - Lengh: 11 m - hight: 3.56 m - Wing Surface 11.5 m2 - MZFW 2 220 kg - MTOW 4 540 kg
Crew	***Flight Deck (2):*** Left Position: Remote Pilote Right Seat: Sensor Operator The two positions have the same instrumentation and controls. The visualizations can be adjusted on demand. The positions are independent and interchangeable. ***Mission crew:*** Located in a separate cabin, but in connection with the crew screws the onboard telephone. The tactical coordinator has access to environmental information and can provide support when the situation requires it
Endurance	24 hours
Communication	1 On board VUHF radio set. The ATC coms are relayed by the Satcom link between the Remote Cockpit and the UA and, then, radiated by the UA between the UA and the ACC. 1 VUHF radio set in the Cockpit that is used to communicate with the Airport, Tower and Approach, during the Launch and RecoveryPhases. Telephone line (backup)
Navigation Equipment and Performances	- Three independent Hybrid GPS -Inertial Navigation System. A single GPS receiver - The performances are compliant to RNAV requirement and allow performing GNSS approach.
Surveillance	- IFF mode 1,2,3,4,C
Instrumentation	- Three independent air data systems (Pito probes with anti-icing). - Two independent Altimeters - Vertical Velocity, digital display on th HUD - HIS indication elaborated by the Air-data system - OAT probe and indication
Speed / velocity	- KIAS Climb: 100 to 120 kts - KIAS Descent: 100 to 160 kts (adjustable) - Vv climb(rate of climb) : 1200ft / mn (max) - Vv Decent (rate of descent): 500 to 2500 ft/ mn (adjustable)
Turn Rate (manouverablitiy)	- 14° max roll angle in automatic mode - 25° max roll angle in BLOS mode - 40° mas Roll angle in LOS mode

Item	*Specifications*
Speed / Velocities	

Annex III- Concept of operation

DIRECTION DES OPÉRATIONS
DÉPARTEMENT ESPACE

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE	MINISTÈRE DES ARMÉES
Direction des Services de la Navigation Aérienne Direction des Opérations N° 21/82 DO/DSNA	Direction de la Sécurité Aéronautique d'État Direction de la Circulation Aérienne Militaire N° 2842/ARM/DSAE/DIRCAM
GOBIERNO DE ESPAÑA MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA	**GOBIERNO DE ESPAÑA MINISTERIO DE DEFENSA**
Enaire	Ejército del Aire

Concept of operations of the experiment of UAV flight out of segregated airspace conducted between DSNA, ENAIRE, DIRCAM and the Spanish Air Force

Athis Mons, 09 septembre 2021 Le chef du Domaine « Espace » de la Direction des opérations de la DSNA Mr Vital BRIDE	Villacoublay, le 13 septembre 2021 Le Sous-directeur Espace aérien de la Direction de la Circulation aérienne militaire COL Christophe HINDERMANN Colonel Christophe HINDERMANN Sous-directeur Espace Aérien DSAE/DIRCAM
Madrid, 22 de septiembre 2021 ~~Director de Navegación Aérea de ENAIRE~~ Director de Operaciones de Enaire	Madrid, Jefe de la Sección de Espacio Aéreo del Estado Mayor del Ejército del Aire PEREZ CUARTERO ARTURO VICENTE |19096981N GOBIERNO DE ESPAÑA Firmado digitalmente por PEREZ CUARTERO ARTURO VICENTE |19096981N Nombre de reconocimiento (DN): c=ES, o=MINISTERIO DE DEFENSA, ou=PERSONAS, ou=CERTIFICADO ELECTRONICO DE EMPLEADO PUBLICO, serialNumber=IDCES-19096981N, sn=PEREZ CUARTERO |19096981N, givenName=ARTURO VICENTE, cn=PEREZ CUARTERO ARTURO VICENTE |19096981N Fecha: 2021.09.16 13:41:09 +02'00'

DIRECTION DES OPÉRATIONS
DÉPARTEMENT ESPACE

References:

1 Concept of operations for phase 3.1 of the segregated out-of-air space UAV flight experiment between DSNA and DIRCAM;

2 EPIS-CA DO-EC Experiment on the integration of a MALE UAV into controlled airspace outside segregated areas - Phase 3 (GLOB-006264 and GLOB-006904);

3 Instruction n°1550/DSAE/DIRCAM on guidelines and procedures for the execution of UAV flights in military air traffic in peacetime.

4. Real Decreto 601/2016, de 2 de diciembre, por el que se aprueba el Reglamento de la Circulación Aérea Operativa.

5. Normas del Jefe de Estado Mayor del Ejército del Aire, como Autoridad Aeronáutica Competente Militar, para la operación de Sistemas Aéreos No Tripulados (UAS) militares de febrero de 2021.

Context:

The French Air Navigation Services Directorate (DSNA), the French Military Air Traffic Management Directorate (DIRCAM) and the French Airforce created and commissioned the Working Group known as the « XP Drone Working Group».

The WG aims to identify and test the operational procedures in order to integrate a MALE type UAV into the civilian Air Traffic Control airspaces.

Thus, the national authorities will be provided with the accurate information to guide future developments in the national or European regulations on MALE UAV flights in order to enable the implementation of these operational solutions and therefore spare of both civil aviation and defense's interests.

In January 2017, three HARFANG UAV's flights were carried out as part of SESAR 2020 PJ 10-05, outside segregated airspace managed by Aquitaine approach in their airspaces.

A second phase involving two long-distance flights by a HARFANG UAV was conducted in November and December 2017. It enabled, by testing transfers between civilian and military control organizations, the possibility to control a MALE UAV at medium altitude (FL130 maximum) outside segregated airspace in order to carry out a defense mission in a dedicated area.

Then a third phase took place to further expand the concept and test flights with a REAPER UAV with superior characteristics to the HARFANG in ACC managed areas. Subsequently, a first stage was carried out between July and December 2018 in order to test the off-space segregated inclusion of the REAPER by the South-West ACC (Bordeaux) and/or the Limoges approach (depending on the cruise Flight Level). The flights were carried out in the context of missions requiring reaching areas LF-R34 or LF-R68 from Cognac airport.

By starting the third phase we intend to show it's possible to carry out long range flights. After completing a flight with a transfer between two French ACCs during the step 1 of this phase, the aim of the step 2 is to study the compliance and the transfers between several ACCs in France and in Spain and operational steps.

Objective :

The specific objectives of the experimental phase 3.3 step 2 are to extend the concept studied in the previous phases, namely the further study of operational procedures for UAV control by one ACC to UAV control by several ACCs (French and Spanish) as well as the ACC/ACC and ACC/Defense Organization transfer procedures.

The objectives are as it follows:

- Fly a MALE REAPER UAV in class C and D airspace at least controlled by the en-route air navigation centers of Bordeaux (South-West), Madrid, Barcelona, Marseille and finally Bordeaux again. Indeed, the absence of a "Detect and avoid" system on board the REAPER UAV requires maintaining the UAV in airspace in which the control bodies know all the traffic (class C or D airspace) and are able to act on it.

- Carry out multiple transfers of control between civilian and military control agencies:
  - Cognac Approach <-> Bordeaux ACC
  - Bordeaux ACC <-> Madrid ACC
  - Madrid ACC <-> Military ATS unit (Zaragoza TACC)
  - Military ATS unit (Zaragoza TACC) <-> Military tactical air control unit (GRUNOMAC / GRUCEMAC)
  - GRUNOMAC / GRUCEMAC <-> Military ATS unit (Zaragoza TACC)
  - Military ATS unit (Zaragoza TACC) <-> Madrid ACC
  - Madrid ACC <->Barcelona ACC
  - Barcelona ACC <-> Marseille ACC
  - Marseille ACC <-> Bordeaux ACC
  - Bordeaux ACC <-> Cognac Approach
- Test flight plan services between ACC (French and Spanish)
- Validate the flight rules applicable to UAV:
  - Implement ongoing two-way communication between UAV and civilian and military agencies,
  - Apply the control instructions in the horizontal and vertical dimensions,
  - Be equipped with an A/C mode transponder,
  - File an IFR flight plan and follow the flight plan trajectory with an accuracy of +/- 1 NM and the flight level assigned to +/-200ft in automatic mode.
  - Adopt predictable behavior in known degraded mode.
- Firm up the chosen hypotheses for managing degraded UAV modes (radio failure and link loss of control, see paragraph 5), including the use of the direct line between the UAV pilot and the controllers in charge of it.

The single flight to be carried out during this experimental phase is departing from Cognac AFB to Spain (Bordeaux ACC / Madrid ACC), handover from a civilian to a military ATS unit (Madrid ACC / Zaragoza TACC), handover from a military ATS unit to a military tactical air control unit (Zaragoza TACC / GRUNOMAC or GRUCEMAC), handover from a military tactical air control unit to a military ATS unit (GRUNOMAC or GRUCEMAC / Zaragoza TACC), handover from a military ATS unit to a civilian ATS unit (Zaragoza TACC / Madrid ACC) then proceeding to the Mediterranean Sea under Barcelona ACC control, followed by a handover to France (Barcelona ACC / Marseille ACC) and a return phase (Marseille ACC / Bordeaux ACC / Cognac AFB).

This flight test is also an occasion to feed EDA's works in the same domain. In 2018, European Defense Agency (EDA) ordered a study entitled "Accommodation of large RPAS scenarios and safety case".

The Study report "MALE-type RPAS Accommodation Study" published in February 2019, defined standard scenarios and associated tailored risk assessment (safety case) to accommodate MALE type RPAS operation in General Air Traffic.

Some real time simulations were used to assess the safety cases. The result was an enhanced aviation safety case assessment methodology for RPAS, helping to cover, through various scenarios stemming from the generic one, relevant threats and aviation hazard analysis, which may occur when a RPAS MALE is accommodated into the European airspace, alongside manned aviation.

To complete those simulations, a follow-up study is being conducted under real flights conditions in order to endorse scenarios for MALE RPAS accommodation during a portion of their flight performed in non-segregated airspace, namely, en-route phase.

Take-off, initial climb, operational part of the flight (OAT portions) and final descent and landing are excluded from the scope of EDA's study.

Operational procedures:

Selected trajectories:

Way to Spain

- Departure from Cognac airfield: climb to FL190,
- Hand-over to Bordeaux ACC: VELIN / SAUVAGNAC / ENSAC/ MAGEC / BIARRITZ / DONOS,
- Hand-over Bordeaux ACC to Madrid ACC at FL 190.
    - Control sectors:
        - Bordeaux ACC: TG, BN.

Spain :

French border to Spanish military area and return to French border. In Spanish airspace, OAT flight controlled by civilian ATCOs from Madrid and Barcelona ACCs and by military ATCOs from Zaragoza TACC.

OAT DONOS FL230 R299 BEGUY R299 PPN,

Handover from Madrid ACC to Zaragoza TACC before reaching Zaragoza TMA,

Proceed to LED-50 (Bardenas) to carry out simulated military operation,

Handover from Zaragoza TACC to GRUNOMAC / GRUCEMAC before reaching LED50 (Bardenas),

Handover from GRUNOMAC / GRUCEMAC to Zaragoza TACC before leaving LED50 (Bardenas),

Proceed from LED-50 (Bardenas) to RONKO, to reach RONKO at FL 220,

Handover from Zaragoza TACC to Madrid ACC before leaving Zaragoza TMA,

RONKO UM601 MARIO,

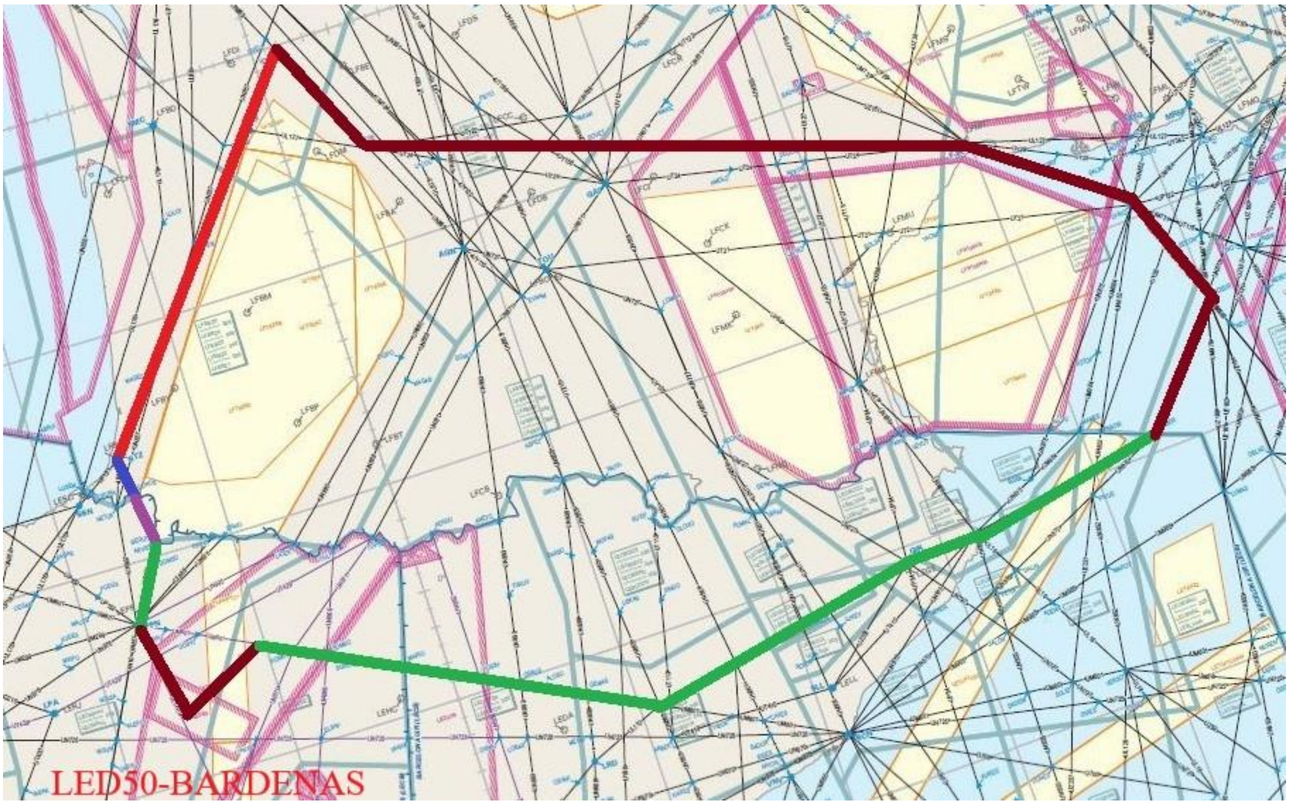
Handover from Madrid ACC to Barcelona ACC at MARIO,

MARIO UM601 REBUL UL110 BAGUR UL110 DIBER,

Handover to Marseille ACC at DIBER.

Return France to Cognac

- Entry point DIBER (FL 220) – UN 870 – SOSUR – UM154 DIVKO-SALIN-AFRIC – handover to Bordeaux ACC – G39 – SECHE – R17 – VELIN – Cognac Approach.
    - Control sectors:
        - Bordeaux ACC : BN, TG
        - Marseille ACC : ML



FLIGHT PLAN PROFILE

Flight profile:

4.2.1 In French Airspace:

Flight levels are defined according to the weather of the day.

In Bordeaux ACC's airspace: FL 190 maximum and in Marseille ACC airspace FL 240 maximum.

4.2.2 In Spanish Airspace

FL 230 until LED-50 (Bardenas). FL 220 from LED-50 (Bardenas) to DIBER.

Other flight levels might be tactically cleared if requested and available.

Coordination

The training in LED 50 Bardenas area will be coordinated before the flight between French REAPER squadron and the Spanish Air Force Air Staff.

Telephone lines:

A direct line between the control sectors concerned and the pilot (located in one of the control stations called GCS1 and GCS2) is configured within Bordeaux ACC, Madrid ACC, Zaragoza TACC, GRUNOMAC / GRUCEMAC, Barcelona ACC and Marseille ACC. Tactical coordinator numbers are provided as backup (TC1 and TC2). Two cockpits are possible; the one in service is confirmed at the beginning of the flight.

Tests to verify the operation of the lines will be organized by CFA/BAAC no later than D – 1.

A line test must be performed before obtaining a penetration clearance in Bordeaux ACC airspaces. The 2 telephone lines of the cockpit used must be functional at the time of the test. In the opposite case, the flight for the experiment is postponed.

The flight must be coordinated with Madrid and Barcelona ACC Supervisors, and with Zaragoza TACC and GRUNOMAC / GRUCEMAC over telephone line 30' before take-off (confirmation of the flight by the REAPER squadron), and at T – 30' before DONOS with Madrid ACC Supervisor (confirmation of the arrival of the REAPER by Bordeaux ACC).

A list of telephone numbers is provided in appendix 1.

Flight plan management :

4.5.1 France

Instruction N° 1550/DIRCAM (ref 9) and the flight plan and visualization service requirements for the Air Navigation Centers require that OAT and GAT IFR flight plans be filed simultaneously for each experimental flight.

During the previous phase, it turned out that the option of a single Cognac-Cognac flight plan with STAY indication in the flight plan did not allow correct sector coverage after the military work in area and requires maintaining the GAT status of the flight plan all along with the inherent visualization.

The solution to be tested is either a mixed GAT/OAT (Spain part)/GAT or two GAT flight plans, one for the track Cognac/DONOS and the second for track DIBER/Cognac (solution has to be checked before the flight).

The REAPER call sign is FAFXXXX.

4.5.2 Spain

According to the "Spanish Reglamento de la Circulación Aérea Operativa":

- An OAT flight plan must be filled for the flight.

- The portion of the flight within spanish airspace must be performed under OAT rules.

Control frequencies:

4.6.1 France

- Cognac Approach: 318.175 Mhz - backup frequency : 122.550 Mhz
- Bordeaux ACC: *TZ* 133,780 Mhz*,* TG 125.305 Mhz, BN 125.105 Mhz - backup frequency: LM 127,675 Mhz
- Marseille ACC: ML 128.850 Mhz - backup frequency MO 123.9 Mhz

4.6.2 Spain

- Madrid ACC: PAL 124.875 Mhz, ZGZ 127.230 Mhz
- Zaragoza TACC: 119.300 MHz - backup frequency: 127.050 MHz
- GRUNOMAC (callsign: Polar) / GRUCEMAC (callsign: Pegaso): 246.850 MHz - backup frequency: 278.375 MHz
- Barcelona ACC: DDN 135.805 Mhz, T1 125.250 Mhz, XAR 133.030 Mhz

IFF code management :

For the part in France, one or two flight plans will be submitted *(cf 4.4)*. The codes used will be those allocated by the STPV. This will then allow correlation and provide the safety net.

In order to ensure that the first code allocated by the STIP is given at the beginning of the UAV flight (in order to avoid possible correlation problems), it will be transmitted when the UAV is started up by telephone coordination between Cognac APP and Bordeaux ACC. The UAV will display this unique code during the flight until arrival at the border.

Spacing rules:

Considering the feedback accumulated during the various operational UAV flights and in particular, during the first experiments relating to flights outside segregated airspace, the UAV has demonstrated its capabilities in terms of navigation and flight level compliance. In addition, there is no longer any EM "Come-back"(Emergency Mission) procedure that can cause the UAV to turn around, but a procedure where the aircraft continues on its way as already cleared and complies with clearance given after a phone call from the pilot to inform control.

The possibility of an increase in the spacing standard also arose due to the absence of a T-CAS system. It was considered at this point that the UAV does not differ from a standard aircraft of less than 5.7 T (T-CAS not mandatory) that operates in IMC.

Considering the above elements, it is agreed that there is no evidence to justify the application of a different standard to the UAV.

In conclusion, it has been decided, like in the previous phases to apply the usual spacing standards within each organization during this experiment, i.e., 5 NM/1000ft at the French and Spanish ACC.

Flight planning :

The Cognac UAV squadron will provide flight notification to DSNA (Bordeaux and Marseille ACC with copy to do-2u-exomil) department, Madrid ACC, Barcelona ACC and Spanish Air Force Air Staff one week before the flight. The flight will then be confirmed on the last working day before the date of flight as far as possible before 1000Z and imperatively before 1400Z. In order to guarantee the presence in the control room of a person who participated in the organization of the experiment, the flight must be operate from Monday, 4 October 2021, to Friday, 01 April 2022, from 0630Z to 1230Z.

GAT VFR (Only applicable in French airspace)

Considering the length of the experimental flight routes, the number and choice of spaces flown, the periods chosen, it was considered by the group in charge of the experiment that the publication of a specific NOTAM or SUP AIP to inform users of the progress of the experiment was not of interest given the difficulty for them to take into account the information and assess the risk.

VFR clearances above FL145 in Bordeaux and Marseille ACC airspaces will be delayed or adapted during the transit time of the UAV to avoid interferences between the UAV and possible VFR flights.

If, despite this, interference occurs with VFR traffic, the control services will provide traffic information (Bearing Range Altitude) to the UAV pilot at approximately 10NM whenever possible. This will allow him to acquire a "visual" camera via infrared.

Hand-over procedures:

Hand-over coordination will take place 20 minutes before the transfer points. The experiment is stopped if there is no radio contact at the transfer point between Cognac APP and Bordeaux ACC. In the event of a radio failure following the flight, the flight may continue in accordance with paragraph 5.

<u>To Spain :</u>

Hand-over Bordeaux ACC -> Madrid ACC: DONOS point.

<u>In Spain</u>

Handover Madrid ACC -> Zaragoza TACC: before reaching Zaragoza TMA.

Handover Zaragoza TACC -> GRUNOMAC / GRUCEMAC: before reaching LED50 (Bardenas).

Handover GRUNOMAC / GRUCEMAC -> Zaragoza TACC: before leaving LED50 (Bardenas).

Handover Zaragoza TACC -> Madrid ACC: before leaving Zaragoza TMA.

Hand-over Madrid ACC-> Barcelona ACC: MARIO point.

Hand-over Barcelona ACC -> Marseille ACC: DIBER point

Back to Cognac :

Hand-over Marseille ACC -> Bordeaux ACC: FL 180 at AFRIC point.

Hand-over Bordeaux ACC -> Cognac Approach (cruising level or FL150 minimum).

Minimum weather conditions :

The REAPER UAV cannot fly in icing and thunderstorm conditions on its route.

Degraded modes Description:

Radio failure of the drone:

A radio failure refers to a failure of ground or on-board equipment that prevents radio communication between the pilot and control. In this case, the drone continues to be controllable. However, it displays code A7600, and complies with the instructions given by the control body via the direct telephone line. If this failure occurs while the drone is on the trajectory to reach the working area in Spain (i.e. first part of the flight), the experimental flight is stopped and the drone returns to Cognac. If the failure occurs in the working area or after:

- The UAV pilot must try to contact Madrid ACC, Barcelona ACC, Spanish Military Control unit (as applicable), Marseille ACC and Bordeaux ACC over telephone line. If the communication is successful, the drone will follow control instructions.
- Otherwise, the mission is cancelled, and the drone initially complies to the latest clearance if any, and then adheres to flight plan as filed. If radio failure occurs during a GAT phase of the flight, return to OAT is not possible. The emergency telephone number is the ACC supervisor number.

Management of an unexpected trajectory of the UAV:

If the pilot or controller notices an unexpected trajectory, the pilot informs control that he will return to manual flight after disengaging the autopilot. The pilot replaces the aircraft in accordance with its intended trajectory and then re-engages the autopilot. If the trajectory continues to be non-compliant, the drone will fly back to Cognac manually, cancelling the mission. In Spanish airspace, the relevant ATC unit must clear the return route.

The procedure for the come back to Cognac is the same as that defined in the event of radio failure.

Evolutions under FL145

In the event that the UAV is forced to operate at a FL below FL145 following an emergency (code 7700, code 7600), the civil and military control agencies inform the concerned approaches or sectors.

Loss of the UAV command link (Loss of Link: LoL):

The real loss of link during an experimental flight implies the termination of the experiment and the postponement of the flight.

In order to limit the risks of actual link loss, there will be no scheduled flight in the event of a storm or particular electromagnetic events such as solar flares.

In case of loss of control link, the UAV, after tests to recover from it, displays the code A7600 and starts a programmed EM (Emergency Mission) route that allows the return to Cognac and recover a Radio Line Of Sight (RLOS). If this recovery fails, the drone squawks 7700 and continues on its way to ditch at sea.

In all cases, the pilot (or a crew member), identifying with his call sign, will contact by telephone, the control organization with which he was in radio contact at the time of the loss of link and the switch in 7600, and will then describe precisely to the control organization the Emergency Mission that the aircraft will follow (crossing points, levels, speeds, estimated time of passage in OAT, etc.).

- Loss of link within an area:
  - LED50 (Bardenas):
    - GRUNOMAC / GRUCEMAC will notify Zaragoza TACC.
  - Wait 10 minutes in the area before the return flight path according to the programmed EM route.
- En route according to the flight plan to an area:
  - If the failure occurs before DONOS, the UAV goes to Biarritz then turns back to Cognac respecting the return flight plan and maintains the forward FL,
  - If the failure occurs between DONOS and Bardenas area, the UAV turns back towards Cognac the drone will take a reverse trajectory to that of the inbound flight plan. However, maintaining the outward FL. The drone should be transferred to Bordeaux ACC at FL180 at DONOS.

- En route back to Cognac after Bardenas area:
  - If the failure occurs in and after Bardenas area, the UAV follows is flight plan and continues towards Cognac respecting the FL determined before the flight between REAPER squadron and the ATS units (FL in Barcelona ACC and changing level in Marseille ACC). The drone shall change flight level between SALIN and FJR points from level 220 to level 180.
  - The UAV continue as planned until the arrival inside the LF-R49 area. The descent will begin only inside this area.

UAV IFF failure:

In the event of a real transponder failure, the experimental nature of the flight is stopped. The UAV remains under ATS control and has to be managed as a standard IFR aircraft. He must then turn around and return to Cognac according to the control instructions.

If this failure occurs while the drone is on the trajectory to reach the working area in Spain (i.e. first part of the flight), the experimental flight is stopped and the UAV will proceed according to control instructions.

If the failure occurs after Bardenas area, the UAV will continue the flight as planned

This IFF failure will not be simulated during the experiment.

UAV Engine failure:

In the event of a real engine failure, the experiment is stopped, the REAPER displays code A7700 and is flown to a crash area of opportunity in the event that Cognac AFB, Mont de Marsan AFB or Istres AFB are not accessible.

In France, the ACC's will inform the approaches concerned of the planned trajectory of the UAV.

In the event of an engine failure during a link loss, the drone crashes following its EM trajectory.

In Spanish airspace, the GCS must immediately inform the relevant ATS or military tactical air control unit and follow control instructions in order to avoid populated zones.

This Engine failure will not be simulated during the experiment.

GPS failure:

In the event of a GPS disturbance, the REAPER automatically changes the type of navigation used. From navigation assisted by a hybrid GPS inertial power unit, the system applies its navigation principle to manual flight using standard flight instruments. The maximum drift in inertial navigation is 0.8NM/h. In this case, the experimental flight is stopped.

If this failure occurs in Spanish airspace:

- If the failure occurs between DONOS and Bardenas area, the UAV will return to Cognac AFB. The drone will take a reverse trajectory to that of the inbound flight plan. The drone should be transferred to Bordeaux ACC at FL180 at DONOS.
- If the failure occurs in and after Bardenas area, the UAV follows is flight plan and continues towards Cognac respecting the FL determined before the flight between REAPER squadron and the ATS units (FL in Barcelona ACC and changing level in Marseille ACC).The drone shall change flight level between SALIN and FRJ points from level 220 to level 180.
- The ATS unit might assist in informing the GCS of the inertial drift when flying along predefined ATS routes.

This GPS failure will not be simulated during the experiment.

UAV Electric failure:

A power failure of the UAV means stopping the experimental flight and then return of the drone to Cognac Air Force Base.

The REAPER is equipped with batteries that allow it to fly for 6 hours in case of simple failure.

But, in case of a double failure, the endurance is reduced to 1.5 hours. In this situation, the REAPER uses squawk 7700. If possible, it returns to Cognac AFB or is diverted to an alternate military AFB (Mont-de-Marsan or Istres) by turning around or continuing its route according to its position at the time of the breakdown.

If the UAV is unable to return to its Military airbases listed above, the UAV squawks 7700 and will be diverted to ditch at sea or in desert area.

This electric failure will not be simulated during the experiment.

Dates and times of the experiment:

The flight must be operated between from Monday, 4 October 2021, to Friday, 01 April 2022, from 0630Z to 1230Z.

Other aspects :

Training:

- ATCOs:
  - The whole community of the controllers concerned by the experiment will be informed by given instructions according to the units' procedures.
- Of the RPAS crew: Briefing + mission Brief. Special attention will be given to the use of the direct phone line (identification of the right interlocutor).
- Off the military ATCOs of Cognac's ESCA:

Military controllers involved in those UAV activities will be informed of the flight, particularly during the morning briefing and via the Daily Orders. The units will ensure that station staff is familiar with the instructions detailed in the CONOPS. The safety study must also be made available to the controllers.

ANNEX I: TELEPHONE NUMBERS

FRANCE

Cognac:

Ground Flight deck GCS1: - PTT: +33 5 XX XX XX XX

Ground Flight deck GCS2: – PTT: +33 5 XX XX XX XX

Tactical Coordinator CT1 (Back-up GCS1): PNIA: 865 709 0574 – PTT: +33 5 XX XX XX XX

Tactical Coordinator CT2 (Back-up GCS2): PNIA: 865 709 0587 – PTT: +33 5 XX XX XX XX

Bordeaux ACC:

Chef de salle : 05 XX XX XX XX

Secteur BN : 05 XX XX XX XX

Secteur TZ : 05 XX XX XX XX

Secteur TG : 05 XX XX XX XX

Secteur LM : 05 XX XX XX XX

Marseille ACC :

Chef de salle : +33 4 XX XX XX XX / Back-up +33 4 XX XX XX XX

Secteur ML: +33 4 XX XX XX XX / Back-up +33 4 XX XX XX XX

Secteur MO (Back-up): +33 4 XX XX XX XX / Back-up +33 4 XX XX XX XX

SPAIN

Madrid ACC:

Supervisor: +34 91 XXX XX X / +34 91 XXX XX X

Spanish Military:

Zaragoza TACC: +34 97 XXX XX X / +34 97 XXX XX X

GRUNOMAC: +34 97 XXX XX X / +34 97 XXX XX X

GRUCEMAC: +34 91 XXX XX X / +34 91 XXX XX X

Barcelona ACC:

Supervisor: +34 93 XXX XX X / +34 93 XXX XX X

ANNEX II: PRESENTATION OF THE REAPER UAV

REAPER UAV system

MALE UAV systems carry out surveillance, reconnaissance and target acquisition missions at long distance and over a long period of time.

They are piloted from a ground cockpit by a remote pilot (French Space and Air Force aircrew).

Control commands are transmitted by direct data link (optical range) or satellite.

The pilot is responsible for radio communications with Air Traffic Control agencies. It has a back-up telephone system in the event of a radio failure.

The UAV carry sensors for optical, infrared and radar imaging.

The characteristics of the REAPER

The airborne vector of the REAPER UAV system is comparable to a glider equipped with a 900 hp turboprop engine.

Features:

- Weight: 4763 kg (Maximum Take-Off Weight, including 1746 kg for payload);
- Length: 36.2 ft / 11 m;
- Wingspan: 66 ft / 20 m;

Manual take-off and landing.

Equipment:

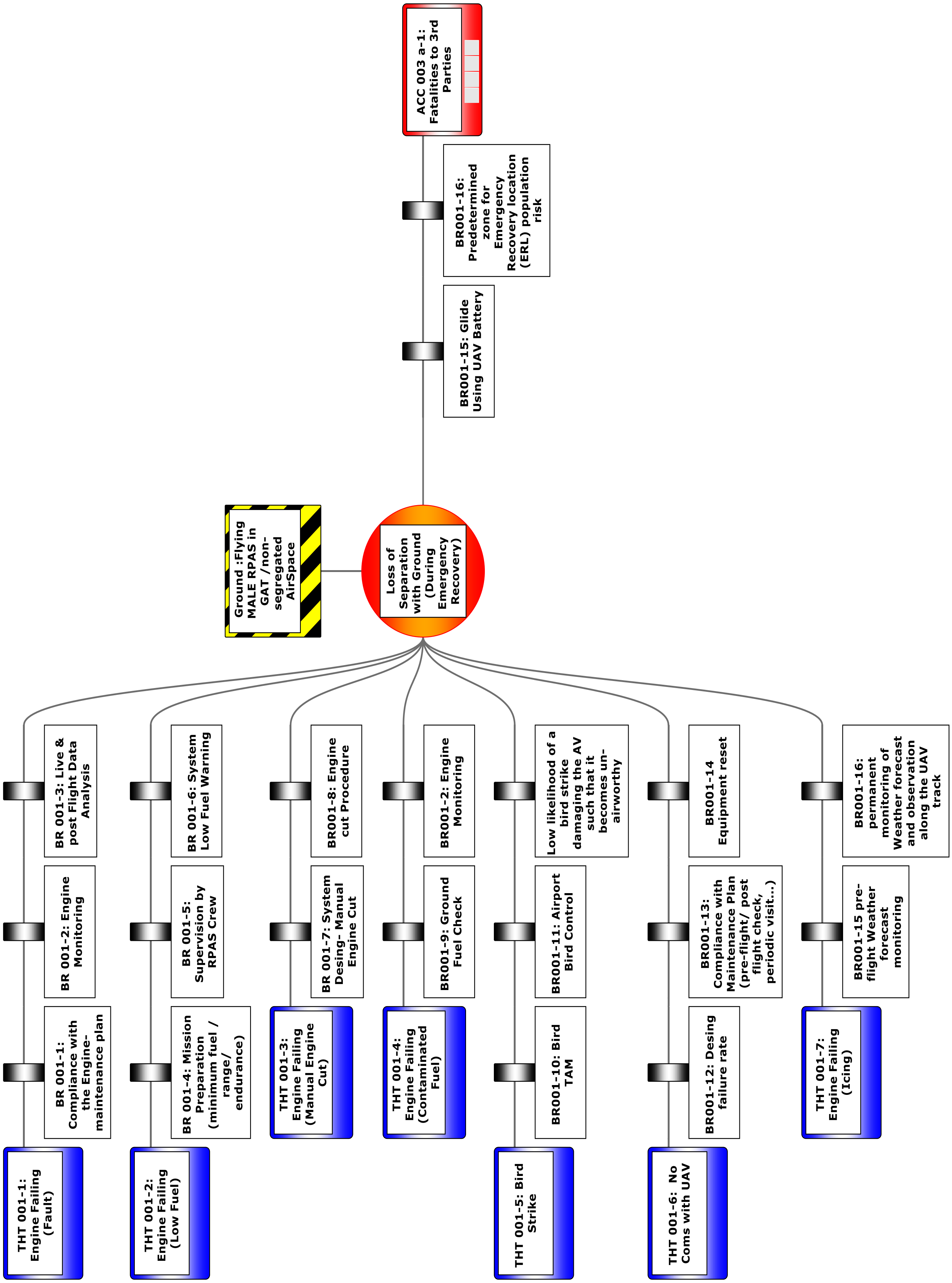
- 1 Radio (VHF + UHF) on air vector, phones/cat/mail in cockpit;
- Transponder: modes A and C;
- Anti-collision and navigation lights;
- No de-icing system.

Performances:

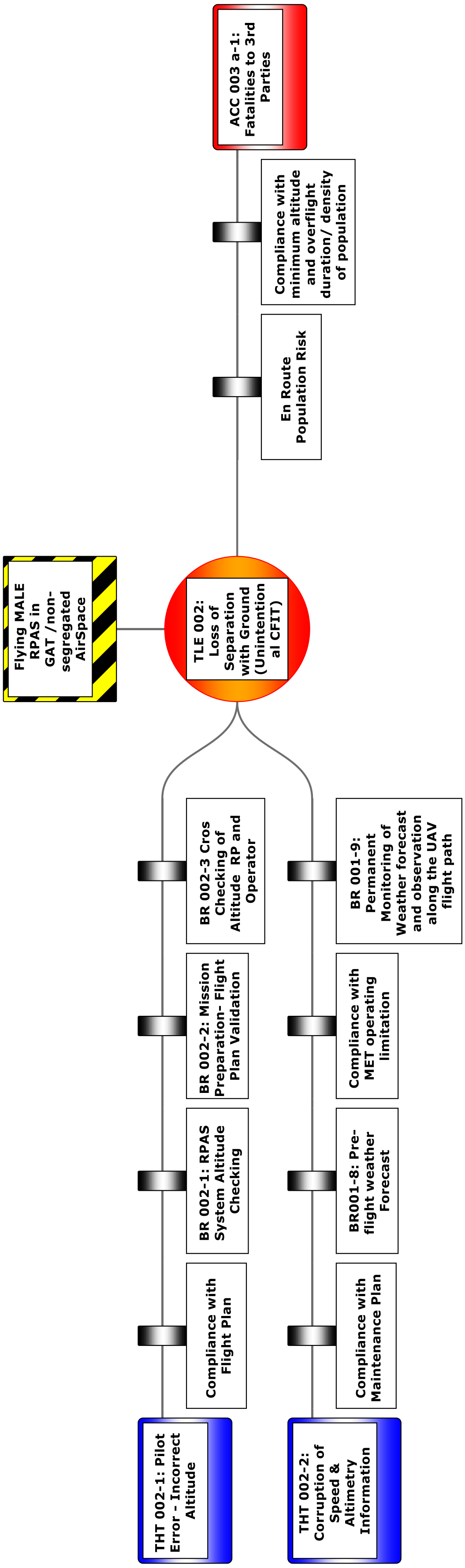
- Speed (IAS): 100 to 180 kt;
- Rate of climb: 1000 ft / minute;
- Rate of Descent: 3000 ft / minute max;
- Max tilt: 14° in automatic mode. In manual mode: 30° in satellite mode, 40° in LOS mode;
- Turning radius: 2500 m at 30° and Vi180kt/FL180 (CAS235kt);
- Endurance: 24 hours;
- Maximum ceiling: 40,000 ft (not achievable in the operational configuration);
- Working altitude: 15 000 ft to 25 000 ft;
- Range of action: more than 1500 km;
- Evolutions at least 25Nm from any storm/CB;
- Flight in clouds is prohibited except in cases of force majeure.

Annex IV - Refined Bow Tie Charts

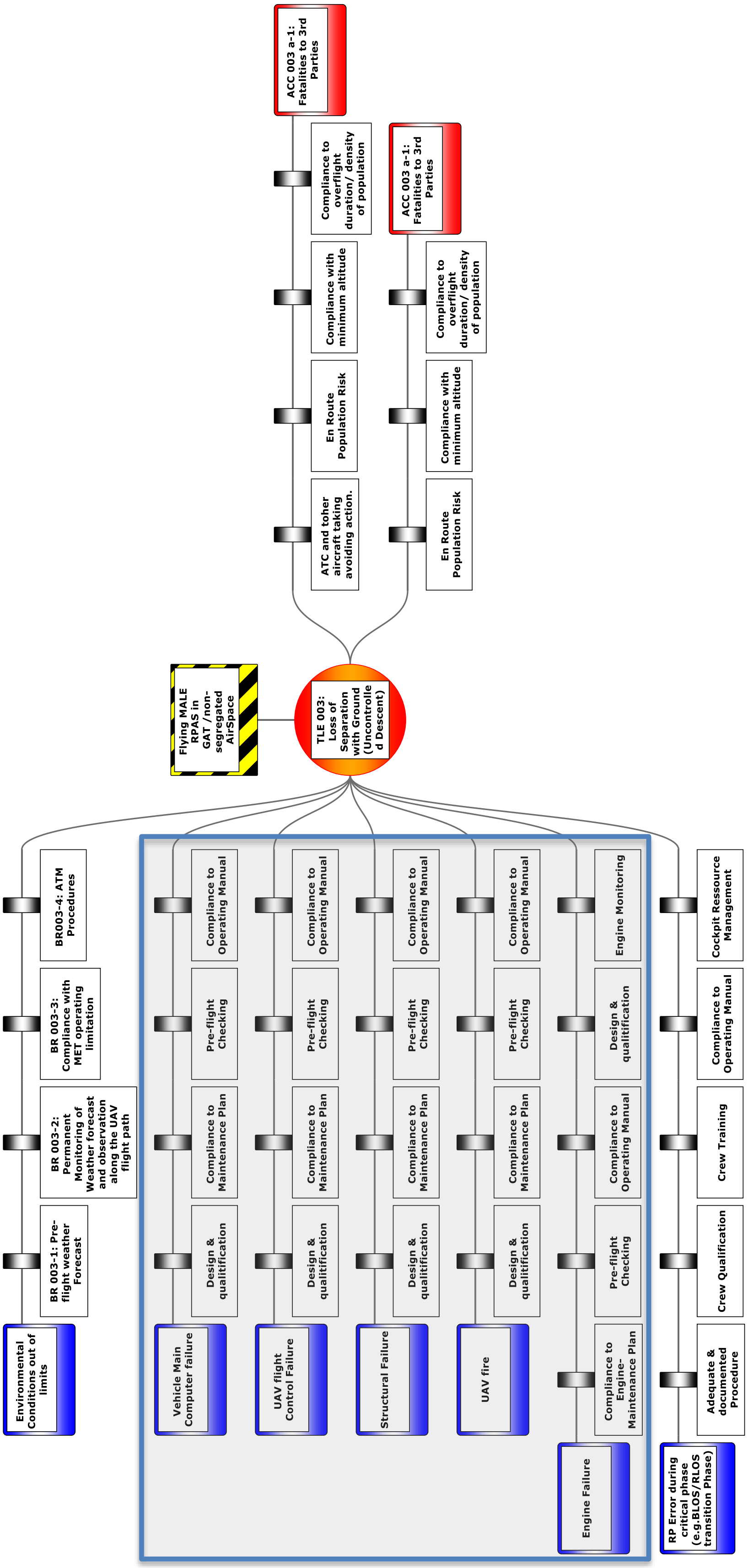
TLE 001: Loss of Separation with ground (during Emergency Recovery):



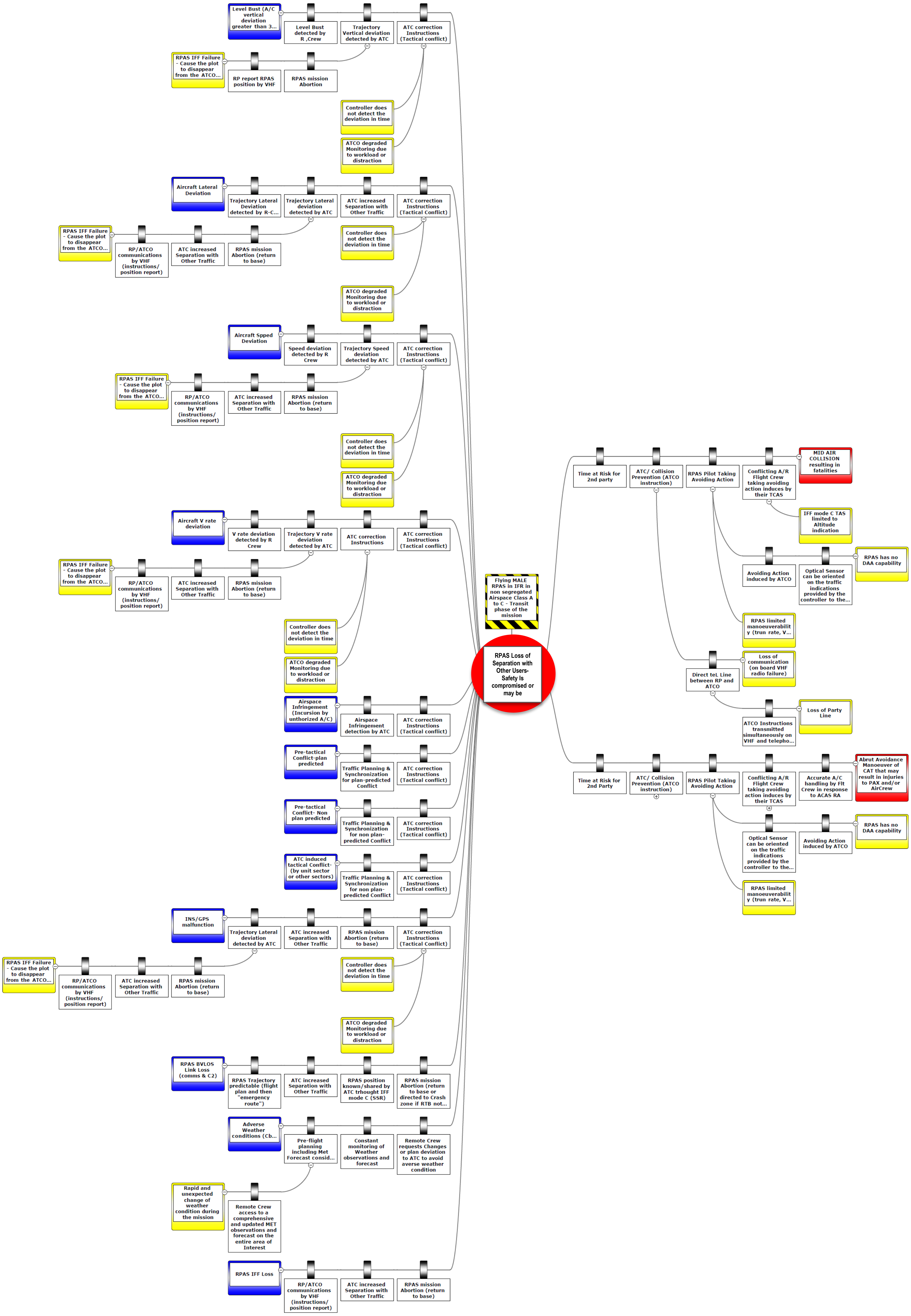
TLE 002: Loss of Separation with ground (Unintentional CFIT):



TLE 003: Loss of Separation with ground (Uncontrolled Descent):



TLE 005: Loss of Separation with other Users



Annex V- Validation Approach

Validation Approach for the experiment

Reminder

The objective of this experiment is to show that "flying a MALE RPAS in non-segregated airspace (Cat A to C within the limits of the scenario) is safe subject to appropriate "accommodation measures" ".

Validation Objectives to be explored

- General acceptability of UAS flight in GAT-IFR, non-segregated, cat A to C, "Enroute" airspace ,
- Strategic domain, tactical domain (density of traffic, meteo sensitivity, preparatory measures). Mainly human factor.
  - Information provision before the flight
  - Automated processing of the flight plan which present some specificities of a MALE RPAS mission
  - Manning to pilot and control UAS
  - Impact on ATCO in normal conditions (

- Acceptability from a technical point of view of integration UAS in IFR, non-segregated, "Enroute" airspace. Strategic domain, tactical domain
  - Frequency and latency of radio communications
  - Performances of the UAV
  - Performance of the UAS
  - Tools adequacy
  - Dedicated phone line

- Acceptability from a procedural point of view of UAS integration in non-segregated, "Enroute" airspace. Strategic domain, tactical domain
  - Flight plan,
  - Spacing
  - Phraseology

- Acceptability of safety level of UAS in IFR, non-segregated, cat A to C, « en route » airspace
  - Impact on ATCO in normal conditions
  - Estimated impact and acceptance of UAS in abnormal and faulty conditions (not played during the flight)

Validation Success Criteria

- Positive feedback from air traffic controllers and remote pilots on the flight and associated accommodation measures.

Evaluation Method for the Validation

Preparation observation (strategic to tactical areas)

- Questionnaire filled by actors
- A ranking system is given to help the appreciation and the analysis
- Some open questions give the opportunity to add some information.
- Interviews to complement the questionnaire
- Post flight common debriefing
- Exploitation of the material at our disposal at the end of the flight.

Collection of data and material to complement flight analysis

- Briefings, de-briefings
- Questionnaires feedback and Interviews
- Aeronautical documentation
- CONOPS and safety studies
- Technical UAS documentation
- Screenshots and audio recording

Prerequisite

The UAS is certified and has a standard equipment in conformity with the scenario airspace regulations. The UAS is in conformity with airworthiness regulations.

Accommodation measures are in place and operational (dedicated phone line, etc...)

The pilot and the ATCO are « qualified ».

The traffic density allows the insertion of an experimental use case. (for example, the summer overcrowded period is avoided).

Abnormal and faulty conditions will not be played in this real flight. Their potential impact will be estimated in accordance with the conditions of the day (weather condition, traffic density…) using a post flight “what if” analysis approach.

Annex VI- Collection of observations and Questionnaire

Instruction for Info gathering and Observations

Those instructions are at disposal of observers and services involved in the Flight test of MAE RPAS in a non-segregated airspace.

The intent is to collect elements to inform the study and the following associated events.

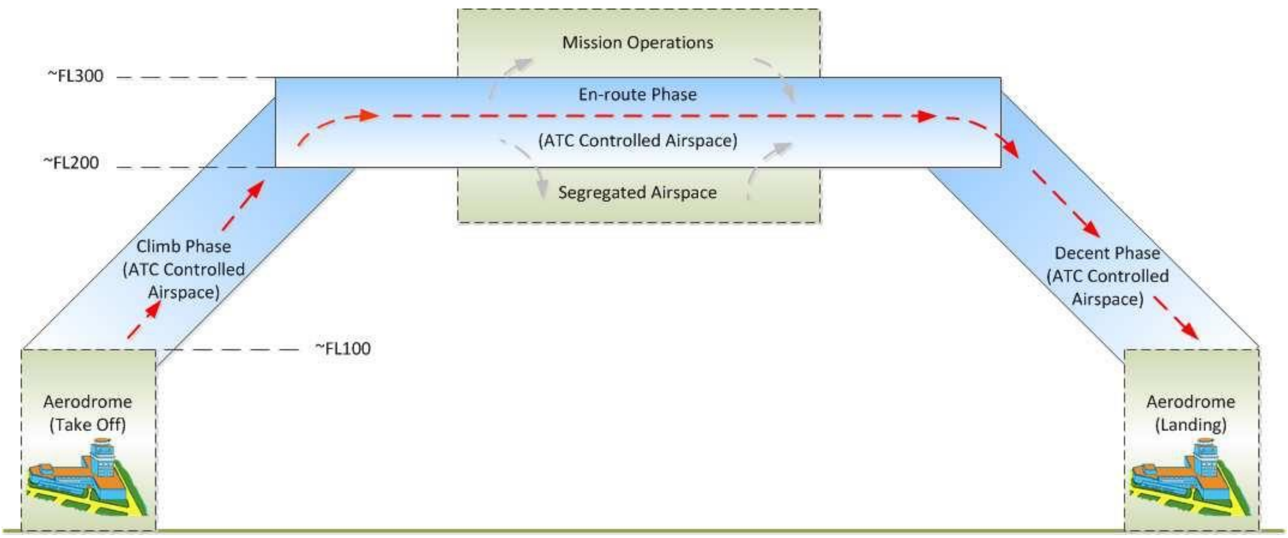
Background

This study takes place in a suite of works initiated by EDA in response to MS's willingness to make progresses in the integration of MALE type RPAS in non segregated airspace.

In 2018, EDA ordered a study entitled « accommodation of large RPAS scenarios and safety case ». A report published in February 2019, defined standard scenarios and associated tailored risk assessment (safety case) of this kind of operation. Some real time simulations were used to validate the safety cases. The result was an enhanced aviation safety case assessment methodology for RPAS, helping to cover, through various scenarios stemming from the generic one, relevant threats and aviation hazard analysis which may occur when a RPAS MALE is accommodated into the European airspace, alongside manned aviation.

Following those simulations, during an ESMAB policy meeting in January 2019, France offered the possibility to perform a real flight, including a cross border portion, in order to facilitate the validation of the results of the initial accommodation study, as well as the use cases developed in the "Guidelines for the Accommodation of Military IFR MALE-type RPAS under GAT Airspace classes A-C".

The study, object of this document aims at performing real Flight Test in order to validate scenarios for MALE RPAS accommodation during a portion of their flight performed in non-segregated airspace.



The analysis of the flight and the safety study will be shared with EU member states and this needs some material which will be collected before, during and after the flights.

Preparatory elements for the dissemination phase.

- Group photo,
- Specific photos (screens displaying RPAS data (flight parameter, configuration & status).
- Possibility to take pictures, photos or short videos for the restitution of the experimental campaign?
    - During Preparatory meetings with civil and military.
    - Preparation of the flight: maps, METEO, simulator. The telephone and the C2 link. Satellites. Reaper cabins. Access to INTERNET. Screens with RPAS information. Take off from Cognac etc…
- Documentation: preparation of the flight; CONOPS, SAFETY STUDY, etc…
- Flight plan with specificities

Observations Form / guide

In order to report the experiment, we intend to place one observer in each control center and in the cockpit if possible within contingencies.

- **Controllers:**
    - Qualifications level of the controller
    - General description of the organization and specific for this flight.
    - Description of the working method and material (i.e: one room chief, two controllers for one sector, visualisation system, radio, information specific for the RPAS on the screen, on the desk, telephone numbers and direct line.
- **ATC/ ATM Point of attention during the flight:**
    - Tranfers - change of FL - instructions change of headings - cross border - etc…
    - Reaction time between the instruction given by ATCo and its execution.
    - Appreciation of delays of dialogues, execution of instructions.
        - Is it different from manned aircrafts?
        - Visualisation of effects of instructions on the screens. Possibility to make a waiting pattern?
        - Eventually « squawk ident » to measure the delays
- **Remote Pilot Station (Cockpit):**
    - Documentation at disposal for the pilot, the crew.
    - Crew resource Management
    - etc…

- **Raw data that should be collected for further analysis of the key points of the flight**
  - Screenshots or radar situations during the flight, for each specific moments (i.e.. Change of FL, headings, transfers between sectors and cross border, Tranfers – instructions change of headings - cross border - etc…)
  - Any other suggestion is welcomed

1. Questionnaire for Air Traffic Controllers

1.1. Quantitative Assessment regarding the new operation "controlling a RPAS Flight"

N	Question	Ranking	Mark	Rationale if any
1	I was able to handle the traffic efficiently	1 never - 5 always		
2	I was satisfied with my level of control	1 never - 5 always		
3	I did not experience interference with my work as controller	1 no impact - 5 very high impact		
4	I experienced safety issues during the flight	1 no impact - 5 very high impact		
5	I was able to plan and organize my work as I wanted	1 no impact - 5 very high impact		
6	What is the impact of RPAS on situation assessment?	1 no impact - 5 very high impact		
7	What is the impact of RPAS on your workload?	1 no impact - 5 very high impact		
8	What WOULD BE the impact of RPAS emergency procedure?	1 no impact - 5 very high impact		
9	What is the impact of RPAS on problem solving and Decision-making?	1 no impact - 5 very high impact		
10	What is the impact on RPAS on required controller actions? (eg system inputs, RT calls, coordination)	1 no impact - 5 very high impact		
11	I was surprised by an event I did not expect	1 never - 5 always		
12	The traffic was light /dense	1 very light - 5 very dense		
13	The weather impacted the traffic	1 no impact - 5 very high impact		
14	I noticed a difference in R/T (e.g. time delay for reply) with the RPAS remote pilot	1 no impact - 5 very high impact		
15	The current CWP HMI was sufficient for RPAS Accommodation operation	1 fully agree – 5 fully disagree		

N	Question	Ranking	Mark	Rationale if any
16	The phone line with the remote pilot was used	1 never - 5 always		
17	I am used to control Military manned aircraft	1 never - 5 always		

1.2. **Open question, Additional remarks/ observation from ATCos**

During normal operation of the RPAS, did something interfere with your work as controller?
If yes, please specify if these interference are related specifically to the RPAS operation or related to the rest of the – manned - traffic.

Any specific remark on cross CRNA/ ACC transfer?

Did you have to apply any contingency procedure during the flight?
If yes, please specify if this was related to the RPAS operation or related to the rest of the – manned - traffic.

Have you received a verbal briefing/document(s) as preparation for the RPAS Accommodation flight (normal operations/non-normal and emergencies)?
If yes, Did you feel sufficiently informed/prepared to implement the planned procedures in the event of unforeseen events? *(Related to traffic density or weather or RPAS malfunctions)*

Would you suggest any improvement regarding the accommodation of RPAS in GAT, from your point of view?