

Unmanned Aircraft System Operations in UK Airspace – Guidance

CAP 722

A large abstract graphic consisting of overlapping, semi-transparent shapes in various shades of blue and grey, creating a layered, geometric effect that fills the lower two-thirds of the page.

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Revision History

Second Edition 12 November 2004

The major changes in this document are on legal, certification, spectrum and security issues.

Details of the CAA Policy on Model Aircraft/Light UAV have also been included.

Third Edition 28 April 2008

Introduction

Following discussions at the CAA Unmanned Aircraft Systems (UAS) Working Group, held on 12 October 2006, it was considered that sufficient progress had been made in many areas of UAS work to warrant a substantial review of CAP 722. In particular, as an upsurge in UAS activity is envisaged over the coming years it is essential that both industry and the CAA, as the regulatory body, clearly recognize the way ahead in terms of policy and regulations and, more importantly, in safety standards.

With an ever increasing number of manufacturers and operators, it is vital that the regulations keep pace with UAS developments, without losing sight of the safety issues involved in the simultaneous operation of manned and unmanned aircraft. As a living document, it is intended that CAP 722 will be under constant review and that it will be revised, where necessary, to take account of advances in technology, feedback from industry, recognised best practice and changes in regulations, which are developed to meet these demands. However, it is recognised that with continual rapid developments there will inevitably be times when Chapter sponsors will have to be approached directly for further guidance.

Revisions in this Edition

The layout of the document has been amended to more clearly separate Civil and Military guidance and as such the Chapters have changed in many areas. In addition, while there are many minor textual changes to the document, a significant revision has been made in many areas and as such it is recommended that those involved in UAS operations review the entire content of the document to ensure that they are fully cognisant with the update.

Impending Changes to Regulation

The CAA is in the process of a consultation with industry over a proposal to amend the Air Navigation Order which will require operators of UAS with a UAV component of less than 7 kg mass to obtain a CAA permission, as is currently the case for UAVs with a mass of 7-20 kg. This proposal intends to ensure public safety by applying operational constraints to

UAVs of less than 7 kg mass, as deemed appropriate to the type of operation envisaged and the potential risk to members of the public.

If the consultation exercise approves the proposal, it is likely that the ANO Amendment will pass into law in December 2008. Potential operators of UAS with a UAV component of less than 7 kg must ascertain, before commencing operations, whether or not they are required to obtain a CAA permission.

Third Edition incorporating amendment 2009/01 14 April 2009

This amendment is published in order to update contact details and references throughout the document and make some editorial corrections.

Fourth Edition 6 April 2010

This edition incorporates the changes to legislation introduced in Air Navigation Order 2009 (ANO 2009) regarding the requirement for operators of small unmanned aircraft to obtain a CAA permission when their aircraft are being used for aerial work, and also in some cases for surveillance or data acquisition purposes (now termed small unmanned surveillance aircraft).

Unmanned aircraft having a mass of less than 7 kg are now covered by this new legislation, which is intended to ensure public safety by applying appropriate operational constraints, dependent on the flying operation being conducted and the potential risks to third parties. In line with this change, some guidance on the additional details to be provided within an application for permission to operate small unmanned aircraft have also been included (Annex 1 to Section 3, Chapter 1).

Expanded guidance regarding the reporting of incidents/occurrences involving the operation of unmanned aircraft has also been included; such reporting is viewed as being a vital element in the successful development of the 'fledgling' civilian UAS industry.

Finally, in line with continued developments in UAS terminology, and the principle that unmanned aircraft are still to be treated as aircraft rather than as a separate entity. In line with this, the term 'pilot' (i.e. the person who operates the controls for the aircraft) is used more frequently. The term 'Remotely Piloted Aircraft' (RPA) is also emerging in some areas, although it has not yet been wholeheartedly accepted for use in the UK.

Fifth Edition 10 August 2012

The changes at this edition primarily concentrate on updating areas where terms, definitions or procedures have evolved significantly and where details of chapter sponsors have also been changed. The specific areas to note are:

- Revised Abbreviations and Glossary (also reflected throughout the document), which reflect worldwide developments in UAS terminology.
- Introduction of a Human Factors chapter.

- A complete rewrite of the 'Civil Operations, Approval to Operate' chapter.
- Amendments to civilian Incident/Accident Procedures.
- A complete revision to Section 4 (Military Operations), which reflects the formation of the Military Aviation Authority (MAA) and the revised Military Aviation Regulatory Publications.

Sixth Edition March 2015

CAP 722 has been completely refreshed and restructured under this revision. Key changes to the document are:

- Complete restructure of the document.
- Updates to all Chapters (including Abbreviations and Glossary of Terms).
- Introduction of a Concept of Operations Approach (ConOps)
- Introduction of the UAS OSC - Unmanned Aircraft System Operating Safety Case (formerly titled Congested Areas Operating Safety Case).
- Introduction of an Approval Requirements Map.
- Removal of Military Operations Chapters.
- Addition of Alternative Means of Compliance to demonstrate Operator Competency.
- Introduction of Restricted Category Qualified Entities.

Foreword

Aim

CAP 722, Unmanned Aircraft System Operations in UK Airspace – Guidance, is compiled by the Civil Aviation Authority's Intelligence, Strategy and Policy (ISP) division. CAP 722 is intended to assist those who are involved in the development of UAS to identify the route to certification, outline the methods by which permission for aerial work may be obtained and ensure that the required standards and practices are met by all UAS operators.

Furthermore, the document highlights the safety requirements that have to be met, in terms of airworthiness and operational standards, before a UAS is allowed to operate in the UK.

In advance of further changes to this document, updated information is contained on the CAA website¹.

Content

The content of CAP 722 is wholly dependent on contributions from lead agencies; it does not replace civil regulations, but provides guidance for civil UAS operations. Wherever possible the guidance contained herein will be harmonised with the MAA and European nations.

It is acknowledged that not all areas of UAS operations have been addressed fully. It is therefore important that operators, industry and government sectors remain engaged with the CAA and continue to provide comment on this document.

Availability

The primary method of obtaining a copy of the latest version of CAP 722 is via the CAA website².

¹ www.caa.co.uk/uas

² www.caa.co.uk/CAP722

Point of Contact

Unless otherwise stated, all enquiries relating to CAP 722 must be made to:

For queries relating to the content of CAP 722:

ISP Operations Management
CAA
Safety and Airspace Regulation Group
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

E-mail: ISPOperationsManagementTeam@caa.co.uk

For matters concerning operations or approvals:

Shared Services Centre
CAA
Safety and Airspace Regulation Group
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Telephone: 01293 573517

E-mail: uavenquiries@caa.co.uk

Abbreviations and Glossary of Terms

The terminology relating to UAS operations continues to evolve and therefore the Abbreviations and Glossary of Terms sections are not exhaustive. The terms listed below are a combination of the emerging ICAO definitions and other 'common use' terms which are considered to be acceptable alternatives.

Abbreviations

A

AAIB	Air Accidents Investigation Branch
ACAS	Airborne Collision Avoidance System
AIP	Aeronautical Information Publication
ANO	Air Navigation Order
ANSP	Air Navigation Service Provider
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit

B

BMFA	British Model Flying Association
BRLOS	Beyond Radio Line of Sight
BRS	Ballistic Recovery Systems
BVLOS	Beyond Visual Line of Sight

C

CA	Congested Area
CAA	Civil Aviation Authority
CAT	Commercial Air Transport

ConOps	Concept of Operations
CPL	Commercial Pilot Licence
CRM	Crew Resource Management
C2	Command and Control
D	
DA	Danger Area
DAA	Detect and Avoid
DAP	Directorate of Airspace Policy
E	
EASA	European Aviation Safety Agency
ERF	Emergency Restriction of Flying
EVLOS	Extended Visual Line of Sight
F	
FIR	Flight Information Region
FISO	Flight Information Service Officer
FMC	Flight Management Computer
FRTOL	Flight Radio Telephony Operators' Licence
G	
GCS	Ground Control Station
H	
HALE	High Altitude Long Endurance
HMI	Human-Machine Interface
I	
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
J	
JARUS	Joint Authorities for Rulemaking on Unmanned Systems

M

MAA	Military Aviation Authority
MALE	Medium Altitude Long Endurance
MOD	Ministry of Defence
MOR	Mandatory Occurrence Reporting
MRP	MAA Regulatory Publication(s)
MTOM	Maximum Take-off Mass

N

NAA	National Aviation Authority
NOTAM	Notice to Airmen

R

RA (T)	Restricted Area (Temporary)
RCS	Radar Cross Section
RLOS	Radio Line of Sight
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RPS	Remote Pilot Station
RTF	Radiotelephony
RTS	Release to Service

S

SARPs	Standards and Recommended Practices
SARG	Safety and Airspace Regulation Group
SSR	Secondary Surveillance Radar
SUA	Small Unmanned Aircraft
SUSA	Small Unmanned Surveillance Aircraft

T

TC	Type Certificate
TCB	Type Certification Basis

TCAS Traffic Collision Avoidance System

TDA Temporary Danger Area

U

UA Unmanned Aircraft

UAS Unmanned Aircraft System(s)

UAS OSC Unmanned Aircraft System(s) Operating Safety Case

UIR Upper Flight Information Region

V

VFR Visual Flight Rules

VLOS Visual Line of Sight

Glossary of Terms

A

Aircraft - Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the Earth's surface.

Air Navigation Order - CAP 393 Air Navigation: The Order and the Regulations include the ANO and the Rules of the Air Regulations.

Autonomous Aircraft - An unmanned aircraft that does not allow pilot intervention in the management of the flight.

Autonomous Operation - An operation during which an unmanned aircraft is operating without pilot intervention in the management of flight.

C

Continued Airworthiness - The monitoring, reporting and corrective action processes used for in-service aircraft to assure they maintain the appropriate safety standard defined during the initial airworthiness processes throughout their operational life.

Continuing Airworthiness - The system of management of the aircraft and the scheduling and actioning of ongoing preventative and corrective maintenance to confirm correct functioning and to achieve safe, reliable and cost effective operation.

Command and Control Link (C2) - The data link between the remotely-piloted aircraft and the remote pilot station for the purposes of managing the flight.

Concept of Operations - describes the characteristics of the organisation, system, operations and the objectives of the user.

D

Detect and Avoid - The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.

G

Ground Control Station (GCS) - See 'Remote Pilot Station'.

Note: RPS is the preferred term as it enables the consistent use of one term with the same meaning irrespective of its location (e.g. on a ship or in another aircraft).

H

Handover - The act of passing piloting control from one remote pilot station to another.

High Authority - those systems that can evaluate data, select a course of action and implement that action without the need for human input.

Highly Automated - those systems that still require inputs from a human operator (e.g. confirmation of a proposed action) but which can implement the action without further human interaction once the initial input has been provided.

I

Initial Airworthiness - The system used to determine the applicable requirements and establish that an aircraft design is demonstrated to be able to meet these requirements.

L

Lost Link - The loss of command and control link contact with the remotely-piloted aircraft such that the remote pilot can no longer manage the aircraft's flight.

O

Operator - A person, organisation or enterprise engaged in or offering to engage in an aircraft operation.

Note: In the context of remotely-piloted aircraft, an aircraft operation includes the remotely-piloted aircraft system.

P

Pilot - The person in direct control of the UA - See also 'Remote Pilot'.

R

Radio Line-Of-Sight (RLOS) - A direct radio link point-to-point contact between a transmitter and a receiver.

Remote Pilot - A person charged by the operator with duties essential to the operation of a remotely-piloted aircraft and who manipulates the flight controls, as appropriate, during flight time.

Remotely Piloted Air System - A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other material relevant to the operation of the remotely piloted aircraft system.

Remote Pilot Station (RPS) - The component of the remotely-piloted aircraft system containing the equipment used to pilot the remotely-piloted aircraft.

Remotely-Piloted Aircraft (RPA) - An unmanned aircraft which is piloted from a remote pilot station.

Remotely-Piloted Aircraft System (RPAS) - A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

RPA Observer - A trained and competent person designated by the operator who, by visual observation of the remotely-piloted aircraft, assists the remote pilot in the safe conduct of the flight.

RPAS Commander - A trained and competent person who is responsible for the conduct and safety of a specific flight and for supervising the person in direct control of the RPAS. His duties are equivalent to those of an Aircraft Commander.

S

Safety - The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

Safety Management System (SMS) - A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

Sense and Avoid - See 'Detect and Avoid'.

Small Unmanned Aircraft (SUA) - Any unmanned aircraft, other than a balloon or a kite, having a mass of not more than 20 kg without its fuel but including any articles or equipment installed in or attached to the aircraft at the commencement of its flight.

Small Unmanned Surveillance Aircraft (SUSA) - A small unmanned aircraft which is equipped to undertake any form of surveillance or data acquisition.

U

Unmanned Aircraft (UA) - An aircraft which is intended to operate with no human pilot on board, as part of an Unmanned Aircraft System. Moreover a UA:

- is capable of sustained flight by aerodynamic means;

- is remotely piloted and/or capable of degrees of automated or autonomous operation;
- is reusable; and
- is not classified as a guided weapon or similar one-shot device designed for the delivery of munitions.

Note: RPA is considered a subset of UA.

Unmanned Aircraft System (UAS) - An Unmanned Aircraft System comprises individual 'System Elements' consisting of the Unmanned Aircraft (UA) and any other System Elements necessary to enable flight, such as a Remote Pilot Station, Communication Link and Launch and Recovery Element. There may be multiple UAs, RPS or Launch and Recovery Elements within a UAS.

V

Visual Line-Of-Sight (VLOS) Operation - An operation in which the remote pilot or RPA observer maintains direct unaided visual contact with the remotely-piloted aircraft.

SECTION 1

General

Chapter 1

Introduction

Policy

- 1.1 It is CAA policy that UAS operating in the UK must meet at least the same safety and operational standards as manned aircraft. Thus, UAS operations must be as safe as manned aircraft insofar as they must not present or create a greater hazard to persons, property, vehicles or vessels, whilst in the air or on the ground, than that attributable to the operations of manned aircraft of equivalent class or category.
- 1.2 In consideration of the limited aviation background of some UAS manufacturers and operators, the guidance contained herein is necessarily prescriptive. The CAA will supplement CAP 722 with further written guidance when required. Rules for Avoiding Aerial Collisions are set out in the Rules of the Air Regulations. For the purpose of UAS operations, the 'See and Avoid' principle employed in manned aircraft is referred to as 'Detect and Avoid'.
- 1.3 Edition 6 of CAP 722 introduces a Concept of Operations (ConOps) approach for UAS and moves away from a mass centric classification approach. In doing so it describes how UAS operations should be approached so that all functional areas of the operations are considered.

Scope

- 1.4 The guidance within CAP 722 concerns unmanned aircraft and UAS as they are defined in the Glossary of Terms. It primarily focuses on the aspects connected with Remotely Piloted Aircraft (RPA), whilst acknowledging the potential for autonomous operations in the future.
- 1.5 Military Systems are regulated by the Military Aviation Authority (MAA). All enquiries regarding military RPAS must be made to:

Military Aviation Authority
Juniper Building
Abbey Wood (North)
Bristol, BS34 8QW
Email: DSA-MAA-EnquiriesMailbox@mod.uk
Internet site: www.gov.uk/government/organisations/military-aviation-authority
- 1.6 Similarly the guidance for operating model aircraft for sporting and recreational purposes is not included, this guidance is published in CAP 658: Model Aircraft: A Guide to Safe Flying.

Chapter 2

Legal Considerations

Policy

The Chicago Convention

- 2.1 As a signatory to the Chicago Convention and a member of ICAO, the United Kingdom undertakes to comply with the provisions of the Convention and Standards contained in Annexes to the Convention save where it has filed a Difference to any of those standards.
- 2.2 Article 3 of the Convention provides that the Convention applies only to civil aircraft and not to State aircraft. State aircraft are defined as being aircraft used in military, customs and police services. No State aircraft may fly over the territory of another State without authorisation. Contracting States undertake when issuing Regulations for their State aircraft that they will have due regard for the safety of navigation of civil aircraft.
- 2.3 Article 8 of the Convention provides that no aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a Contracting State without special authorisation by that State.
- 2.4 Article 8 of the Convention also requires that “each contracting State undertake to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft”.

Law

European Regulation

- 2.5 EC Regulation 216/2008 (the Basic EASA Regulation) establishes the European Aviation Safety Agency (EASA) and makes provision for Implementing Rules dealing with airworthiness certification, continuing airworthiness, operations, pilot licensing, air traffic management and aerodromes.
- 2.6 Neither the Basic EASA Regulation nor the Implementing Rules apply to aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft). EU Member States must, however, ensure that such services have due regard as far as practicable to the objectives of the EASA Regulation.
- 2.7 Certain categories of civil aircraft are also exempt from the need to comply with the Basic EASA Regulation and its Implementing Rules. These exempt categories are listed in Annex II to the Basic EASA Regulation (Annex II aircraft).

The exempt categories which are of relevance for UAS are:

- aircraft specifically designed or modified for research, experimental or scientific purposes and likely to be produced in very limited numbers;
- ex-military aircraft; and
- unmanned aircraft with an operating mass of 150 kg or less.

- 2.8 Any aircraft which is subject to the Basic EASA Regulation and Implementing Rules (e.g. an unmanned aircraft more than 150 kg which is neither experimental nor used for State purposes) will be required to have an EASA airworthiness certificate.
- 2.9 An aircraft which is not required to comply with the Basic EASA Regulation, either because it is a State aircraft or because it comes within one of the exempt categories, remains subject to national regulation so far as airworthiness certification and continuing airworthiness are concerned.
- 2.10 Implementing Rules for airworthiness certification and continuing airworthiness have been in force for some years. The Implementing Rule for pilot licensing is also now in force. The Implementing Rules for operations and aerodromes have been made and are coming into force, subject to transition arrangements, during 2014 to 2017. The Implementing Rule for air traffic management will come into force from 2015. Until the Implementing Rules are fully in force, national regulations will continue to apply in certain circumstances. The CAA's website will contain up to date information concerning this transition.
- 2.11 An Implementing Rule is also in force introducing Common Rules of the Air (SERA). These largely replace the UK Rules of the Air 2007 although certain complementary UK rules are being retained.
- 2.12 In the case of the United Kingdom, the National Regulations are as described below.

National Regulation

Civil and Military Regulations

- 2.13 In the United Kingdom, there are two regulatory regimes: civil and military. Military requirements are a matter for the Ministry of Defence. A military aircraft for this purpose includes any aircraft which the Secretary of State for Defence certifies must be treated as a military aircraft.
- 2.14 Any aircraft which is not a military aircraft must, under United Kingdom aviation safety legislation, comply with civil requirements. There is no special provision for other types of non-military State aircraft such as those carrying out police, search and rescue, fire fighting, coastguard or similar activities or services.

The Air Navigation Order 2009

- 2.15 The main civil requirements are set out in the ANO.
- 2.16 The provisions in the ANO concerning equipment requirements, operational rules, personnel licensing, aerodrome regulation and regulation of air traffic services apply to all non-military aircraft, organisations, individuals and facilities.
- 2.17 As explained above, insofar as these national requirements concern airworthiness certification or continuing airworthiness they will only apply to non-military State aircraft and Annex II aircraft. Such aircraft are exempt from the need to comply with the Basic EASA Regulation and Implementing Rules and thus remain subject to national regulation.
- 2.18 A non-military State aircraft or an Annex II aircraft registered in the United Kingdom which is outside the Basic EASA Regulation and Implementing Rules must have a certificate of airworthiness or a permit to fly issued by the CAA (or be operating under A or B Conditions) under the ANO, unless it is:
an unmanned aircraft of mass 20-150 kg with an exemption from the ANO issued by the CAA (see paragraph 2.2); or
a 'small unmanned aircraft' as defined in the ANO.
- 2.19 A small unmanned aircraft is defined in the ANO as any unmanned aircraft weighing not more than 20 kg. None of the above main requirements apply to such small aircraft. Instead, a set of conditions are included at Articles 166 and 167 of the ANO subject to which small aircraft may be flown without complying with airworthiness or flight crew licensing requirements. These conditions include a prohibition on flight in controlled airspace or within an aerodrome traffic zone unless in either case the permission of the Air Traffic Control (ATC) unit has been obtained, a normal maximum height of 400 ft above the surface and a prohibition on flight for the purposes of aerial work without the specific permission of the CAA. Article 167 specifically covers the use of small unmanned aircraft for surveillance or data gathering.

Exemptions and Permissions granted by the CAA

- 2.20 A UA which is subject to national regulations and which weighs more than 20 kg is not a 'small unmanned aircraft' for the purposes of the ANO so that all the requirements referred to above (certificate of airworthiness or permit to fly, licensed flight crew) must be complied with. If an aircraft cannot comply with all of these requirements the CAA may be prepared to issue an Exemption under Article 242 of the ANO 2009. To operate a UA which weighs 20 kg or less for aerial work purposes, a CAA Permission is also required as described in ANO 2009 Article 166(5).

Insurance

- 2.21 EC Regulation 785/2004 came into force on 30 April 2005 requiring most operators of aircraft, irrespective of the purposes for which they fly, to hold adequate levels of insurance in order to meet their liabilities in the event of an accident. This EC Regulation specifies amongst other things the minimum levels of third party accident and war risk insurance for aircraft operating into, over or within the EU (including UAS) depending on their Maximum Take-Off Mass (MTOM). Details of the insurance requirements can be found on the CAA website³ under “Mandatory Insurance Requirements”.
- 2.22 UK legislation which details insurance requirements is set out in Civil Aviation (Insurance) Regulations 2005⁴.
- 2.23 The EC Insurance Regulation does not apply to State aircraft or to model aircraft with an MTOM of less than 20 kg.

Lead Agency

- European Aviation Safety Agency – for civil aircraft which are not exempt from the EASA Regulation.
- Civil Aviation Authority – for civil aircraft which are exempt from the EASA Regulation.
- Military Aviation Authority – for United Kingdom military aircraft.
- Department for Transport – for insurance matters.

³ <http://www.caa.co.uk/default.aspx?catid=122&pagetype=90&pageid=4510>

⁴ <http://www.opsi.gov.uk/si/si2005/20051089.htm>

SECTION 2

Approvals

Chapter 1

UAS Classification System

Scope

- 1.1 This chapter gives guidance on the classification philosophy for UAS in the United Kingdom.

UAS Classifications

- 1.2 The current framework established and used by the CAA, and other NAAs, classifies aircraft based on simple discriminants or type (e.g. balloon, fixed or rotary wing) and mass. This reflects the historic developments in manned aviation – but is not necessarily fully appropriate for UAS hence the ConOps approach being taken by the UK. However, until such time as alternative classification protocols are agreed this system is in place.
- 1.3 Working within this means we have very simple categorisations - Table 1 describes these.

Mass Category	Mass (kg)	Responsible Regulatory Body
SUA	0-20	National Aviation Authority
Light UAS	> 20 to 150	National Aviation Authority
UAS	> 150	EASA ⁵

Table 1 - Mass Categories Relating to UAS

- 1.4 Aircraft of greater than 150kg fall within the remit of the EASA Basic Regulation, unless they are outside of this due to the exceptions defined in Annex II, or aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft). For non-military state aircraft and Annex II aircraft the CAA has based the applicable certification requirements, organisation and operational approvals on those that would be applied by EASA as this provides maximum alignment and would offer potential operating benefits within Europe.
- 1.5 For 150kg and below the assumption is that certification is a fully national process and hence, will automatically be considered for UK operational use only.

⁵ NAA - for Annex II aircraft

Future Classification Development

- 1.6 Work is ongoing within ICAO and JARUS to formulate internationally recognised classifications for UAS. These classifications will likely use mass as a discriminator but will also consider other factors including operating environment and system complexity; this is very much in line with the UK ConOps approach.

Chapter 2

Approval Requirements Map

Scope

- 2.1 This chapter gives guidance to UAS operators on the approach currently taken by the CAA to determine the level of assurance and assessment required prior to the issue of a permission.
- 2.2 This chapter is top level guidance only and is intended to give the community a starting point from which to develop understanding of the requirements. Section 2, Chapter 3 of this publication gives detailed policy and guidance on the approach to be taken when applying for a permission.

Basic Requirements

- 2.3 The CAA ConOps philosophy underpins the approval process (and thus approval requirements) and aims to ensure that the public and other airspace users are not exposed to unacceptable risk introduced by UAS commercial operations.
- 2.4 The CAA approach is to categorise UAS and the intended operations as detailed at Figure 1; all operations will fall into either category A, B or C. Category A may be extended for a higher mass dependent upon the environment and complexity of the system (for example a standard permission for 20kg or less UAS may fall into category A).
- 2.5 In Figure 1, the term 'Technical Complexity' is used to describe how complex the system is (for example number of flight control modes, flight management systems etc.); whereas the term 'Operating Environment Complexity' describes how complex the environment is (for example congested areas, complex airspace, etc.)
- 2.6 There are scenarios that are not described, which will require differing levels of assessment (for example, a very light UAS operating in a complex environment with an extremely complex flight management system). It is therefore essential that operators contact the CAA early in the developmental process to ensure that the correct approach is being taken.

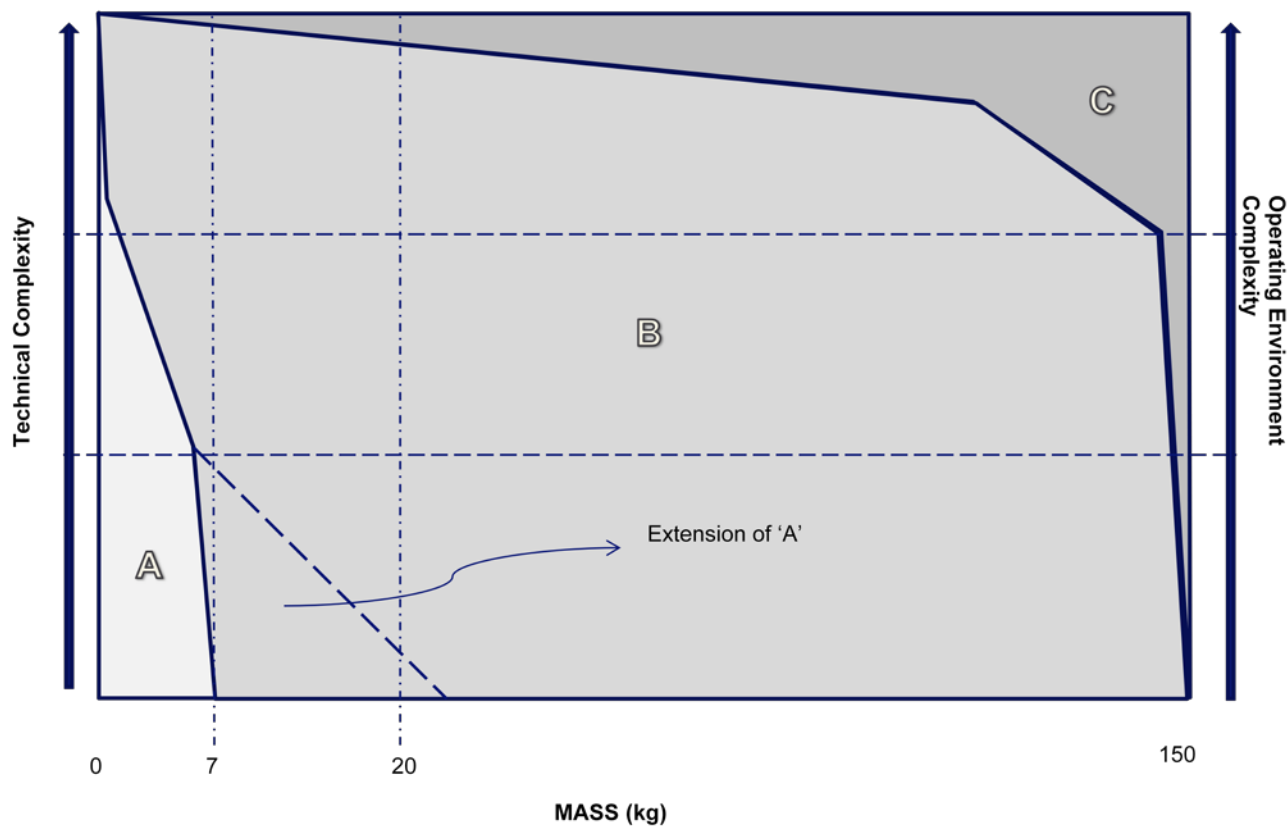


Figure 1 - Simple UAS ConOps Approvals Requirements Map

	A	B	C
Airworthiness	No Design, production or other airworthiness approval No Type Certificate (TC) or Type Certification Basis (TCB)	Airworthiness assessment based upon UAS Operating Safety Case (UAS OSC) submission (elements of design, production, continuing and continued airworthiness will be assessed) No design approval or production approval or TC or TCB	TCB agreed Possibility of requirement for TC Design and Production approval required Continuing and continued airworthiness processes assessed
Operational	No Operational Approval required; or, Approval based on UAS OSC Volume 1	Approval based upon UAS OSC Volume 1, 2 and 3 submission	Approval based upon UAS OSC and airworthiness submission; or, more rigorous assessment based loosely on AOC type assessment
Pilot Competence	For 'Standard Permission' evidence of pilot competency required	Evidence of pilot competency required	Evidence of pilot competency required
Operating Environment	Visual Line of Sight Not in densely populated areas Below 400 feet Very low risk environment	Congested Areas Complex environment where third party risks are judged to be above that of a 'standard permission'. VLOS, EVLOS	Congested Areas; and/or, High risk environment; and/or, BVLOS, BRLOS etc.; and/or, Complex airspace
Influencing Factors	Low complexity, low mass, benign operating environment	Low to medium complexity Congested areas or higher risk environment than 'A' Increased mass	Highly complex; and/or high mass; and/or, Densely populated or high risk environment Overflight of groups of people Complex flight profiles Swarming or multiple UAs under the control of one operator.

Table 2 - UAS Approval Categories

Chapter 3

Approval to Operate

Scope

- 3.1 This Chapter gives guidance on the approval application requirements and processes to operate UAS in the UK.

Introduction

- 3.2 All civil aircraft fly subject to the legislation of the Air Navigation Order 2009 (ANO) and the associated Rules of the Air Regulations. However, in accordance with its powers under Article 242 of the ANO, the CAA may exempt UAS operators from the provisions of the ANO and the Rules of the Air, depending on the UA's potential to inflict damage or injury and the proposed area of operation. Small Unmanned Aircraft (SUA) are exempted from most of the provisions of the ANO and Rules of the Air Regulations by the provisions of Article 253.
- 3.3 Changes, updates and further information are published on the CAA website⁶.

Approvals, Permissions and Exemptions

- 3.4 The CAA may issue an exemption or permission for UA to operate if the applicability criteria detailed in Table 2 are met and the CAA is satisfied that the UA will be operated within the constraints stipulated. If a UA is intended for operation outside these constraints, the applicant must submit a UAS OSC and discuss these issues directly with the CAA.

Aircraft Mass	Airworthiness Approval	Registration	Operating Permission	Pilot Qualification
20 kg and less	No	No	Yes (Note 1)	Yes (Note 1& 2)
More than 20 kg, up to and including 150 kg	Yes (Note 3)	Yes (Note 3)	Yes	Yes (Note 2)
More than 150 kg	EASA approval; or, CAA approval in certain cases (e.g. Annex 2 aircraft) (Note 3)	Yes	Yes	Yes (Note 2)

Table 3 - Prerequisites for Operating a UA

⁶ www.caa.co.uk/uas

Notes:

1. Applicable for aircraft used for Aerial Work purposes or if flown within a congested area or close to people or property.
2. Equivalent pilot experience will be considered on a case-by-case basis during application for an operating permission.
3. It may be possible to obtain certain exemptions from the airworthiness and registration requirements.

3.5 A CAA permission only addresses the flight safety aspects of the flight operation and does not constitute permission to disregard the legitimate interests of other statutory bodies such as the Police and Emergency Services, the Highway Agency, Data Commission, Transport for London or local authorities.

3.6 The following permissions and exemptions are required prior to operation:

- Operators who intend to conduct aerial work using SUA are required to apply for a permission from the CAA in accordance with ANO 2009 Article 166(5).
- Operators of unmanned aircraft over 20 kg are required to apply for an exemption from the CAA. Any aerial work aspects will also be covered within this exemption.
- Operators who intend to fly a Small Unmanned Surveillance Aircraft (SUSA) within the separation criteria of ANO 2009 Article 167(2) are required to apply for a permission from the CAA and must submit a safety case including a risk assessment of the operation.

3.7 The provision of images or other data solely for the use of controlling or monitoring the aircraft is not considered to be applicable to the meaning of 'Surveillance or Data Acquisition' covered at ANO 2009 Article 167 for SUSA.

Meaning of Aerial Work

3.8 ANO 2009 Article 259 'Meaning of Aerial Work' details that a flight is for the purpose of aerial work if valuable consideration is given or promised in respect of the flight or the purpose of the flight.

3.9 The article must be carefully consulted to determine if any flight will be considered as aerial work. An additional document 'Summary of the Meaning of Commercial Air Transport, Public Transport and Aerial Work' is also available on the CAA website⁷.

3.10 Flying operations such as research or development flights conducted 'in house' are not normally considered as aerial work provided there is no valuable

⁷ www.caa.co.uk/uas

consideration given or promised in respect of that particular flight.

Operations

Visual Line of Sight (VLOS)

- 3.11 Operating within Visual Line of Sight means that the Remote Pilot is able to maintain direct, unaided (other than corrective lenses) visual contact with the UA which is sufficient to monitor its flight path in relation to other aircraft, persons, vessels, vehicles and structures for the purpose of avoiding collisions. Within the UK, VLOS operations are normally accepted out to a maximum distance of 500 m horizontally and 400 ft vertically from the Remote Pilot. Operations at a greater distance from the Remote Pilot may be permitted if an acceptable safety case is submitted. For example, if the aircraft is large it may be justifiable that its flight path can be monitored visually at a greater distance than 500 m. Conversely, for some small aircraft, operations out to a distance of 500m may mean it is not possible to assure or maintain adequate visual contact.

Extended Visual Line of Sight (EVLOS)

- 3.12 EVLOS operations are operations, either within or beyond 500 m / 400 ft, where the Remote Pilot is still able to comply with his collision avoidance responsibilities, but the requirement for the Remote Pilot to maintain direct visual contact with the UA is addressed via other methods or procedures. It is important to note, however, that collision avoidance is still achieved through 'visual observation' (by the Remote Pilot and/or RPA Observers).
- 3.13 The operator must submit a safety case including a risk assessment for the operation. Factors taken into consideration must include:
- the procedures for avoiding collisions;
 - aircraft size;
 - aircraft colour and markings;
 - aircraft aids to observation;
 - meteorological conditions and visibility, including background conditions (cloud / blue sky);
 - the use of deployed observers; and
 - operating range limits - suitable radio equipment must be fitted in order to be able to effect positive control over the UA at all times.

Beyond Visual Line of Sight (BVLOS)

- 3.14 Operation of a UA beyond a distance where the Remote Pilot is able to respond to or avoid other airspace users by visual means is considered to be a BVLOS

operation.

- 3.15 UA intended for operation beyond visual range of the pilot will require an approved method of aerial separation and collision avoidance that ensures compliance with Rule 8 of the Rules of the Air Regulations 2007 (Rules for avoiding aerial collisions), or will be restricted to operations within segregated airspace. Note: this requirement to avoid collisions applies to all flights conducted under IFR and to flights made with an ATC clearance, as well as to flights under VFR.

Insurance

- 3.16 UAS Operators must comply with Regulation (EC) 785/2004 (Article 2) on Insurance Requirements for Air Carriers and Aircraft Operators. Operators of SUA are advised to consult the Regulation to determine a minimum suitable level of insurance (see Section 1, Chapter 2).

UAS OSC Requirements

- 3.17 Formerly known as the 'Congested Areas Operating Safety Case (CAOSC)⁸', the UAS Operating Safety Case (UAS OSC) has been devised using the ConOps methodology to give a flexible method by which the applicant can provide the CAA with a safety argument for intended operations. Each application for a permission to operate must be accompanied by a UAS OSC (templates for the separate volumes of the UAS OSC are at the Appendices).
- 3.18 Table 4 below provides UAS OSC requirements guidance when applying for a permission to operate.

⁸ All applications made using the CAOSC template prior to the publication of Edition 6 of CAP 722 will be accepted by the CAA

Mass (kg)	Operating examples	Volume 1	Volume 2	Volume 3
0-7	Standard Permission	Required	Recommended	Recommended
	<50m in CA	Required	Required	Required
>7-20	Standard Permission	Required	Recommended	Recommended
	<150m in CA	Required	Required	Required
>20-150	Low Complexity UAS and/or Rural Environment	Required	Recommended	Required
	Low Complexity UAS and/or Semi-rural ⁹	Required	Required	Required
	High Complexity UAS and/or Complex Airspace ¹⁰	Required	Required	Required

Table 4 – Aerial Work UAS OSC Approval Requirements UAS 0-150 kg

Requirements for Small Unmanned Aircraft

3.19 The table below details the applicable legal requirements in articles 166 and 167 of the ANO 2009 for the operation of any SUA dependent upon the mass of the aircraft and whether or not it is surveillance equipped¹¹.

The requirements in the ANO 2009 for SUA (Small Unmanned Aircraft of masses between 0 and 20 kg)	SUA	SUA	SUSA	SUSA
	0-7 kg	>7 kg	0-7 kg	>7 kg
166(1)	✓	✓	✓	✓
166(2)	✓	✓	✓	✓
166(3)	✓	✓	✓	✓
166(4) (a), (b), (c)		✓		✓
166(5)	✓	✓	✓	✓

⁹ May require more formal airworthiness certification

¹⁰ Will require more formal airworthiness certification

¹¹ The CAA-issued permission may allow some exemptions against Article 167(1) and (2) dependent upon the mass of the aircraft.

The requirements in the ANO 2009 for SUA (Small Unmanned Aircraft of masses between 0 and 20 kg)	SUA	SUA	SUSA	SUSA
	0-7 kg	>7 kg	0-7 kg	>7 kg
167(1)&(2) (a),(b),(c),(d)			✓	✓
167(3)&(4)			✓	✓

3.20 The CAA-issued Permission for aerial work has been updated as follows. The current ANO Articles 166 and 167 Permission document is produced in two categories: Permission for SUA not exceeding 7 kg and Permission for SUA of greater than 7 kg but not exceeding 20 kg. Both these Permission documents list the actual type(s) (models) of aircraft that the operator intends to operate. In line with adjusting to the future structure, 'standard' permissions will not list specific types (models) but will grant permission to fly any SUA within one or more of the following classes:

- SUA multirotor with a maximum take-off mass (MTOM) not exceeding 7 kg.
- SUA multirotor with a MTOM greater than 7 kg but not exceeding 20 kg.
- SUA fixed-wing with a MTOM not exceeding 7 kg.
- SUA fixed-wing with a MTOM greater than 7 kg but not exceeding 20 kg.

3.21 Within each class, the applicant will be free to vary or add SUA as they wish without the requirement to undertake a practical flight assessment for each individual machine or when adding or changing to a new type (model). Both categories of NQE (see below) should make their recommendations to the CAA in one or more of the above classes. Existing Permissions, although currently listing individual aircraft, will automatically have the same privileges.

Small Unmanned Aircraft Systems in Congested Areas

Congested Areas

3.22 ANO 2009 Article 255 defines the meaning of 'Congested Areas'. The definition states that a 'Congested Area' means any area in relation to a city, town or settlement which is substantially used for residential, industrial, commercial or recreational purposes. Operations of SUA within congested areas may be permitted in specific locations on the basis of a UAS OSC being submitted as part of an application for aerial work. Separation distances from persons, vessels, vehicles and structures (dependent on whether or not they are under the control of the Remote Pilot) must be specified in the UAS OSC.

Protection of Third Parties

3.23 Under ANO 2009 Article 138, operators of SUA must not recklessly or

negligently cause or permit their aircraft to endanger any person or property. SUA flights within the densely-populated urban environment have a high probability of causing endangerment unless conditions are put on their use so that they reduce the risk to third parties, i.e. the general public. SUA do not currently have any recognised design, certification or other airworthiness standards and therefore operational restrictions have been established that limit the circumstances and locations at which the aircraft can be operated. Each specific limitation can only be varied or exempted in accordance with a permission or exemption granted by the CAA. For operations in congested areas, a SUA operator will need to apply to the CAA for permission to fly a camera-equipped SUA (i.e. a SUSAs):

- Over or within 150 metres of any congested area.
- Over or within 150 metres of an organised open-air assembly of more than 1,000 persons.
- When not engaged in take-off or landing, within 50 metres of any person, vessel, vehicle or structure which is not under the control of the person in charge of the aircraft (during take-off or landing this may be reduced to 30 metres or less if attendant persons are under the control of the person in charge of the aircraft).

3.24 Such a permission would be suitable for those SUA operators that find they are frequently engaged in towns and cities to carry out work for film and TV productions, advertising agencies, marketing or other publicity events, photographic work for large property developments or survey or infrastructure inspections at industrial sites, etc. There is no guarantee that permission can be granted to reduce these distances.

Standard Permissions

3.25 The standard CAA permission for SUA/SUSA in the 7 kg or less category allows flight in congested areas to within 50 metres of persons, structures etc. (or within 30 metres if the persons are under the control of the person in charge of the aircraft). This category of SUA/SUSA cannot fly within 150 metres of open-air assemblies of 1,000 people or more where only a standard permission has been granted.

3.26 The standard CAA permission for SUA/SUSA in the mass category of above 7kg but not exceeding 20 kg does not normally allow flight within congested areas. An operator may apply, utilising the UAS OSC, to the CAA to have their existing permission varied.

3.27 In any circumstances or mass category, it must be noted that flights directly overhead persons and vehicles will not be allowed at any height in a congested area, or otherwise, unless these vehicles and persons are under the control of

the person in charge of the aircraft.

Person under the Control of the Person in Charge

3.28 Persons under the control of the person in charge of the aircraft can generally be defined as:

- Persons solely present for the purpose of participating in the SUA flight operation.
- Persons under the control of the event or site manager who can reasonably be expected to follow directions and safety precautions to avoid unplanned interactions with the SUA. Such persons could include building-site or other industrial workers, film and TV production staff and any other pre-briefed, nominated individuals with an essential task to perform in relation to the event.

3.29 Spectators or other persons gathered for sports or other mass public events that have not been specifically established for the purpose of the SUA operation are not regarded as being 'under the control of the person in charge of the aircraft'.

3.30 In principle, persons under the control of the person in charge of the aircraft at a mass public event must be able to:

- elect to participate or not to participate with the SUA flight operations;
- understand the risk posed to them inherent in the SUA flight operations;
- have reasonable safeguards instituted for them by the site manager and SUA operator during the period of SUA flight operations;
- not have restrictions placed on their engagement with the purpose of the event or activity for which they are present if they do not elect to participate with the SUA operation.

Note: As an example, it is not sufficient for persons at a public event to have been informed of the operations of the SUA via such means as public address systems, website publishing, e-mail, text and electronic or other means of ticketing, etc. without being also able to satisfy the points above. Permissions have, however, occasionally been granted for SUA flights at public events and these involved a segregated take-off site within the main event, with the SUA operating only vertically within strict lateral limits that keep it directly overhead the take-off site. Such flights were also limited by a height restriction and the tolerance of the SUA to wind effects and battery endurance.

3.31 Further guidance on Operational Factors for SUA Flights within Congested Areas can be found at Appendix A to this publication.

Application Process

- 3.32 In order to ensure that sufficient safety measures have been put in place, operators that are required to apply for permission from the CAA will be asked to demonstrate that they have considered the safety implications and taken the steps necessary to ensure that the UA will not endanger anybody.
- 3.33 It is important to understand that it is the operator (defined in ANO 2009 Article 255 - i.e. the person having management of the UA, and not another person who may, for example, have contracted with the operator to have work done) who must apply for an exemption or permission.
- 3.34 Applications for an exemption or permission must be made using the application form (www.caa.co.uk/SRG1320). Submission of applications for UA with an operating mass of 150 kg or less may be submitted direct to the CAA or to an appropriately approved Qualified Entity (see below). All submissions for UA over 150 kg must be submitted, in the first instance, directly to the CAA.

National Qualified Entities

- 3.35 The CAA approves National Qualified Entities (NQEs) to conduct assessments of operators and make recommendations to the CAA based upon these assessments. The NQE will validate the submission and then forward a recommendation for the granting of a permission to the CAA.

NQE Application and Approval System

- 3.36 NQE approvals will be assigned in one of two categories:
- **Full Category.** A Full Category NQE approval corresponds to the pre-existing, conventional approval for an NQE to assess the full range of pilot competency and to act as a 'one-stop shop' for candidates with no existing aviation qualifications or experience. In the move to the new structure, some of the more onerous NQE organisational requirements have been eliminated and a reduced annual fee structure has been introduced. A Full Category NQE must be able to provide a full course but can also choose to offer the individual critical elements to suitable applicants as required. The approval requirements for an organisation to act as a Full Category NQE are set out at Appendix E to this document.

- **Restricted Category.** The Restricted Category NQE approval has been instituted to allow existing 'standard' permission holders to act as a restricted NQE where they will only be approved to conduct practical flying assessments in addition to their general commercial activities. Restricted Category NQE organisations/individuals must have held at least a 'standard' Permission from the CAA for a minimum of one year before they can apply for NQE status. In addition, trade, industry and permission-holder membership organisations wishing to run voluntary coaching and proficiency courses may also apply for an NQE approval, as long as their members who intend carry out practical flying assessments are current permission holders in their own right. The approval requirements for an organisation to act as a Restricted Category NQE are set out at Appendix E to this document.

3.37 NQE organisations should note that Full and Restricted Category approvals granted under this process are UK National approvals only and do not confer any form of approval under European legislation. Specifically, a UK NQE is not a Qualified Entity as defined in Regulation (EC) No. 216/2008 ('The Basic Regulation').

3.38 The CAA has not hitherto stipulated practical flight assessment standards and has allowed UK NQEs to be flexible in designing the actual test conditions. This practice is likely to continue until such time as national or European regulation defines practical test standards for SUA equivalent to those required for national or European Aviation Safety Agency (EASA) Part-FCL flight crew licences. UK NQEs should however ensure that their students are able to satisfactorily demonstrate at least the following skills during the practical flight assessment:

- Pre-flight actions including:
 - Mission planning, airspace considerations and site risk-assessment.
 - Aircraft pre-flight inspection and set-up (including flight controller modes and power-source hazards).
 - Knowledge of the basic actions to be taken in the event of an aircraft emergency or if a mid-air collision hazard arises during the flight.
- In-flight procedures including:
 - Maintaining an effective look-out and keeping the aircraft within Visual Line of Sight (VLOS) at all times.
 - Performing accurate and controlled flight manoeuvres at representative heights and distances (including flight in 'Atti' mode (non-GPS assisted) or equivalent where fitted).
 - Real-time monitoring of aircraft status and endurance limitations.

- Demonstration of a 'return-to-home' function following deliberate control-link transmission failure. Fixed-wing aircraft may demonstrate an equivalent procedure that results in a suitable automated, low-impact descent and landing.
- Post-flight actions including:
 - Shutting down/making-safe the aircraft.
 - Post-flight inspection and recording of any relevant data relating to aircraft general condition, aircraft systems, aircraft components and power-sources, controller functionality and crew health and fatigue.

3.39 It is important to note that approved NQEs offering practical flight assessments must not carry out any 'on-the-job' training or assessment of students during their own normal commercial work activity. Student attendance during such events should only be in the guise of observer status, ancillary to any employee contractual obligations. Prospective NQEs should therefore carefully consider their own legal liability under the relevant commercial and private activity legislation before exposing their students to any work-place related hazard as may be found at public and private venues, building sites, film-sets, etc.

3.40 Details of all approved NQEs can be found on the CAA website¹².

Regulatory Enforcement

3.41 The CAA takes breaches of aviation legislation seriously and will seek to prosecute in cases where dangerous and illegal flying has taken place.

3.42 More information on the regulation of SUA, including a list of operators with permission to fly SUA for commercial use, is available at www.caa.co.uk/uas.

Source Documents

- CAP 393 Air Navigation: The Order and the Regulations.
- CAP 032 UK Aeronautical Information Publication.

¹² www.caa.co.uk/uas

Chapter 4

Civil UAS Remote Pilot Competency

Scope

- 4.1 This Chapter applies to all civil UAS operations in United Kingdom airspace. State (non military) operated UAS are expected to comply with this Chapter, unless otherwise directed by the CAA.
- 4.2 UAS operations conducted for the purposes of testing or development under Design, Production or Maintenance approvals are expected to comply with this Chapter as far as is practicable. However, qualification requirements for Remote Pilots engaged in such operations will be assessed by the CAA at the point of submission for operating approval.

Policy

- 4.3 The requirements for the licensing and training of United Kingdom civil Remote Pilots have not yet been fully developed. It is expected that United Kingdom requirements will ultimately be determined by ICAO Standards and Recommended Practices (SARPs) and EASA regulations.
- 4.4 ICAO is currently developing standards for a Remote Pilot's License (RPL). However until formal licensing requirements are in place the CAA will determine the relevant requirements on a case-by-case basis. In determining whether to permit a person to act as pilot or commander of a UAS, the CAA will consider a number of factors (based upon the ConOps approach) such as pilot experience, maximum aircraft mass, flight control mode, operational control and safety assessment.

Maximum Operating Mass

- 4.5 UAS are currently classified into four categories relating to aircraft mass; the flight crew qualification requirements are related to these. Table 5 details the anticipated qualification level requirement for pilots of UAS in the relevant aircraft mass category.

Operating Mass (maximum)	Pilot Competency / Licensing Requirements
7 kg or less	None, or NQE competency assessment or AMC

Operating Mass (maximum)	Pilot Competency / Licensing Requirements
More than 7 kg to 20 kg	None, RPL,NQE competency assessment or AMC
More than 20 kg to150 kg	RPL, NQE competency assessment or equivalent
More than 150 kg	RPL or equivalent

Table 5 Unmanned Aircraft Mass Related Pilot Competency and Licensing Requirements

UAS Flight Control Mode

- 4.6 Remote Pilots will also be required to meet training and testing requirements for each class or type of UAS they will operate. UAS type or class ratings may be determined on the basis of individual type in the case of larger aircraft, or by class for smaller ones. In seeking to determine whether a particular UAS will be rated according to type or class, the CAA will take into consideration the classification or certification of the UAS, and whether the UAS will be flown by Remote Pilots dedicated to the type.

Small UAS - Pilot Competency Alternative Means of Compliance

Grant of an SUA Permission – Critical Elements

- 4.7 The CAA has identified three critical elements which, taken together, constitute acceptable evidence of pilot competency. These three elements are:
- Adequate theoretical knowledge/general airmanship;
 - Successful completion of a practical flight assessment on the class of SUA that is being applied for; and
 - A minimum amount of recent flying experience on the class of SUA that is being applied for.
- 4.8 Although completion of all three elements constitutes acceptable evidence of pilot competency, the CAA also requires the submission and acceptance of an operations manual in each case before the Permission itself can be granted.
- 4.9 The CAA accepts recommendations from approved NQEs in order to grant a 'standard' Permission for aerial work. The traditional NQE route allows an individual with no formal pilot qualifications or experience to undertake a course which can lead to a recommendation to the CAA for a grant of a CAA Permission. The courses cover all of the critical elements mentioned in paragraph 4.7 plus an assessment of the student's operational procedures as set

out in their operations manual (Vol 1 of the UAS OSC). On successful completion of the course, the applicant will be granted a certificate by the NQE (typically the Basic National UAS Certificate – Small (BNUC-S™)/Remote Pilot Qualification (RPQ), etc). The Permission applicant is then able to apply through the NQE or directly to the CAA for the grant of a CAA Permission that will allow aerial work (flights for commercial purposes). The operations manual (ideally in electronic .pdf format) should accompany the formal application on form SRG 1320 www.caa.co.uk/srg1320, along with electronic copies of the critical evidence of pilot competency and the correct fee.

- 4.10 As the SUA industry has developed, the CAA has been increasingly asked to accept alternative qualifications and methods of demonstrating pilot competency other than those provided through the NQE route. Many recent applicants for a Permission have formal aviation qualifications, hobbyist certificates or recent flight experience that are highly relevant for fulfilling the critical elements set out in paragraph 4.7 above. An analysis of the critical elements points towards the practical flight assessment as being the single most essential of the elements as small unmanned multirotor and fixed-wing aircraft have unique flight and control systems and characteristics. Unless an applicant has already been objectively assessed by a third-party (such as through the British Model Flying Association (BMFA) certificate system), then there still exists a need for applicants to complete this critical element through an independent assessment.
- 4.11 Following this recent review of operational policy, the CAA will now accept alternative methods of satisfying the critical elements in addition to completing a full NQE course. This will necessitate changes to the NQE approval system so that although a practical flight assessment will still need to be undertaken, completion of a full course will only be generally applicable to students with no existing aviation qualifications or experience. The changes to the NQE system are set out at Section 2 Chapter 3. Acceptable alternatives to fulfil the critical elements (evidence of pilot competency) are shown at Table 5.

Other Factors

- 4.12 Prior to the implementation of formal UAS Remote Pilot licensing requirements, the CAA will consider factors such as the arrangements for operational control of a UAS, and the safety risk assessment of a proposed UAS operation, when considering whether to permit an application for a person to act as a Remote Pilot.

Flight Radio Telephony Operators' Licence

- 4.13 Remote Pilots intending to use radiotelephony must ensure that they hold a Flight Radio Telephony Operators' Licence (FRTOL) valid for the privileges intended to be exercised.

	(a)	(b)	(c)	(d)
	Existing Aviation Qualification:	Critical Element: Theoretical Knowledge Requirement / General Airmanship (no requirement for annual renewal)	Critical Element: Initial Practical Flight Assessment Requirement (no requirement for annual renewal)	Critical Element: Experience Requirement (annual renewal)
1	Nil	Completion of a Full Category NQE course		2 hours total flight experience logged within the last 3 calendar months on the class of SUA for which a Permission is sought. Pilots may self-certify through logbook entries.
2	Current EASA Fixed-Wing, Helicopter or Microlight license	Nil	Pilot flight skills assessment verified to the CAA by a Full or Restricted Category NQE in at least one of the following four classes: a) SUA multirotor with a maximum take-off mass (MTOM) not exceeding 7 kg. b) SUA multirotor with a MTOM greater than 7 kg but not exceeding 20 kg. c) SUA fixed-wing with a MTOM not exceeding 7 kg. d) SUA fixed-wing with a MTOM greater than 7 kg but not exceeding 20 kg.	
3	Current UK National Fixed-Wing, Helicopter or Microlight license	Nil		
4	UK Military pilot / remote pilot or RPAS operator qualification (applicable where basic flight training has been carried out in non-segregated UK airspace) RAF VGS Instructor qualifications commencing at G1 Instructor level are also acceptable	Nil		
5	British Gliding Association (BGA) - Bronze 'C' and above (or EASA equivalent)	Nil		
6	BMFA 'A' or 'B' Certificates	Nil	Nil. Helicopter certificate accepted for multirotors	
7	Non-UK SUA/RPAS qualification/license Other lapsed pilot licences or certificates	Case-by-case CAA assessment		

Table 5 - Pilot Competency Criteria for Small Unmanned Aircraft Permission under ANO articles 166 and 167

SECTION 3
Policy

Chapter 1

CAA Policy on Detect and Avoid Capability

Scope

- 1.1 This Chapter offers guidance to industry on how to satisfy the requirements for a Detect and Avoid functions.

Introduction

- 1.2 A significant increase in both civil and military UAS flying is anticipated, most of which will require access to some if not all classes of airspace if it is to be both operationally effective and commercially viable. To achieve this, UAS will have to be able to meet the existing safety standards applicable to equivalent manned aircraft types, appropriate to the class (or classes) of airspace within which they are intended to be operated.

Aim

- 1.3 The aim of this policy statement is to clarify the position of the CAA in respect of its role in assisting the UAS industry to find solutions to achieving a capability and level of safety which is equivalent to the existing 'see and avoid' concept. It is also recognised that the Detect and Avoid capability is only one of a number of requirements that will need to be addressed for safe operation of UAS.

Policy

General

- 1.4 The overriding principle when assessing if proposed UAS Detect and Avoid functions are acceptable is that they must not introduce a greater hazard than currently exists for manned aviation. Any proposed functions must demonstrate at least equivalence with manned aircraft safety standards and, where these standards exist, the UAS must comply with the rules and obligations that apply to manned aircraft including those applicable to separation and collision avoidance.

Separation Assurance and Collision Avoidance Elements

- 1.5 There are two distinct and potentially independent elements to a Detect and Avoid capability, as described below. It must be noted that the remote pilot could act as an element within one or both of these elements, subject to being able to affect the desired outcome.

Detect Function

- 1.6 The detect function is intended to identify potential hazards (other aircraft, terrain, weather etc.) and notify the appropriate mission management and navigation systems.

Avoid Function

- 1.7 The avoid function may be split down into two parts:

- **Separation Assurance:**

This term is used to describe the routine procedures and actions that are applied to prevent aircraft getting into close proximity with each other. Any resolution manoeuvring conducted at this stage must be conducted in accordance with the Rules of the Air. When flying in airspace where the provision of separation is the responsibility of ATC, however, the Remote Pilot must manoeuvre the aircraft in accordance with ATC instructions, in the same fashion as is done for a manned aircraft.

- **Collision Avoidance:**

This is the final layer of conflict management and is the term used to describe any emergency manoeuvre considered necessary to avoid a collision; such a manoeuvre may contradict the Rules of the Air or ATC instructions. While the Remote Pilot would normally be responsible for initiating a collision avoidance manoeuvre, an automatic function may be required in order to cater for collision avoidance scenarios where the Remote Pilot is unable to initiate the manoeuvre in sufficient time, e.g. due to command and control (C2) latency issues or lost link scenarios.

- 1.8 The Detect and Avoid (separation and collision avoidance) capabilities must be able to:

- Detect and avoid traffic (air and ground operations) in accordance with the Rules of the Air;
- Detect and avoid all airborne objects, including gliders, hang-gliders, paragliders, microlights, balloons, parachutists etc.;
- Enable the Remote Pilot to determine the in-flight meteorological conditions;
- Avoid hazardous weather;
- Detect and avoid terrain and other obstacles;
- Perform equivalent functions, such as maintaining separation, spacing and sequencing that would be done visually in a manned aircraft.

Research and Development

- 1.9 It is not the role of the CAA to carry out research and development activities; this must be performed by the UAS industry. The research and development process will include full and open consultation with the CAA at appropriate stages so that the CAA can provide guidance on the interpretation of the applicable rules and regulations.
- 1.10 It is strongly recommended that developers of Detect and Avoid technology for the use of UAS in non-segregated airspace set up a programme of regular discussion and review of their research and development activity with the CAA; early engagement is vital in the process. This will ensure that system developers will have access to the best advice on the applicable regulations, thereby increasing the likelihood of the ultimate acceptance of any Detect and Avoid system by the civil authorities.
- 1.11 UAS designers will need to demonstrate equivalence to the regulatory and airworthiness standards that are set for manned aircraft.
- 1.12 To ensure that the Detect and Avoid function can provide the required level of safety they will be developed for the various component functions which include threat detection, assessment of the collision threat, selection of an appropriate avoidance manoeuvre and execution of a manoeuvre compatible with the aircraft's performance capabilities and airspace environment. It is recommended that the System Safety Assessment process be followed (Section 4 Chapter 4) as this will support determination and classification of the various hazards and thus the level of integrity that may be required from particular system approaches.

Factors for Consideration when Developing Detect and Avoid Capability

- 1.13 The CAA does not define the matters to be taken into account for the design of aircraft or their systems. However, for the guidance of those engaged in the development of Detect and Avoid systems, some of the factors that may need to be considered are listed below:
- Ability to comply with the Rules of the Air;
 - Airworthiness;
 - Control method, controllability and manoeuvrability;
 - Flight performance;
 - Communications procedures and associated links.
 - Security (physical and Cyber);

- Emergency actions, reversionary or failure modes in the event of degradation of any part of the UAS and its associated Control and/or Relay Stations;
- Actions in the event of lost communications and/or failure of on-board Detect and Avoid equipment;
- Ability to determine real-time meteorological conditions and type of terrain being overflown;
- Nature of task and/or payload;
- System Authority of operation and control;
- Method of sensing other airborne objects;
- Remote Pilot level of competence;
- Communications with ATS providers, procedures and links with control station;
- Means of launch/take-off and recovery/landing;
- Reaction logic to other airspace objects;
- Flight termination;
- Description of the operation and classification of the airspace in which it is planned to be flown;
- Transaction times (e.g. including delays introduced by satellite links);
- Address both cooperative and non-cooperative air traffic.

Note: This list above is not exhaustive.

Chapter 2

CAA Policy on Human Factors in UAS Operations

Scope

- 2.1 This Chapter offers guidance to industry on how to address the human factors issues associated with the design, operation and maintenance of UAS.

Introduction

- 2.2 It is recognised by the CAA that Human Factors represent an important aspect of the design, operation and maintenance of UAS.
- 2.3 The fundamental concepts of Human Factors in aviation are covered by CAP 719. Additional guidance on human factors issues associated with aircraft maintenance is provided in CAP 716.
- 2.4 It is important to recognise that the human is an integral element of any UAS operation and, therefore, in addition to the standard Human Factors issues that relate to aviation development, operation and maintenance, a number of unique Human Factors issues associated with remote operation will also need to be addressed.
- 2.5 This guidance outlines a number of Human Factors recommendations related to the design, production operation and maintenance of UAS flown routinely in UK airspace.

Policy

General

- 2.6 A system of systems approach must be adopted in the analysis, design and development of the UAS. This approach deals with all the systems as a combined entity and addresses the interactions between those systems. Such an approach must involve a detailed analysis of the human requirements and encompass the Human Factors Integration domains:
- Manpower;
 - Personnel;
 - Training;
 - Human Engineering;
 - System Safety;

- Health Hazards;
- Social and Organisational;
- Ergonomics;
- Human-Machine Interface (HMI) Development and Assessment;
- Human Performance, including workload, situational awareness, teamwork and user acceptance;
- Human Error Assessment.

2.7 This approach must be applied to all the Human Factors issues identified in this Chapter.

Design Human Factors

2.8 There are two types of Human Factors issues that need to be addressed for design:

- Human factors that affect design teams
- Design induced remote pilot or maintenance human factors issues

Human Factors That Affect Design Teams

2.9 The set of problems that can initiate Human Factors issues for design teams are not dissimilar to other environments. These include but are not limited to:

- Insufficient time to perform a task;
- Insufficient training and experience to perform a task;
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Rapid and/or uncontrolled changes to requirements;
- Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual's time);
- Fatigue;
- Poor or non-existent working relationships with management and/or other teams.

2.10 Each of these issues can result in a design team making an error and failing to detect it before the aircraft or aircraft system enters service. These errors can result in operational or maintenance problems (system failures, inappropriate maintenance etc) and can even drive additional human factors issues in other aviation domains such as the flight deck or maintenance.

2.11 Organisations that are developing UAS must ensure that the programme

management aspects of their projects address potential Human Factors issues (e.g. provision of appropriate work spaces and instructions, effective control of the number of simultaneous demands made on individuals, effective control of the rate of requirement change, management of fatigue etc). The means by which this will be achieved must be described to the authority for any proposed certification project

Design Induced Remote Pilot Human Factors

2.12 The set of design induced remote pilot Human Factors issues includes but is not limited to:

- Insufficient situational awareness (as a result of missing/inadequate information and/or data latency);
- Information overload/underload;
- Incorrect prioritisation of alerts¹³;
- Insufficient notice of the need to perform a task (possibly related to data latency);
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Lack of clarity regarding where to find the relevant control instructions (Standard Operating Procedures, Aircraft Flight Manuals etc);
- Non-obvious system mode changes or mode confusion.

2.13 Each of these issues can result in a remote pilot either making an error or failing to detect an aircraft safety issue.

2.14 Organisations that are developing UASs must ensure that any identified potential Human Factors issues (e.g. management of situational awareness, effective control of the number of simultaneous demands made on remote pilots etc) are addressed and mitigated as part of the UAS development processes. The means by which this will be achieved must be described to the authority for any proposed certification project.

Design Induced Maintenance Human Factors

2.15 The set of design induced maintenance Human Factors issues includes but is not limited to:

- Insufficient situational awareness (as a result of missing/inadequate information and/or data latency);
- Information overload/underload;

¹³ Alerts is a generic term that includes warnings, cautions and status messages.

- Incorrect prioritisation of alerts¹⁴;
- Insufficient notice of the need to perform a task (possibly related to data latency);
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Lack of clarity regarding where to find the relevant control instructions (Standard Operating Procedures, Aircraft Flight Manuals etc);
- Non-obvious system mode changes.

2.16 Each of these issues can result in a maintenance error which could result in an aircraft safety issue.

2.17 Organisations that are developing UASs must ensure that any identified potential maintenance Human Factors issues (e.g. provision of clear and unambiguous task instructions etc) are addressed and mitigated as part of the UAS development processes. The means by which this will be achieved must be described to the authority for any proposed certification project.

Outstanding Problem Reports

2.18 Any outstanding problem reports that are related to the interface between the system and the remote pilot or maintenance functions must be carefully evaluated in terms of any potential human factors issues. If the problem is likely to result in Human Factors issues and it cannot be rectified before the system enters service then:

- The certification flight or maintenance teams must be informed of the problem and its likely consequences;
- Where applicable the relevant flight or maintenance documentation must be updated to ensure that the remote pilots or maintenance team are aware of both the problem and any action(s) they need to take in order to mitigate it;
- The certification team must be provided with an analysis of the problem, the necessary resolution and the plan for incorporating that resolution.

Production Human Factors

2.19 The set of problems that can initiate Human Factors issues for production teams is not dissimilar to other environments. These include but are not limited to:

- Insufficient time to perform a task;
- Insufficient training and experience to perform a task;

¹⁴ Alerts is a generic term that includes warnings, cautions and status messages.

- Inadequate, incomplete or ambiguous procedures, work instructions;
- Uncontrolled changes to build specifications;
- Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual's time);
- Fatigue.

2.20 Organisations that are developing UASs must ensure that their production management processes address potential Human Factors issues (e.g. provision of appropriate work spaces and instructions, effective control of the number of simultaneous demands made on individuals, management of fatigue etc). The means by which this will be achieved will be described to the authority for any proposed certification project.

Operational Human Factors

2.21 In addition to the “standard” operational Human Factors issues, the physical separation of the Remote Pilot introduces a number of issues that need to be considered. These include but are not limited to:

- Degradation of situational awareness due to remote operation and associated lack of multi-sensory feedback;
- Temporal degradation resulting from data latency, pilot recognition, pilot response and pilot command latency over the data link requires consideration in the design of controls and displays;
- The Remote Pilot's risk perception and behaviour are affected by the absence of sensory/perceptual cues and the sense of a shared fate with the vehicle;
- Bandwidth limitations and reliability of the data link compromising the amount and quality of information available to the Remote Pilot and thereby limiting his awareness of the RPA's status and position.

2.22 It is therefore important to:

- Avoid presenting misleading cues and to consider alternative methods of representing the UAS data;
- Prioritise relevant data sent over the C2 link to satisfy the needs for all phases of the operation; and
- Ensure that data link characteristics and performance (such as latency and bandwidth) are taken account of within the relevant information and status displays in the Remote Pilot Station (RPS).

Authority and Control

- 2.23 The Remote Pilot is ultimately responsible for the safe conduct of the aircraft. They will, therefore, be required to sanction all actions undertaken by the aircraft whether that is during the planning stage (by acceptance of the flight plan) or during the execution of the mission via authorisation, re-plans or direct command. Though fully autonomous operation of a UAS is not currently envisaged, certain elements of a mission may be carried out without human intervention (but with prior authorisation). A good example of this is the Collision Avoidance System where, due to possible latency within the C2 link, the Remote Pilot may not have sufficient time to react and therefore the on-board systems may need to be given the authority to take control of the aircraft.
- 2.24 This level of independent capability, that must operate predictably and safely when required, can also be harnessed as a deliberative function throughout the flight. This supports a change in the piloting role from a low-level 'hands-on' type of control to an effective high-level decision maker. Due to the nature of remote operation, the RPS need no longer be constrained to follow a traditional cockpit design philosophy and must be designed to fit the new operator role. Account may be taken of enhanced system functionality allowing the pilot to control the systems as required via delegation of authority.
- 2.25 A clear understanding of the scope of any autonomous operation and its automated sub-systems is key to safe operations. Specific areas that need to be addressed are:
- User's understanding of the system's operation;
 - Recovery of control after failure of an automated system;
 - User's expertise in manual reversion (they will not necessarily be pilots);
 - Boredom and fatigue; and
 - Design of the controls, including the design 'model', allowing the user to understand how the different levels of automation operate.

Ergonomics

- 2.26 The RPS will be the major interface between the Remote Pilot and the aircraft. The advice contained herein relates to the type of information and the nature of the tasks that would be undertaken at an RPS, it does not set the airworthiness, technical or security requirements. The ergonomic standards must ensure that the pilot works in an environment that is fit for purpose, does not create distractions and provides an environment that will allow pilots to maintain alertness throughout a shift period.
- 2.27 The ergonomic requirements of 'hand held' (VLOS) remote pilot stations must

also be considered. Careful consideration must be given to the environmental conditions that will be encountered when operating outdoors (excesses in temperature, wet or windy conditions etc.). The potential for distraction to the pilot is also much greater in this environment.

Flight Crew Awareness

- 2.28 A number of sub-systems associated with the operation of a UAS are likely to be complex in their operation and therefore may very well be automated. The system must provide the operator with appropriate information to monitor and control its operation. Provision must be made for the operator to be able to intervene and override the system (e.g. abort take-off, go around).

Transfer of Control between Remote Pilots

- 2.29 UAS operations may require the transfer of control to another pilot. This operation needs to be carefully designed to ensure that the handover is accomplished in a safe and consistent manner and would be expected to include the following elements:
- Offer of control;
 - Exchange of relevant information;
 - Acceptance of control; and
 - Confirmation of successful handover.
- 2.30 The exchange of information between Remote Pilots (co-located or remotely located) will require procedures that ensure that the receiving pilot has complete knowledge of the following:
- Flight Mode;
 - UAS flight parameters and aircraft status;
 - UAS sub-system status (fuel system, engine, communications, autopilot etc);
 - Aircraft position, flight plan and other airspace related information (relevant NOTAMs etc.);
 - Weather;
 - The current ATC clearance and frequency in use;
 - Positions of any relevant RPS control settings in order to ensure that those of the accepting RPS are correctly aligned with the transferring RPS.
- 2.31 The transferring pilot will remain in control of the RPA until the handover is complete and the accepting pilot has confirmed that he is ready to assume control. In addition:

- Procedures to cater for the recovery of control in the event of a failure during the transfer process will be required; and
- Special attention will be required when designing handover procedures involving a significant change in the control interface, for example between a VLOS 'Launch and Recovery Element' RPS and a BVLOS 'En-Route' RPS.

Crew Resource Management

2.32 Workload and Crew Resource Management play an equally important role in the ground station as they do on a manned flight deck. The allocation and delineation of roles must ensure a balanced workload and shared situation awareness of the UAS status and proximity to other aircraft and flight paths to ensure that:

- The display design provides clear and rapid information retrieval matched to the human needs; and
- The Remote Crew Station design promotes good team co-ordination.

Fatigue and Stress

2.33 Fatigue and stress are contributory factors to human error. Therefore, in order to ensure that vigilance is maintained at a satisfactory level in terms of safety, consideration must be given to the following:

- Crew duty times;
- Regular breaks;
- Rest periods;
- Health and Safety requirements;
- Handover/Take Over procedures;
- The crew responsibility and workload.

The work regime across the crew must take this into account.

Degradation and Failure

2.34 Degradation of performance and failures will require a philosophy for dealing with situations to ensure consistent and appropriate application of warnings, both visual and auditory. The philosophy must ensure that:

- The design provides good error detection and recovery;
- The design is fail-safe and protects against inadvertent operator actions that could instigate a catastrophic failure;

- In the event of degraded or total breakdown in the communication link the status of the lost link will be displayed to the operator. Ideally the expected planned reactions of the UA to the situation will also be displayed to the operator;
- Operating procedures are designed to be intuitive, not ambiguous and reinforced by training as required.

Maintenance Human Factors

2.35 The set of problems that can initiate Human Factors issues for maintenance teams is not dissimilar to other environments. These include but are not limited to:

- Insufficient time to perform a task;
- Insufficient training and experience to perform a task;
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual's time);
- Fatigue;
- Poor or non-existent working relationships with management and/or other teams.

2.36 Each of these issues can result in a maintenance team making an error and failing to detect it before the aircraft or aircraft system enters service. These errors can result in operational or maintenance problems (system failures, inappropriate maintenance etc.) and can even drive additional Human Factors issues in other aviation domains such as the flight deck or maintenance.

2.37 Organisations that are developing UASs must ensure that any maintenance Human Factors issues (e.g. provision of clear and unambiguous instructions) are addressed. The means by which this will be achieved must be described to the authority for any proposed certification project.

Future Trends

2.38 Future developments in UAS are moving more towards mitigating Remote Pilot workload through advanced decision support systems. Human Factors expertise will be central to such developments to produce a system that is not only safe but also ensures the correct level of crew workload for all mission tasks and phases of flight.

Source Documents

- CAP 719 Fundamental Human Factors Concepts
- CAP 716 Aviation Maintenance Human Factors (EASA/JAR145 Approved Organisations)
- CAP 737 Crew Resource Management (CRM) Training
- CAP 789 Requirements and Guidance Material for Operators
- ISO 9241
- ISO 13407

Chapter 3

CAA Policy on UAS Autonomy

Scope

- 3.1 This guidance relates to the regulatory interpretation of the term “autonomous” and provides clarification on the use of high authority automated systems in civil UAS.

Introduction

- 3.2 The dictionary definition of autonomy is “freedom from external control or influence”. The need to meet the safety requirements, defined in the various Certification Specifications under CS XX.1309, for "Equipment, Systems and Installations" means that at this point in time all UAS systems are required to perform deterministically. This means that their response to any set of inputs must be the result of a pre-designed data evaluation output activation process. As a result, there are currently no UAS related systems that meet the definition of autonomous.
- 3.3 In general, UAS systems fall in to two categories:
- Highly automated – those systems that still require inputs from a human operator (e.g. confirmation of a proposed action) but which can implement the action without further human interaction once the initial input has been provided.
 - High authority automated systems – those systems that can evaluate data, select a course of action and implement that action without the need for human input. Good examples of these systems are flight control systems and engine control systems that are designed to control certain aspects of aircraft behaviour without input from the flight crew.
- 3.4 The concept of an “autonomous” UAS is a system that will do everything for itself using high authority automated systems. It will be able to follow the planned route, communicate with Aircraft Controllers and other airspace users, detect, diagnose and recover from faults and operate at least as safely as a system with continuous human involvement. In essence, an autonomous UAS will be equipped with high authority control systems that can act without input from a human.

What is the Difference between Automation and Authority?

- 3.5 Automation is the capability of a system to act using a set of pre-designed functions without human interaction (e.g. robotic manufacturing).
- 3.6 The level of authority a system has is defined by the results that the system can achieve. For example a flight control computer will be limited in terms of the amount of bank angle it can command (e.g. 45°) whereas the human flight crew will be able to demand up to 60° of bank. A full authority system will be able to achieve the same results as a human operator.

Use of High Authority Automatic Systems

- 3.7 High authority automatic systems have the capability to take actions based on an evaluation of a given dataset that represents the current situation including the status of all the relevant systems, geographical data and environmental data.
- 3.8 Although these systems will take actions based on an evaluation of a given dataset they are required to be deterministic in that the system must always respond in the same way to the same set of data. This means that the designs of the associated monitoring and control systems need to be carefully considered such that the actions related to any given dataset are appropriate and will not hazard either the aircraft or any third parties in the same area.
- 3.9 High authority automatic systems are usually composed of a number of sub-systems used to gather data, evaluate data, select an appropriate set of actions and issue commands to related control systems. These systems can include flight management systems, detect and avoid systems, power management systems, etc.
- 3.10 In an UAS a system can have authority over two types of function: general control system functions (e.g. flight control computers) and navigational commands.

Delegation to a High Authority Automatic System

- 3.11 The concept of high authority automatic systems covers a range of varying degrees of system authority ranging from full authority where the systems are capable of operating without human control or oversight to lesser levels of authority where the system is dependent upon some degree of human input (e.g. confirmation of proposed actions).
- 3.12 The level of authority a system can have with respect to navigational commands may vary during any flight, dependent upon the hazards the aircraft is faced with (e.g. terrain or potential airborne conflict with other aircraft) and the time available for the human operator to effectively intervene. If the aircraft is flying in clear airspace with no nearby terrain the system may be designed such that any flight instructions (e.g. amendment to a flight plan) are instigated by a human

operator. However, if the aircraft is faced with an immediate hazard (terrain/other aircraft) and there is insufficient time for a human operator to intervene (based on signal latency etc.) the UAS will need to be able to mitigate that risk. These mitigations may include the use of full authority automatic systems.

- 3.13 Although it is anticipated that most systems will be operated using a lesser level of authority, the design of the overall system (control station, air vehicle and related operational procedures) will need to take account of the failure conditions associated with loss of the command and control communications link between the control station and the air vehicle and this may drive a need for the use of full authority systems.

Potential Future Developments

Learning/Self Modifying Systems

- 3.14 A learning or self modifying system is one that uses data related to previous actions to modify its outputs such that their results are closer to a previously defined desired outcome. Although learning systems do have the potential to be used in UAS, the overall safety requirements (for example the need to comply with CS XX.1309) still apply. This means that it may not be possible to use these systems to their full potential.
- 3.15 It is also important to note that these systems have the potential to be more susceptible to the effects of emergent behaviour and, as such, the evaluation of such systems would out of necessity need to be very detailed.

Other Potential Developments

- 3.16 It is possible that, at some point in the future, the aviation industry may consider the use of non-deterministic systems to improve overall system flexibility and performance.
- 3.17 Whilst there are no regulations that specifically prohibit this, the use of non-deterministic systems will drive a number of system and operational safety assessment issues that will need to be addressed before the use of this type of technology could be accepted for use in aviation.

Policy

General

- 3.18 All past and current civil aircraft operations and standards have an inherent assumption that a competent human is able to intervene and take direct control within a few seconds at any stage, and that the human will be presented with enough information to have continuous situational awareness. It is to be expected that, for the foreseeable future, the civil aviation authorities would require this human intervention facility to be available for all UAS regardless of

their level of autonomy.

Human Authority over Autonomous UAS

- 3.19 CAA policy is that all UAS must be under the command of a Remote Pilot. Dependent upon the level of autonomy, a Remote Pilot may simultaneously assume responsibility for more than one aircraft, particularly when this can be accomplished safely whilst directing the activities of one or more other Remote Pilots. However, if this option is to be facilitated the applicant will need to demonstrate that the associated human factors issues (displayed information, communication protocols, etc) have been fully considered and mitigated.

Safe Operation with Other Airspace Users

- 3.20 Autonomous UAS must demonstrate an equivalent level of compliance with the rules and procedures that apply to manned aircraft. It is expected that this will require the inclusion of an approved Detect and Avoid capability when UAS are operating outside segregated airspace.

Compliance with Air Traffic Management Requirements

- 3.21 Autonomous UAS operation is expected to be transparent to ATM providers and other airspace users. The autonomous UAS will be required to comply with any valid ATC instruction or a request for information made by an ATM unit in the same way and within the same timeframe that the pilot of a manned aircraft would. These instructions may take a variety of forms and, for example, may be to follow another aircraft or to confirm that another aircraft is in visual sight.

Emergencies

- 3.22 The decision making function(s) of any autonomous UAS must be capable of handling the same range of exceptional and emergency conditions as manned aircraft, as well as ensuring that malfunction or loss of the decision making function(s) itself does not cause a reduction in safety.

Factors for Consideration when Applying for Certification of Autonomous Systems

Data Integrity

- 3.23 Autonomous systems select particular actions based on the data they receive from sensors related to the aircraft environment (airspeed, altitude, met data etc), system status indicators (fault flags, etc), navigational data (programmed flight plans, GPS, etc.) and command and control data received from control stations. As such, UAS developers will need to ensure that any data related to autonomous control has a sufficient level of integrity such that the ability to comply with basic safety requirements is maintained. This will require the

development of appropriately robust communication and data validation systems.

Security

- 3.24 An autonomous system must be demonstrated to be protected from accepting unauthorised commands, or from being “spoofed” by false or misleading data. Consequently, UAS will have a high degree of dependence upon secure communications, even if they are designed to be capable of detecting and rejecting false or misleading commands.

Chapter 4

CAA Policy on Security Issues for UAS Operations

Scope

- 4.1 This chapter offers guidance to industry on how to implement and satisfy the requirements for security through all UAS lifecycle activities (i.e. initial concept, development, operation and maintenance and decommissioning).

Policy

- 4.2 It is CAA Policy that any UAS operating outside of a UK Danger Area will not increase the risk to existing airspace users and will not deny airspace to them. This policy requires a level of safety and security equivalent to that of manned aviation.
- 4.3 Current policy also states that an UAS must have adequate security to protect the system from unauthorised modification, interference, corruption or control/command action.

Factors for Consideration when Developing Security for UAS

Holistic Approach

- 4.4 When considering security for the UAS it is important to take a holistic approach, paying equal cognisance to technical, policy and physical security for the UAS as a whole. Utilising this approach will help ensure that issues are not overlooked that may affect security and ultimately safety.
- 4.5 By utilising proven industry approaches to the protection of Confidentiality, Integrity and Availability (CIA), security measures applied can benefit the UAS operator by assuring availability of service and the integrity and confidentiality of both data and operations.

Security Aspects to be Addressed

- 4.6 Security aspects are required to address particular potential weaknesses to UAS such as employees, location, accessibility, technology, management structure and governance.
- 4.7 Such security aspects include but are not limited to:
- The availability of system assets, e.g. ensuring that system assets and information are accessible to authorised personnel or processes without undue delay;

- Physical security of system elements and assets, e.g. ensuring adequate physical protection is afforded to system assets;
- Procedural security for the secure and safe operation of the system, e.g. ensuring adequate policies such as Security Operating Procedures are drafted, applied, reviewed and maintained;
- Data exchange between system elements, e.g. ensuring the confidentiality and integrity of critical assets is maintained during exchanges within the system, over communication channels and by other means such as physical media;
- Accuracy and integrity of system assets, e.g. ensuring threats to system assets caused by inaccuracies in data, misrouting of messages and software/hardware corruption are minimised and actual errors are detected;
- Access control to system elements, e.g. ensuring access to system assets is restricted to persons or processes with the appropriate authority and 'need-to-know';
- Authentication and identification to system assets, e.g. ensuring all individuals and processes requiring access to system assets can be reliably identified and their authorisation established;
- Accounting of system assets, e.g. ensuring that individual accountability for system assets is enforced so as to impede and deter any person or process, having gained access to system assets, from adversely affecting the system availability, integrity and confidentiality;
- Auditing and Accountability of system assets e.g. ensure that attempted breaches of security are impeded, and that actual breaches of security are revealed. All such attempted and actual security incidents must be investigated by dedicated investigation staff and reports produced;
- Object Reuse of system assets, e.g. ensure that any system resources re-usage, such as processes, transitory storage areas and areas of disk archive storage, maintains availability, integrity and confidentiality of assets;
- Asset Retention, e.g. ensuring that system assets are securely retained and stored whilst maintaining availability, integrity and confidentiality.

4.8 Identified and derived requirements would then sit within each identified security aspect and be applied (where necessary) to parts of the UAS, e.g. ground based system (including the communications link) and the UA itself. The requirements must be ultimately traced to the overall policy requirements.

Security Process

4.9 Any agreed security design, evaluation and accreditation process will be

integrated (where necessary) with the existing certification, approval and licensing processes utilised for manned aircraft.

- 4.10 The security design, evaluation and accreditation process will be considered as a factor to the operational scenario, including but not limited to:
- Applicable flight rules;
 - Aircraft capabilities and performance including kinetic energy and lethal area;
 - Operating environment (type of airspace, overflown population density);
 - Opportunities for attack and desirability.
- 4.11 The operational scenarios, along with other applicable factors, must be combined with possible weaknesses to the system to determine a measure of perceived risk. A possible security lifecycle for the UAS is shown in Figure 1 and this particular phase is referred to as the risk assessment phase of the process.
- 4.12 Risk management techniques must then be utilised to reduce the perceived risk to an acceptable level of residual risk. As shown in Figure 1 this phase is referred to as the risk mitigation phase of the process.
- 4.13 The risk management techniques implemented are verified and evaluated for effectiveness in a regular cycle of 'action and review' ensuring optimum effectiveness is maintained throughout the lifecycle. As shown in Figure 1 this phase is referred to as the validation and verification phase of the process.
- 4.14 Although the approach above is directly applicable to technical security it must be borne in mind that this process must be supported by the application of both good physical security and procedural security and these could be drawn up by interactions between industry, the CAA and Government agencies.

Current UAS Security Work

- 4.15 The current security research work draws on sector experience and recognised security standards. Through liaison with Government agencies, system security policies are formed that are not only thorough due to their holistic approach but also achievable due to the recognition that systems will have varying operational roles.

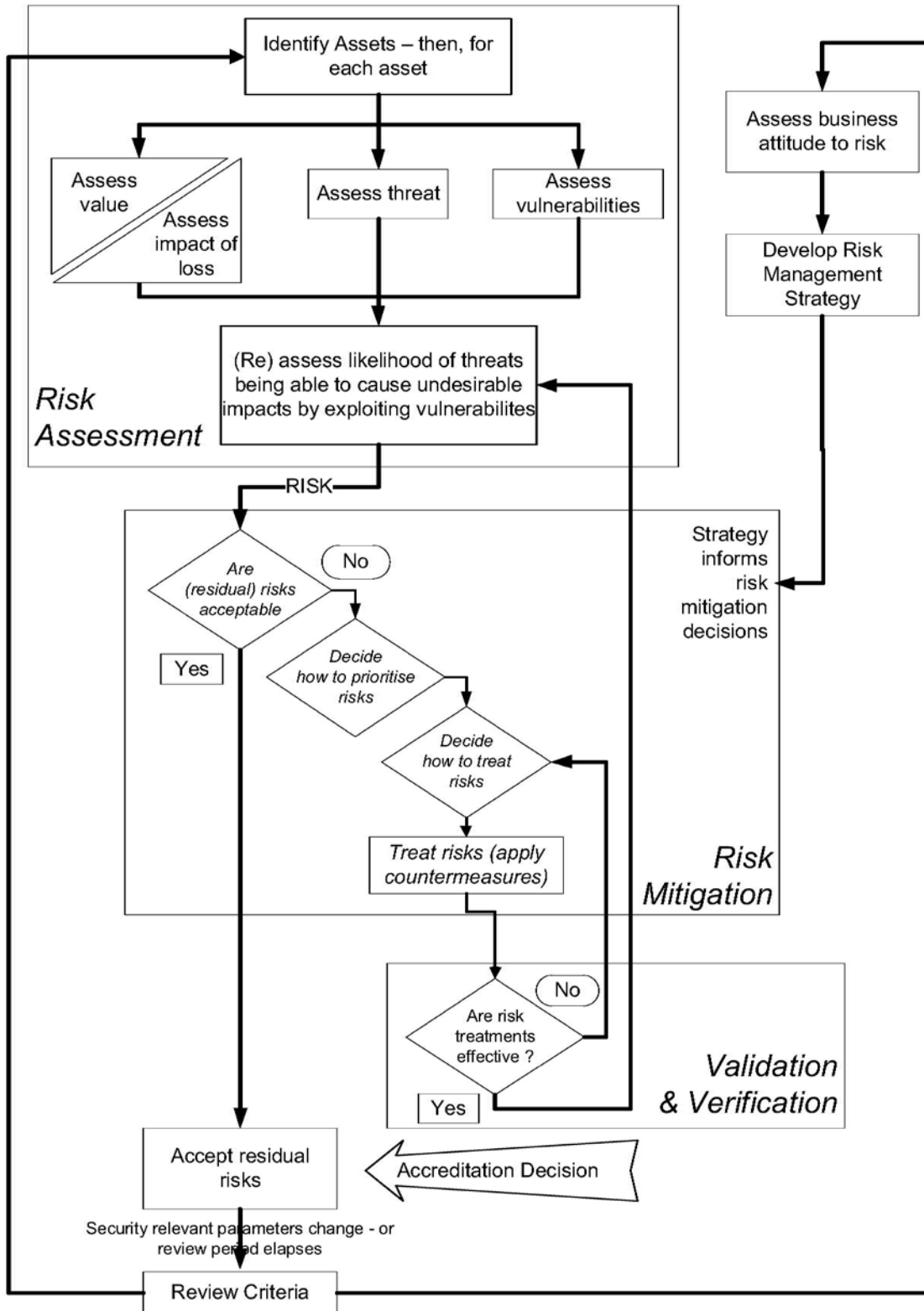


Figure 1 Possible Security Approach

Chapter 5

CAA Policy on UAS Spectrum Issues

Scope

- 5.1 This chapter provides:
- guidance to industry on the CAA policy on the use of frequencies to support UAS operations;
 - guidance to industry on the assignment of frequencies in the absence of specifically identified UAS spectrum;
 - guidance to industry with respect to current activities to progress the allocation of dedicated spectrum to support safety-critical UAS functionality (Command and Control / Detect and Avoid) through the relevant International Telecommunication Union (ITU) processes.

Introduction

- 5.2 The provision of a number of radiocommunication systems is essential to the safe and expeditious operation of UAS. The number and type of these radiocommunication systems vary according to the UAS application. A number of the safety-critical applications are already supported by existing aeronautical systems that operate in dedicated spectrum that ensures the appropriate level of protection.
- 5.3 However, the identification of suitable spectrum for certain UAS safety-critical systems, such as Command and Control, is still in its infancy and under further consideration by the ITU. During the World Radiocommunications Conference in 2012 (WRC 12), 61 MHz of additional terrestrial aeronautical safety spectrum was allocated in the frequency band 5030-5091 MHz; no additional spectrum was allocated for aeronautical satellite use, but the regulatory provisions pertaining to 150 MHz of aeronautical safety satellite spectrum in the frequency band 5000-5150 MHz were revised to ease access to the spectrum and increase protection. Further details will be published when clarified.

Aim

- 5.4 The aim of this policy statement is to clarify the position of the CAA in respect to how it expects the UAS industry to use spectrum and how it is prepared to assist in obtaining access to dedicated spectrum for safety-critical systems.

Policy

- 5.5 The CAA policy is:
- to ensure that frequencies used to support safety-critical UAS functionality meet both international and national regulations/legislation;
 - to ensure that all frequencies used to support safety-critical UAS functionality have been co-ordinated and licensed in accordance with the appropriate licensing regime;
 - to ensure that any such licence obtained provides suitable protection to the use of that frequency appropriate to the functionality and safety criticality of the systems being supported and the area of operation;
 - to assist in the identification of suitable dedicated spectrum to support UAS safety-critical functionality.

Assignment of Frequencies

- 5.6 The assignment of frequencies within the UK is the responsibility of OFCOM; however, in the bands below the responsibility is undertaken by the CAA on behalf of OFCOM:
- 255 - 526.5 kHz Radionavigation
 - 108 – 137 MHz Radionavigation/Radiocommunications
 - 328.6 – 335.4 MHz Radionavigation
 - 960 – 1 350 MHz Radionavigation/Radar
 - 2 700 – 3 100 MHz Radar
 - 4 200 – 4 400 MHz Radionavigation
 - 5 000 – 5 150 MHz Radionavigation
 - 9 000 – 9 200 MHz Radar
 - 9 300 – 9 500 MHz Radar
- 5.7 Applications for the assignment of frequencies within the bands identified above must be addressed to the CAA. Applications for the use of frequency other than those listed above must be addressed to OFCOM. Of additional note is that any aircraft system transmitting on 1030 MHz, as may typically be used in collision warning or sense-and avoid systems, must not be operated without an approval from the National IFF and SSR Committee (NISC) (see CAP 761).

Allocation of Spectrum

- 5.8 The CAA support OFCOM by providing the UK lead on issues related to aeronautical spectrum, including UAS. For information on how to participate in the process for the identification and allocation of spectrum that can be used to support UAS operations contact the CAA.

Use of 35 MHz, 2.4 GHz and 5.8GHz

- 5.9 There are no specific frequencies allocated for use by UAS in the UK. However, the most commonly found are 35 MHz, 2.4 GHz and 5.8 GHz.
- 5.10 35 MHz is a frequency designated for Model Aircraft use only, with the assumption that clubs and individuals will be operating in a known environment to strict channel allocation rules. It is therefore not considered to be a suitable frequency for UAS operations where the whereabouts of other users is usually difficult to assess.
- 5.11 2.4 GHz is a licence free band used for car wireless keys, household internet and a wide range of other applications. Although this is considered to be far more robust to interference than 35 MHz, operators must act with appropriate caution in areas where it is expected that there will be a high degree of 2.4 GHz activity.
- 5.12 In addition, operations close to any facility that could cause interference (such as a radar station) could potentially disrupt communications with the UAS, whatever the frequency in use.

Chapter 6

CAA Policy on UAS Registration

Scope

- 6.1 The registration requirements for civil UAS are contained in the ANO and are in line with the requirements of ICAO Annex 7.

Policy

- 6.2 The registration requirements for unmanned aircraft are the same as for any other aircraft. The legislative requirements are contained in the ANO, Articles 3 to 10.
- 6.3 UA with an operating mass in excess of 20 kg are required to be registered unless they are flying under an exemption or under the provisions of a 'B Conditions' approval issued to an organisation under BCAR A8-9 (see www.caa.co.uk/cap553). UA with an operating mass of more than 150 kg must be registered with the CAA. Once the CAA has processed the application, the aircraft will be issued with a registration ID consisting of five characters starting 'G-' (e.g. G-ABCD) and the details will be entered into the aircraft register. The registration must be displayed permanently on the aircraft in accordance with Part 3 of Schedule 3 to the ANO 2009.
- 6.4 EC Regulation 785/2004 requires most operators of aircraft, irrespective of the purposes for which they fly, to hold adequate levels of insurance in order to meet their liabilities in the event of an accident. This EC Regulation specifies amongst other things the minimum levels of third party accident and war risk insurance for aircraft operating into, over or within the EU (including UAS) depending on their MTOM.
- 6.5 Compliance monitoring of the insurance regulation is carried out by the CAA Aircraft Registration Section. Details of the insurance requirements can be found on the CAA website¹⁵ under "Mandatory Insurance Requirements".

Source Documents

- 6.6 Air Navigation Order 2009, Articles 3 to 10. Other guidance material is available at www.caa.co.uk/aircraftregister.

¹⁵ www.caa.co.uk/default.aspx?catid=122&pagetype=90&pageid=4510

Chapter 7

CAA Policy on Radar Surveillance

Scope

- 7.1 There have been no previous CAA regulations governing the surveillance requirements for civil registered UAS in UK airspace. All civil aircraft fly subject to the legislation of the ANO. However, in accordance with its powers under Article 242 of the ANO 2009, the CAA may exempt UAS operators from the provisions of the ANO and the Rules of the Air, dependent upon the aircraft's potential to inflict damage and injury. This policy is applicable to all civil UAS operating within the UK Flight Information Region (FIR) and Upper Flight Information Region (UIR), regardless of origin.

Policy

- 7.2 This surveillance policy is complementary to the Detect and Avoid guidance contained in Section 3, Chapter 1. In broad terms, UAS must be able to interact with all other airspace users, regardless of the airspace or aircraft's flight profile, in a manner that is transparent to all other airspace users and Air Navigation Service Providers (ANSPs), when compared to manned aircraft. Unmanned aircraft must be interoperable with all surveillance systems without any additional workload for ATCOs, surveillance systems, manned aircraft pilots or other Remote Pilots. UAS must carry suitable equipment so as to be able to be interoperable with aircraft equipped with mandated Airborne Collision Avoidance System (ACAS) such as TCAS II. It must be noted that, where a UAS employs a collision avoidance system with reactive logic, any manoeuvre resulting from a perceived threat from another aircraft must not reduce the effectiveness of a TCAS II resolution advisory manoeuvre from that aircraft.
- 7.3 It is recognised that the Radar Cross Section (RCS) and size of certain categories of aircraft will make detection by non-cooperative¹⁶ surveillance systems difficult, especially at low-level. Consequently, cooperative ground and/or air based surveillance systems¹⁷ are traditionally deployed by ANSPs to complement coverage of non-cooperative systems, especially in controlled airspace.
- 7.4 The primary means of cooperative surveillance within the UK is SSR Mode Select Elementary Surveillance (Mode S ELS). However, within certain areas of

¹⁶ Primary Surveillance Radar (PSR).

¹⁷ Secondary Surveillance Radar (SSR).

UK airspace, the carriage of an SSR transponder is not mandatory (see UK AIP Gen 1.5). In such airspace, where an Air Traffic Radar service is not mandatory, non-transponder equipped aircraft will not be 'visible' to ACAS. Consequently, in these areas 'see and avoid' is often the primary means of separation of aircraft. Therefore, until unmanned aircraft can comply with the 'Detect and Avoid' capabilities¹⁸ and the SSR carriage policy for such platforms can be reviewed, if necessary on a case-by-case basis, all UAs within non-segregated airspace must be equipped with, and be able to operate, an SSR Mode S transponder. The only exception to this rule is for UAS operating within Visual Line of Sight (VLOS) of the operator and staying below 400 ft for which a transponder is not required.

Source Documents

- UK AIP GEN 1.5
- ANO 2009
- ICAO Annex 10 SARPs

¹⁸ Described in Section 2, Chapter 2.

Section 4

Airworthiness

Chapter 1

Certification

Scope

- 1.1 This chapter offers guidance to industry on what aircraft certification is and how the activities associated with aircraft certification interrelate with the activities associated with continuing and continued airworthiness.

Lead Agency

- 1.2 Within Europe the regulatory framework is defined by the European Commission (EC) and enacted by the European Aviation Safety Agency (EASA) and National Airworthiness Authorities (NAA). The regulatory framework responsibilities are therefore shared between EASA and NAAs and address:
- Initial Airworthiness (certification and production)
 - Continued and Continuing Airworthiness
 - Operations
 - Air Traffic Management
- 1.3 The regulatory framework and sharing of roles and responsibilities is described within the EASA Basic Regulation (Commission Regulations 216/2008). In very simple terms EASA is the primary agency for all rulemaking activities and conducting initial and continued airworthiness aspects.
- 1.4 It must be noted that within the Basic Regulation certain aircraft categories are currently defined to be outside of scope and hence these aircraft remain subject to national regulation. This applies to aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft).
- 1.5 A number of exceptions to this are also defined – these are commonly referred to as Annex II aircraft. With respect to UAS these are:
- Aircraft specifically designed or modified for research, experimental or scientific purposes and likely to be produced in very limited numbers;
 - Ex-military aircraft;
 - Unmanned aircraft with an operating mass of 150kg or less.

Policy

- 1.6 The following text provides an overview of the objectives of the airworthiness and certification processes and is intended to give a general understanding of the various aspects of civil certification and the related organisational oversight activities. It is not a complete or detailed explanation of this complex subject.
- 1.7 Whilst UAS of 150 kg and below are not normally required to undergo formal airworthiness certification, the principles outlined in this Chapter apply to all UAS operations.

Certification Objectives

- 1.8 Under cover of the International Civil Aviation Organisation (ICAO) and the Convention on International Civil Aviation (commonly referred to as the “Chicago Convention” (ICAO Doc. 7300)) there is a system of internationally agreed standards and recommended practices by which each contracting state can establish a means to ensure a minimum level of safety is established and achieved, thus enabling mutual recognition of individual aircraft operating within each other's airspace.
- 1.9 As not all types of aviation require routine international operating capability, each state can define and establish their own standards and practices for these national activities. Within Europe this has, for most aircraft types, been harmonised across states through the EU Commission and the EASA, as described above.
- 1.10 Therefore, it is important to recognise that the headline title of airworthiness/certification is a means by which an NAA can establish and attest to compliance with an agreed set of standards. These standards cover the necessary range of aircraft types and the activities to be undertaken; typically the standards applied can be, and usually are, different for varying classes of aircraft and their intended use. For example:
- To comply with the ICAO international requirements aircraft must be operated under cover of an Operational Approval; each aircraft must have a valid Certificate of Airworthiness (which is underpinned by an approved Type Design) and be flown by appropriately qualified and licensed flight crew.
- 1.11 At the other end of manned aviation small personal use (recreational) aircraft may have a Permit to Fly, which as a National approval, limits use to that country and could include limitations and conditions on where and when it can be flown (e.g. class of airspace, weather conditions, etc). It must also be noted that a National approval is just that, so precludes automatic rights of use/operation in another country; this does not prevent use or operation in another country but it does mean each NAA will need to determine how and what it will allow by separate process.

- 1.12 Thus, certification is a process by which the capability and operational limits of an aircraft are determined.

Initial, Continuing and Continued Airworthiness

- 1.13 Within the certification and airworthiness system there are three basic processes to set and maintain required standards. These processes determine and maintain the intended level of safety:
- Initial airworthiness processes;
 - Continuing airworthiness processes;
 - Continued airworthiness processes.
- 1.14 The initial airworthiness processes are those used to determine the applicable requirements, and establish that an aircraft design is demonstrated to be able to meet these requirements. This includes the safety targets and the development of instructions for use and ongoing care/maintenance. Within the EASA framework, which is adopted in the UK, it would also cover the elements of production, i.e. those aspects of taking the approved design and manufacturing the end product to the point of a useable aircraft. This phase is therefore complete prior to an aircraft entering into service.
- 1.15 The continuing airworthiness process refers to the system of management of the aircraft and the scheduling and actioning of ongoing preventative and corrective maintenance to confirm correct functioning and to achieve safe, reliable and cost effective operation.
- 1.16 Continued airworthiness refers to the monitoring, reporting and corrective action processes used for in-service aircraft to assure they maintain the appropriate safety standard defined during the initial airworthiness processes throughout their operational life.
- 1.17 In parallel with each of these processes, there are schemes that require or provide for organisation approvals, e.g. design, production, maintenance and organisation approvals. These approvals enable the NAAs to recognise capability within a company system; this limits the level of investigation and oversight that may be necessary to establish compliance against the regulatory standards applicable to individual products.

Initial Airworthiness Processes

- 1.18 The initial airworthiness process is intended to establish a desired level of airworthiness integrity for an aircraft and to demonstrate that this level of integrity can be achieved. In this case, integrity can be taken to include all aspects of the design (structurally and systemically) to cover safety, reliability, availability, capability, etc. When the desired level of airworthiness integrity is met and

consistently shown to be achieved, the aircraft can be considered to provide an acceptable level of safety; this covers both the vehicle (and any person(s) on board, if applicable) and, by inference from continued safe flight, to persons and property on the ground.

- 1.19 The initial airworthiness processes have the following basic elements for design and production:
- Establishment of the design/certification requirements (certification specifications) which define the high level design criteria and showing that these are met.
 - The design organisation aspects which covers the capability and competence of the company for the design of the complete aircraft, systems or individual parts.
 - The production organisation aspects which cover the capability and competence for the manufacture and assembly of the complete aircraft, systems or individual parts in accordance with the approved design and testing of the aircraft prior to delivery.
- 1.20 The design organisation is charged with demonstrating to the certification authority that the proposed design is compliant with the established and agreed certification specifications or other requirements. Similarly the production organisation is responsible to show the end product is in conformance to the design.
- 1.21 For current categories of aircraft there are already established design/certification requirements, such as the EASA Certification Specifications (e.g. Large Aeroplanes (CS-25), Large Rotorcraft (CS-29), Very Light Aircraft (CS-VLA), and Very Light Rotorcraft (CS-VLR)). These also provide guidance material on the intent of the requirement and methods of showing compliance that have been found to be acceptable. However, it is recognised that these do not fully address the range of aircraft potentially possible, how the technology elements pertinent to UAS may cross the boundaries between the categories of the requirements, or indeed what would be considered appropriate for aircraft of mass below 150 kg.
- 1.22 Except for the very smallest aircraft, where the safety aspect is controlled by separation and operational management, each class of aircraft will have some level of safety requirement. At the highest end, where a formal certification approval is necessary, this safety assessment requirement for "Equipment, Systems and Installations" and the associated guidance material is already defined in the Certification Specifications under paragraph CSXX.1309. However, once again this may not be wholly appropriate for all categories of aircraft.

Continuing airworthiness processes

- 1.23 The continuing airworthiness processes are intended to assure that in-service aircraft are managed and maintained and that these actions are performed correctly, by appropriately capable persons, in accordance with the instructions developed by the design organisation so that assumptions and considerations made during the design, particularly in respect of safety, remain valid. As a result, these processes also need effective communication between the operator, maintenance organisations and the design organisations to ensure that necessary information is shared and if necessary corrective actions taken.
- 1.24 The continuing airworthiness process will support any modifications, repair or component replacement once an aircraft has entered service. This is achieved by not only undertaking the incorporation of the changes, but also in the management of configuration records, updating of maintenance instructions, etc.

Continued airworthiness processes

- 1.25 The continued airworthiness processes are intended to provide a closed loop monitor and corrective action cycle for in-service aircraft to assure that the intended level of safety is maintained. The process starts with activity within the certification work (for example the development of the maintenance schedules and instructions on how to perform this activity). Thereafter, it includes the monitoring of experience of in-service aircraft and, when necessary, the definition and promulgation of corrective action instructions.
- 1.26 The development of maintenance schedules typically considers and uses information from the aircraft design and safety assessment processes to determine what maintenance activities are required and how frequently they will be performed to maintain the appropriate level of aircraft integrity (for example replacing parts before they would typically wear out or fail will prevent the consequence of this and hence aid both safety and commercial costs).
- 1.27 The monitoring and reporting processes support the collection and analysis of in-service information and enable the design organisation to be satisfied that the overall level of safety is being achieved, or if necessary, to determine and promulgate corrective actions to address problem areas.
- 1.28 If these programmes are run correctly, they have the potential to save organisations money – it is usually cheaper in terms of both money and time to fix a minor problem before it becomes a serious problem.

Chapter 2

General Certification Requirements

Scope

- 2.1 This chapter offers guidance on the general certification requirements for UAS, where this is applicable.

Policy

- 2.2 The approach taken by CAA for certification is, in principle, the same as that followed by EASA and other NAAs and is described below. Within this process the actual requirements that make up the certification basis, which must be shown to be met, may well be different for each NAA due to the views, experience and concerns of each country.

Applicability

- 2.3 Aircraft over 150kg and within the remit of EASA, i.e. aircraft that meet the conditions specified in EU Regulation 216/2008 (the Basic Regulation), need to be certificated by the EASA and hence reference to them must be made.
- 2.4 Aircraft of 150kg or less, or aircraft which can be considered to meet the conditions specified in Annex II, are subject to national regulation and hence the information and guidance provided in this document applies.
- 2.5 The CAA process and requirements that will be applied for the certification of UAS, where certification is appropriate, is described below.

Certification Process

- 2.6 The initial airworthiness or “Type Certification” process can be considered to follow a simple flowline, albeit there may be parallel paths with obtaining of Design Organisation and Production Organisation Approval, where these are necessary, which must come together at key cross-contact points.
- 2.7 The following describes the typical process for aircraft of 150kg and above.
- **Phase 0:** Company develops idea to point of maturity where certification is considered appropriate or necessary. During this phase the company will need to consider both functional requirements (to derive a product that is capable of performing what is intended) and also the external requirements that may need to be met (certification, operational, legislative, environmental etc.). It may also include the building and testing of initial developmental and prototype machines.

- **Phase 1:** Application is made to the CAA to begin the certification process. At this point the formal process begins which enables two things:
 - The applicable certification requirements are defined as those published at this date. Compliance with these requirements must be demonstrated within five years. If this is not achieved, later published revisions to the requirements may be introduced.
 - The initial or general familiarisation of the product begins, this enables the CAA to begin to review the applicable specific requirements set and notify/confirm this to the company and to determine the technical areas that will require specialist involvement in the project.
- **Phase 2:** Detail or technical familiarisation leading to the agreement of the certification requirements set – the certification basis. In this phase the company briefs the CAA specialists on the detailed design, the requirements that they have considered applicable and how these are planned to be demonstrated as being met – the means or method of compliance. The CAA specialist team considers these proposals and, following further discussion with the applicant, an agreed certification basis is documented. This basis will usually start from one (or more) of the existing Certification Specifications from which unnecessary items will be deleted. Additions may be introduced to cover where the requirement is inadequate or there are no suitable requirements due to the new or novel technologies used. For simple designs these phases can be covered as one.
- **Phase 3:** The Company works to demonstrate compliance with the Certification Basis in the agreed way. If necessary further dialogue is held to ensure that the most effective ways of working are used to agree changes in the means/methods of compliance, or indeed to revise the requirements if changes to the original design are made and warrant this.
- **Phase 4:** Compliance has been shown. The CAA team will complete their report and recommend issuance of the aircraft type design approval, which is recorded by the Type Certificate and the associated Type Certificate Data Sheet. These define the aircraft type, high level features, the certification basis met, applicable maintenance, inspection and operational instructions, key limitations, restrictions and conditions and other necessary information that form the approved design.

2.8 For aircraft of 150kg and below, the current CAA approach is not to mandate airworthiness certification as outlined above but to make use of the UAS Operating Safety Case process. However it is considered worth noting that elements of the safety case must reflect similar information to that which would be developed within the certification process. It is therefore considered that a level of understanding of the certification requirements may therefore be useful,

and maybe beneficial in designing the aircraft, even though not required by the regulatory system.

Certification Basis

- 2.9 From the above processes the derivation of the applicable requirements is clearly a key aspect. However, it is clear that the current requirements set do not align with the types/size/mass of aircraft that are being developed as UAS.
- 2.10 Unfortunately, the timeline for developing requirements is likely always to be behind the rate of technological advancement. The current approach is therefore to identify the category that fits as best as possible to the type/classification of the aircraft – and subtract what is not necessary and add to fill the gaps where required. The gaps can be filled by parts of other requirement sets, where practicable, and/or by developing new material where necessary.
- For example: a simple fixed wing aeroplane design may align well with the VLA (Very Light Aeroplanes) category with respect to structure and control surface actuation etc. However, because of the remote pilot aspects, the design may have a sophisticated command and flight control system, which is not addressed in CS-VLA. Use of the relevant sections of CS-23 or even CS-25 may be applicable.
- 2.11 The main difficulty with this approach, apart from the commercial risk prior to agreement with the CAA, is the potential lack of cohesion between the safety target levels from the different standards.

Interrelationship between the Three Stages of Airworthiness Oversight

Initial and Continued Airworthiness

- 2.12 During the initial certification of an aircraft the initial and continued airworthiness processes may be considered to run concurrently, as the information developed within the initial airworthiness processes feeds into the continued airworthiness processes to develop the “instructions for continued airworthiness”, i.e. the maintenance schedules and tasks which need to reflect the assumptions and considerations of use of the aircraft.
- 2.13 In principle, the intent is that once it has been demonstrated both the initial airworthiness and continued airworthiness requirements have been met, an aircraft type will be issued with a Type Certificate.
- 2.14 Type Certificates are only issued to the following:
- Aircraft
 - Engines
 - APUs

- Propellers
- 2.15 The development of all other types of aircraft system is required to be overseen by the Type Certificate applicant.
- 2.16 Once an aircraft, engine, APU or propeller holds a Type Certificate any changes will fall in to the following categories:
- Major Change – This is a significant change to the design of an aircraft, engine, propeller or related system that is designed and implemented by the holder of the Type Certificate.
 - Supplemental Type Certificate – This is a significant change to the design of an aircraft, engine or propeller that is not designed and implemented by the holder of the relevant Type Certificate.
 - Minor Change – This is a non-significant change to the design of an aircraft, engine, propeller or related system which is not permitted to affect the extant aircraft, engine or propeller level safety assumptions.
 - Change in Operational Use – This is a change to the operational use of an aircraft, engine or propeller that falls outside the agreed scope of use defined during the initial and continued airworthiness processes. In principle this must be discussed and agreed with the relevant TC holder but this is not actually mandated.
- 2.17 Clearly any change to a certificated system that does not involve the TC holder has potential implications for aviation safety.

Continuing Airworthiness

- 2.18 The continuing airworthiness process begins with an evaluation of an organisation to determine whether or not it meets the basic requirements to be allowed to perform initial and/or continued airworthiness functions.
- 2.19 This process seeks to determine compliance against one or more of a number of organisational approval requirements documents:
- Part 21 – “Certification of Aircraft and Related Products, Parts and Appliances, and of Design and Production Organisation”. In simple terms this document applies to organisations involved in initial airworthiness.
 - Part M – “Continuing Airworthiness Requirements”. This relates to organisations that are responsible for managing and overseeing maintenance tasks and maintenance scheduling.
 - Part 145 – “Approved Maintenance Organisations”. This applies to organisations that perform continued airworthiness related tasks under the management of an organisation approved to Part M.

- Part 147 – “Maintenance Training Organisational Approvals”. This applies to organisations that are responsible for the provision of aviation related training.
- Part 66 – “Certifying Staff”. This documents the competency requirements for personnel that are responsible for signing off aircraft or aircraft systems as serviceable.

- 2.20 No organisation is permitted to work within the aviation industry unless they either have the relevant approvals, as dictated by the continuing airworthiness processes or they are overseen by an organisation that holds the relevant approval. This is intended to ensure that any aviation work is performed with a degree of integrity commensurate to the risk associated with that activity. Once an approval has been granted, the continuing airworthiness process runs concurrently with the initial and continued airworthiness processes to ensure that an appropriate level of organisational integrity is maintained to support the individual project/aircraft level tasks overseen by the initial and continued airworthiness processes.
- 2.21 If the initial and/or continued airworthiness processes identify organisational risks, this information is passed back in to the continuing airworthiness processes to ensure that these risks are managed appropriately.

Chapter 3

What Level Of Certification Do I Need?

Scope

- 3.1 This chapter offers guidance to industry on the level of certification required for each UAS type. Where no formal airworthiness certification is required guidance is given on the approach to take.

Policy

- 3.2 The level of certification required for an aircraft or UAS is based upon the intended use.
- 3.3 As described in Chapter 2 of this Section, at the highest level there are aircraft that have a Certificate of Airworthiness underpinned by Type Certification, continued and continuing airworthiness processes and design and production organisation approvals. These aircraft are flown by rated and licensed pilots under the procedures of an approved operator and thus are capable for international operations under the mutual recognition arrangements from ICAO and the International Convention.
- 3.4 At the opposite end of the spectrum, we have aircraft that are not required to hold any airworthiness approvals but can be operated commercially under cover of an operating permission provided they are suitably separated from third parties and property.
- 3.5 Compliance with the most demanding requirements provides for a widest range of operational privileges, whereas a lack of demonstrable airworthiness can still be accommodated – but with significant restrictions on the operations where appropriate.
- 3.6 This approach is intended to provide a reasonable and proportionate level of regulation. This is based on the scale and level of risk each category of aircraft and its use could pose to both the general public and their property, whether on the ground or in an aircraft. The challenge therefore is to match the operational aspirations, and the risk this could pose, with proportionate airworthiness requirements that provide adequate management of this risk.

Aircraft Classification

- 3.7 The current framework established and used by the CAA, and other NAAs, classifies aircraft based on simple discriminates or type (e.g. balloon, fixed or rotary wing) and mass. This reflects the historic developments in manned

aviation – but is not necessarily fully appropriate for UAS. However, until such time as alternative classification protocols are agreed this system is in place. Working within this means we have very simple categorisations.

- 3.8 UA of mass greater than 150kg fall within the remit of the EASA Basic Regulation, unless they are State aircraft or fall within the exceptions defined in Annex II. For these Annex II aircraft provided they are non-military, the CAA bases the applicable certification requirements, organisation and operational approvals on those that would be applied by EASA as this provides maximum alignment and would offer potential operating benefits within Europe.
- 3.9 Below 150kg the current assumption is that certification is a fully national process and hence, will automatically be considered for UK operational use only.

Aircraft between 20kg and 150kg:

- 3.10 For this class of aircraft, the approach taken is based on no formal airworthiness/certification of the aircraft, but an increasing degree of scrutiny of the aircraft design, construction techniques, operational safety management processes and pilot competencies. This will need to be robustly documented in a Safety Case type report (i.e. UAS OSC).
- 3.11 As such, the onus is placed on the operator to understand and describe not just the aircraft design and its capabilities, but also the potential failures of the aircraft and its control systems, the consequence and severity of these and how they are to be mitigated or managed for the operations to be undertaken.
- 3.12 The intent remains that the more complex the aircraft and the more risk posed by the type of operation, the more robust and comprehensive the safety case will need to be.
- 3.13 As such, whilst the requirements may not apply, it is recommended that the higher the mass, or the more complex and more capable the aircraft, the more an organisation must refer to the airworthiness requirements that would apply to the next category of aircraft as this could provide useful information on the types of information to be addressed within the safety case.

Aircraft below 20kg:

- 3.14 For this class of aircraft, if conducting aerial work or operating close to third parties or property, the approach is that no airworthiness/certification of the aircraft is required provided that the pilot is capable to safely fly the aircraft, the type of operation can be undertaken within VLOS, within the defined areas of segregation (400ft altitude, 500m radius) and an operating permission is obtained from the CAA. In the same way as for UAS of 150kg and below, the UAS OSC approach is applied. For SUA with a mass of 7kg or less, a full OSC is not normally required for a "standard" permission to operate at least 50m clear

of third parties.

- 3.15 Where aircraft of less than 20kg are used purely for recreational purposes, away from third party people or property, the CAA does not impose any regulatory burden. However, whether conducting aerial work or operating for recreational purposes, it is always the responsibility of the pilot to ensure that the use of the aircraft does not pose a threat to any other person, property or aircraft.

Chapter 4

General Safety Assessment Points

Scope

- 4.1 This chapter offers guidance on some general safety assessment issues for UAS Certification.

Policy

- 4.2 The intent of a Safety Assessment is to demonstrate that the aircraft is safe enough for the manner and type of operation it is intended to perform. It is not intended here to describe any of the many different types of assessment or analyses that can be undertaken, but to outline the basic aspects to be considered.
- 4.3 It is important however to recognise that Safety Assessments, if conducted as a fundamental and iterative design process, can provide benefits in terms of the level of safety achievable. This also achieves a degree of reliability or availability possible and even minimise the cost of ownership through effective maintenance schedules.
- 4.4 If the Safety Assessment is considered simply as a retrospective analysis the result can only reflect the frozen design. Whilst this could be sufficient, it does also carry the risk that any shortfall can only be addressed by redesign or by limitations or restrictions on the use - which could be significant enough to preclude viable operation.

Assessment Steps

- 4.5 A Safety Assessment may be considered in simple steps:
- Determination of the set of aircraft level threats/hazards related to functional failures are identified;
 - The severity of the consequence for each of these failure conditions is determined/classified;
 - This classification could be different for differing scenarios, e.g. during different phases of flight;
 - The target level of safety (TLOS) is assigned for each failure condition;
 - The systems and component failures that could contribute to each of these failure conditions is assessed or analysed to establish if the individual TLOS is met;

- Compliance with each individual failure condition and the overall aircraft level target is shown.
- 4.6 Within the airworthiness requirements set, as discussed below, the large aircraft certification specifications contain specific requirements and levels of safety defined in probability terms. For smaller classes of aircraft the airworthiness requirements may not define levels of safety to this detail – hence the method of demonstrating compliance is open for discussion and may be able to be based on judgement and justified arguments rather than detailed probabilistic analysis. This is clearly important as with lower levels of robust component reliability data the more challenging is the task of developing probability analyses.

Safety Assessment Considerations

- 4.7 Each of the UAS design requirement sets will include system safety requirements. These are often referred to by the applicable paragraph number of CS-XX.1309. This requires that the probability of a failure is inversely proportional to the severity of its effect at aircraft level, i.e. high criticality systems are required to have an extremely low probability of failure.
- 4.8 These certification requirements were established many years ago based on in-service experience (accident data etc) and a desire to set a standard that would drive improvements in what was then being achieved. For each class of passenger transport aircraft (large and small fixed wing aircraft, rotorcraft, etc.), an acceptable fatal accident rate was defined, e.g. 1 accident in 10 million flight hours (10^{-7} per flight hour), for a large fixed wing aircraft.
- 4.9 Then based on simple assumptions regarding the number of aircraft systems and potentially critical failures in each of these, a target level of safety was defined for each critical failure. This is described in detail within the advisory material that goes with the requirement.
- 4.10 The validity of using these probability targets for UAS is currently a debated subject. Clearly, they relate to passenger transport aircraft and the safety of passengers carried. However, it must be noted that by protecting persons on board an aircraft, third parties on the ground will also be protected.
- 4.11 There is also some discussion that the types of operation undertaken by passenger aircraft is quite different to the range of operations undertaken by UAS, hence once again the probability targets are inappropriate. In respect to this, it must be noted that the safety assessment process already accounts for this to some extent, as due to these differences the consequence or severity of effect could be quite different thus giving a different target level of safety.
- 4.12 For UAS, the safety assessment and any analysis or justification to demonstrate compliance with the level of safety target is primarily based on the aircraft system and its associated failure mechanisms. The aircraft system is the total

system required for safe flight and landing, e.g. the aircraft, control station, command and control datalinks and any launch or landing/recovery systems.

- 4.13 In principle, it does not place reliance on external factors that may mitigate the failure – these are the safety nets that could prevent the worst case scenario.
- 4.14 It must also be noted that where the simple assumptions made in the certification safety assessment requirements are not valid, e.g. independent versus integrated systems, simple versus complex and the number of critical failure conditions, it may be necessary to impose more stringent targets to individual failure conditions in order to meet the aircraft target level of safety.
- 4.15 For aircraft of 150kg or less the proportionate approach taken does not require a safety assessment to the level described above. However, the safety case approach does still require consideration of the hazards (including those that could be due to aircraft system failures), their severity, and justification of how these will be mitigated and managed. It is therefore envisaged that some level of assessment and justification of how and why hazards are suitably managed will be necessary, albeit not to the level that uses detail probability based analyses.

Other Considerations

- 4.16 The value of the safety assessment process in the development of maintenance programmes, e.g. the type and frequency of maintenance actions, must also be recognised. The outputs of the processes provide useful data to determine what maintenance activities are required and how frequently they will be performed to maintain the appropriate level of aircraft integrity. These maintenance actions can prevent critical failures, e.g. by replacing items before they are likely to fail, or by detecting problems before operation of the aircraft. Not only does this support safety but it has the potential to save money – it is usually cheaper in terms of both money and time to fix a minor problem before it becomes a serious problem.

SECTION 5

Operations

Chapter 1

Airspace Principles

Introduction

- 1.1 The purpose of this Chapter is to outline the policies, constraints and regulations that are to be adhered to when conducting UAS operations within UK airspace.
- 1.2 The legal constraints on flying operations, including UAS, within UK airspace are contained within the ANO and it must be noted that the use of Danger Areas (DAs) for the segregation of RPAS activities might be subject to specific regulations pertinent to the DA¹⁹. Information on airspace regulation within DAs must therefore be sought from the relevant Danger Area authority. SARG Airspace Regulation will assist in identifying the appropriate authority if required.
- 1.3 Whilst the segregation of UAS from other airspace users provides a safe operating environment, the process for establishing such airspace reduces the flexibility of operation sought by the user community. This Chapter does not cover reactions to unplanned/emergency situations, as these are already catered for by the use of Restricted Area (Temporary) (RA(T)) and Emergency Restriction of Flying (ERF) procedures.

Scope

- 1.4 The guidance below details the operating principles associated with UAS flights both in segregated and non-segregated airspace. Specific regulations for model aircraft are detailed in CAP 658, Model Aircraft: A Guide to Safe Flying.

Policy

- 1.5 Regulation (EC) 216/2008 (the EASA Basic Regulation) specifically excludes remotely piloted aircraft of 150 kg or less from its scope. Therefore, these aircraft remain under national legislation laid out in the ANO.
- 1.6 There is no lower weight limit below which the ANO does not apply; however, the extent to which the regulations apply depends upon the mass of the aircraft. ANO 2009 Articles 166 and 167 define constraints that are unique to small unmanned aircraft²⁰ and small unmanned surveillance aircraft. Some of these constraints are dependent upon whether the aircraft exceeds 7 kg or if it is used

¹⁹ This includes, but is not limited to, instructions laid down in SARG Policy Statements regarding Danger Areas and Special Use Airspace Safety Buffer.

²⁰ The small unmanned aircraft is defined as a remotely piloted aircraft having a mass of not more than 20 kg without its fuel (ANO 2009 Article 255).

for the purpose of aerial work or surveillance. ANO 2009 Article 138 applies to all weight categories and stipulates that any person operating an aircraft must not recklessly or negligently cause or permit an aircraft to endanger any person or property (which includes other aircraft and their occupants). If the CAA believes that danger may be caused, then the CAA may direct that the aircraft must not be flown (ANO 2009 Article 232).

Airspace Principles for UAS Operations in the UK

- 1.7 UK aviation legislation is designed to enable the safe and efficient operation of manned aircraft in all classes of airspace. UAS operators must work within the same regulatory framework.
- 1.8 UAS do not have an automatic right to airspace if safety provision cannot be made or if such operations would have an unreasonably negative impact on other airspace users. In order to integrate with other airspace users, UAS operators must ensure that their aircraft can demonstrate an equivalent level of compliance with the rules and procedures that apply to manned aircraft. As such, the routine flight of any UAS outside UK DAs or non-segregated airspace cannot be permitted to increase the risk to existing users.
- 1.9 Until UAS can comply with the requirements of the ANO and the Rules of the Air Regulations, one-off or occasional UAS flights outside DAs may be accommodated through the establishment of Temporary Danger Areas (TDAs). TDAs must not be considered to be a convenient 'catch all' for short notice UAS activities that can simply be requested, and implemented, without due consideration for other airspace users. TDAs will mainly be used for longer term measures, where activities have been properly planned and prepared, and adequate time is available for full consideration by SARG Airspace Regulation along with full promulgation. TDAs are covered more fully below.
- 1.10 Unless special provision is made with the Air Traffic Service Unit (ATSU) handling the UAS activity, the provision of an Air Traffic Service (ATS) to an unmanned aircraft must be transparent to the controller. In other words, the controller must not have to do anything different using radiotelephony or landlines than he would for other aircraft under his control, nor must he have to apply different rules or work to different criteria. The following points are of note:
 - UAS must be able to comply with instructions from the ATS provider and with equipment requirements applicable to the class of airspace within which they intend to operate. ATS instructions must also be complied with in a timescale comparable with that of a manned aircraft.
 - All UAS callsigns must include the word "UNMANNED", on first contact with the ATS provider, to ensure that air traffic controllers are fully aware that they are dealing with a UAS flight.

- If “special provisions” are made with the associated ATSU, it is essential that these do not reduce the situational awareness of other airspace users.

General Principles for Remotely Piloted Aircraft Operations outside Segregated Airspace

- 1.11 For all flights outside DAs or segregated airspace, the aircraft performance and all communications with the ATS provider must be continuously monitored by the UAS Commander and/or its pilot. To comply with ATS instructions in a timescale comparable with that of a manned aircraft, it is imperative that the capability of taking immediate active control of the aircraft exists at all times.
- 1.12 Special equipment (e.g. Secondary Surveillance Radar (SSR) Transponder) mandated for manned aircraft in certain classifications of airspace²¹ must also be mandated as a minimum requirement for UAS intending to fly in such airspace.
- 1.13 An approved method of assuring terrain clearance is required.
- 1.14 Standard Operating Procedures are required and these would normally be contained within an organisation’s UAS Operations Manual. As a minimum, the following procedures must be covered:
- Take-off and landing procedures;
 - En-route procedures;
 - Loss of control data link; and
 - Abort procedures following critical system failure.
- 1.15 UAS must comply with the Instrument or Visual Flight Rules (IFR or VFR).
- 1.16 Additional safety requirements that will be considered under permissions and exemptions may include that the aircraft must not be flown:
- Unless it is equipped with a mechanism that will cause the aircraft to land in the event of disruption to or a failure of any of its control systems, including the radio link, and the person in charge of the aircraft has satisfied himself that such mechanism is in working order before the aircraft commences its flight;
 - Unless the person in charge of the aircraft has reasonably satisfied himself that any load carried by the aircraft is properly secured, that the aircraft is in an airworthy condition and that the flight can safely be made. Operators and manufacturers who are in any doubt as to the airworthiness of their system must seek independent assessment from either the CAA or an appropriate CAA-approved qualified entity.

²¹ For example flight above 10,000ft within Class G airspace or flight within a Transponder Mandatory Zone.

Detect and Avoid

- 1.17 An approved method of aerial collision avoidance is required thus UAS operations will not be permitted in non-segregated airspace, outside the direct unaided visual line-of-sight of the pilot, without an acceptable Detect and Avoid system.

Note: The use of 'First Person View R/C' equipment (see CAP 658) is not considered to be acceptable for use as a Detect and Avoid solution.

- 1.18 If the system does not have an approved Detect and Avoid capability, the restrictions detailed below will normally be applied to UAS operations outside segregated airspace as part of the CAA permissions and exemptions process. The aircraft must not be flown:
- In controlled airspace, except with the permission of the appropriate ATC unit;
 - In any aerodrome traffic zone except with the permission of either the appropriate ATC unit or the person in charge of the aerodrome;
 - At a height exceeding 400 feet above the surface;
 - At a distance beyond the visual range of the Remote Pilot/RPA observer of the aircraft, or a maximum range of 500 metres, whichever is less.
- 1.19 Where available, the operator is to make use of an ATS provider to monitor UAS flights and to provide a service to them and to other aircraft operating in the vicinity of the segregated airspace. Communications are to be maintained between the ATS provider and the Remote Pilot, and procedures are to be put in place for, amongst others, emergency recovery, loss of control link and the avoidance of infringing aircraft.
- 1.20 Unless able to comply with the current requirements of the ANO, including the Rules of the Air, UAS flights which are operated beyond the visual line of sight of the pilot are required to be contained within segregated airspace. The UK uses DAs as the primary method of airspace segregation for UAS operations. It is recognised, however, that there may be occasions when UAS flights are planned to take place outside an established DA; in these cases, TDAs could be established to provide the appropriate segregation.

Temporary Danger Areas

Maximum Duration

- 1.21 Although the use of TDAs offers a flexible tool for segregating specific portions of airspace on a temporary basis, it is important to emphasise that segregation effectively denies airspace to otherwise legitimate users.
- 1.22 Due to their 'temporary' nature, TDAs will normally only be established to cover

RPAS activities up to a maximum period of 90 days. The formation of a TDA must not be viewed as a convenient means of establishing segregated airspace for routine, long-term activities; however, such requests will continue to be subject to the Airspace Change Process, as detailed in CAP 725. TDAs will not be routinely 'reissued' to cover periods beyond their original lifespan.

Application Requirements

1.23 Requests for the establishment of TDAs to support UAS operations are to be forwarded to SARG Airspace Regulation. In order to allow time for the appropriate approval and notification to take place, a minimum of 90 days notice is required. In cases where larger volumes of segregated airspace are required, particularly when the airspace extends to higher altitudes, an extended notification period may need to be stipulated. Applications with less than 90 days notice may be considered, but will be taken on a case-by-case basis and any approval/rejection decision will be largely biased towards the likely potential for impact on other airspace users. Applications must contain the following information:

- A clear description of the requirement for the TDA;
- Details of the volume of airspace required, including coordinates;
- Details of the required hours of operation;
- Details of the airspace management procedures that will be employed (ATC, DACS/DAAIS, Flexible Use of Airspace practices, NOTAM procedures, etc.);
- Details of the TDA Sponsor;
- Details of the consultation that has taken place;
- Details of the type(s) of Remotely Piloted Aircraft that will be flown within the airspace, in particular the status of any airworthiness approvals/exemptions.

TDA Sponsorship

1.24 The requirement for sponsorship of a TDA is identical to that required for any other DA. Details regarding DA sponsorship, including Terms of Reference, are contained in the SARG Airspace Regulation Policy Statement 'Danger Areas'.

Decision/Approval

1.25 The decision on whether or not to approve the establishment of a TDA rests with the Group Director, Safety and Airspace Regulation.

Implementation

1.26 Planned TDAs will normally be implemented and promulgated to airspace users via UK Aeronautical Information Publication Supplement (AIP SUP). In cases

where there is insufficient time left to promulgate a TDA via the normal SUP method, full details of the TDA will be issued via a detailed Notice to Airman (NOTAM). In addition, a document containing text and a diagram in a similar format to the SUP will be placed within the 'News' section on the Home page of the NATS AIS website.

General Principles for Remotely Piloted Aircraft Operations inside Segregated Airspace

- 1.27 For flights within segregated airspace, whilst some of the restrictions detailed at paragraph 1.18 may still apply, a remotely piloted aircraft will generally be given freedom of operation within the bounds of the allocated airspace, subject to any agreed procedures and safety requirements. An approval to operate will take into account the risks associated with any unintended excursion from the allocated airspace and it will also consider the possibility of airspace infringements. In addition, measures that may be put in place to enhance the safety of UAS activities will also be considered in the approval process.
- 1.28 While segregated airspace, by its nature, provides exclusive use of that airspace to the UAS activity, boundaries are not impervious to aircraft infringements. In order to enhance the safety of RPAS operations the following constraints may be imposed:
- Where available, the operator is to make use of an ATS provider to monitor UAS flights and to provide a service to them and to other aircraft operating in the vicinity of the segregated airspace;
 - Communications are to be maintained between the ATS provider and the Remote Pilot;
 - Procedures are to be put in place for, amongst others, emergency recovery, loss of control link and the avoidance of infringing aircraft.

SUA Operating in Controlled Airspace and Aerodrome Traffic Zones

- 1.29 London Heathrow and London City airports, for example, exert a major influence over the characteristics of London airspace and often require that any aircraft operating low-level Visual Flight Rules (VFR) flights adhere to notified routes and procedures to avoid traffic conflict. This is particularly true of VFR helicopter flights in and around London, which are often under active control and confined to a route-structure with changing altitude limitations. Information on this low-level VFR helicopter route structure is provided in the [London Heathrow \(EGLL\)](#) entry in the AD section of the Integrated Aeronautical Information Publication (IAIP) and portrayed on Helicopter Routes in the London Control Zone chart (Scale 1: 50,000, Series GSGS 5542). Operators are strongly advised to have a current copy of this chart available when on-site.

- 1.30 Due to their small size and ability to operate out of small sites in towns and cities, SUA are particularly difficult to see against an urban backdrop versus the relatively much larger size of a manned aircraft. The majority of SUA do not have an anti-collision beacon (although they may have other lights of lesser illumination - typically LEDs) and they are not currently required to be fitted with a transponder. The small size and the open-framework, symmetrical structure of a multi-rotor SUA means that it may not be clearly visible until at a much closer distance than would be the case between two manned aircraft, particularly when the SUA is hovering or moving slowly. Sighting of a SUA from another aircraft is likely to be a 'late sighting' with reduced time to alter course.
- 1.31 Therefore, in addition to maintaining direct VLOS and, where required, keeping to a height of no more than 400 feet above the surface, operators of SUA of any weight must avoid and give way to manned aircraft at all times. SUA must not fly higher than 300 feet when operating directly below the London Helicopter routes, whether on land or over the River Thames. Any flight directly below the helicopter routes must obtain a Non-Standard Flight (NSF) approval prior to flight.
- 1.32 In addition to the helicopter route structure and information on London Heathrow and London City, the AD section of the IAIP also includes data and charts for [London Heliport \(EGLW\)](#). The London Heliport Aerodrome Traffic Zone (ATZ) comprises a 2 NM circle from the surface to 2,000 feet and has an associated Local Flying Area (LFA) to the south from the surface up to 1,000 feet. The airspace dedicated to London Heliport may well cover areas where SUA wish to fly including the River Thames and riverside developments.
- 1.33 London has several unlicensed helicopter landing sites including hospital helipads, the Vanguard helipad at the Isle of Dogs, as well as numerous Police helicopter and air ambulance flights, aircraft of which may loiter at low-level or land and take off from any of the Capital's streets or parks. All of these types of helicopter operations may therefore be affected by SUA operations particularly when approaching to land or departing from a site; SUA operators must take active precautionary measures to avoid creating a collision risk.
- 1.34 Whether operating within London Controlled Airspace, or in other UK areas of Controlled Airspace (including any ATZ), pilots of SUA in the mass range between above 7 kg and 20 kg must obtain a prior NSF approval from the appropriate Air Traffic Services (ATS) unit. For SUA of any mass, a further Enhanced NSF (ENSF) approval is required for flight in certain restricted areas in Central London. Details of both the NSF and ENSF process can be found at UK AIP ENR 1.1 Section 4. For NSF applications, operators must apply via the National Air Traffic Services (NATS) NSF website at www.nats.co.uk/nsf no less than 21 days in advance of the planned task. The NSF approval process is a mandatory preparatory action and, even when approval has been given, SUA

operators must establish contact with the appropriate ATS unit on the actual day of operation. At such time, the SUA operator will normally be given a tactical clearance to operate within the limits of their pre-existing NSF approval and advice and information may be provided on the local air situation. This does not absolve the operator from the responsibility for avoiding all other aircraft.

- 1.35 NOTAM action at each site is generally not required due to the typically small scale, duration and operating limitations of SUA operations. Such a requirement must, however, form part of the operator's risk assessment process, particularly outside of controlled airspace and when several SUA will be operating together ('swarming').
- 1.36 Under ANO 2009 Article 166, operators of SUA with a mass of 7 kg or less are not required to gain an NSF approval from Air Traffic Control (ATC) to operate within Class A, C, D or E airspace or within an active ATZ. However ANO Article 166 states that a person in charge of a SUA 'may only fly the aircraft if reasonably satisfied that the flight can safely be made' and that they 'must maintain direct, unaided visual contact with the aircraft ... for the purpose of avoiding collisions'. In practical terms, SUA of any mass could present a particular hazard when operating near an aerodrome or other landing site due to the presence of manned aircraft taking off and landing. Therefore, it is strongly recommended that contact with the relevant ATS unit is made prior to conducting such a flight. As in paragraph 1.34, advice and information may be provided on the local air situation that will help the operator satisfy themselves that the flight can safely be made. Such information provided by the ATS unit does not constitute or infer an approval to operate in the airspace and does not absolve the operator from the responsibility for avoiding all other aircraft. Contact details for aerodromes and ATS units can be found in the [AD section of the UK AIP](#).
- 1.37 Operators of any SUA of mass 7 kg or less, are strongly advised for collision avoidance purposes, to remain clear of charted aerodromes by at least a distance of 5 km, whether or not the aerodrome is in controlled airspace or has an associated ATZ.

London Restricted Areas EG R157, R158 and R159

- 1.38 The Air Navigation (Restriction of Flying) (Hyde Park) Regulations 2004, Air Navigation (Restriction of Flying) (City of London) Regulations 2004 and Air Navigation (Restriction of Flying) (Isle of Dogs) Regulations 2004 within [CAP 393](#) lay down restrictions on aircraft operations (which include SUA) within three defined airspace areas: EG R157 (vicinity of Hyde Park), EG R158 (vicinity of the City of London) and EG R159 (vicinity of the Isle of Dogs). These Restricted Areas are described in the IAIP at [ENR 5.1](#) and are marked on current VFR charts. The restrictions require, with certain exceptions, that no aircraft fly below 1,400 feet Above Means Sea Level (AMSL) within these areas unless in accordance with an ENSF clearance issued by the appropriate ATC unit.

- 1.39 The procedure for gaining an ENSF clearance for these Restricted Areas is described at IAIP ENR 1.1, paragraph 4.1.6 and the clearance is initially granted by NATS. Operators can utilise the web-based application process at the [NATS website](#) as above and will then need to comply with any conditions imposed by the clearance. Operators must note that the ENSF process also involves security considerations that would apply to any flight by a SUA whether or not engaged in aerial work or equipped for surveillance or data acquisition. The ENSF process may take up to 28 days before the grant of an approval.

Source Documents

- CAP 393 Air Navigation: The Order and the Regulations²².
- UK AIP Aeronautical Information Publication.
- Regulation (EU) 923/2012 (Standardised European Rules of the Air).
- EASA Decision 2013/013/R of 17 July 2013 (Acceptable Means of Compliance (AMC) and Guidance Material (GM) for Implementing Regulation (EU) 923/2012 of 26 September 2012)

²² CAP393 sets out the provisions of the Air Navigation Order as amended together with Regulations made under the Order. These Regulations are The Rules of the Air Regulations, The Air Navigation (General) Regulations, the Air Navigation (Cosmic Radiation) (Keeping of Records) Regulations, the Air Navigation (Dangerous Goods) Regulations and a number of permanent Air Navigation (Restriction of Flying) Regulations. It also contains the provisions of the Civil Aviation Authority Regulations.

Chapter 2

Cross Border Operations

Scope

- 2.1 For the purposes of this guidance, international boundaries are considered to be coincident with lateral FIR/UIR boundaries.

Policy

- 2.2 UAS operators planning to operate beyond an international FIR/UIR boundary must comply with the regulatory and ATM requirements applicable to the territories over which the UAS is flown; these may differ from UK requirements. Whilst the CAA will provide guidance on cross border ATC procedures, including detailing the arrangements for those areas of airspace where ATS provision is delegated either to or by the UK, guidance on foreign national procedures is to be sought from the appropriate State National Aviation Authority (NAA). This requirement stems from Article 8 of the Convention on International Civil Aviation ('Chicago Convention'), which states that:
- "No aircraft capable of being flown without a pilot shall be flown over the territory of a contracting State without special authorisation by that State and in accordance with the terms of such an authorisation. Each contracting State undertakes to insure [sic²³] that the flight of such an aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft".
- 2.3 For the purposes of the Convention the territory of a State shall be deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such state (Chicago Convention Article 2).
- 2.4 ICAO requirements concerning the authorisation of UAS flight across the territory of another State are published at Appendix 4 to ICAO Annex 2, Rules of the Air.

23 .ICAO use of "insure" should read "ensure"

Chapter 3

ATM Procedures

Scope

- 3.1 Air Traffic Services (ATS) in the UK are provided by personnel who are suitably trained and qualified to provide services at one or more of the three levels of provision: Air Traffic Control, UK Flight Information Services and Air/Ground Communication Service. It is not possible to anticipate all of the issues and queries relating to ATS integration that will inevitably arise during the future development of UAS and their operational procedures. Any enquiries for further guidance or to establish the UK policy on a particular issue must be made to the CAA.
- 3.2 This Chapter provides guidance on the policy associated with the provision of Air Traffic Services within UK airspace.

Policy

- 3.3 Individual ATS units may provide services within clearly defined geographic boundaries (such as a specific portion of airspace) or may provide services within a general area (for example, in the vicinity of an aerodrome).
- 3.4 The rules pertaining to aircraft flight and to the ATS provided will be determined by a number of factors (including airspace categorisation, weather conditions, aircraft flight rules and type of ATSU).
- 3.5 Not all aircraft within the same geographic area will necessarily be in communication with the same ATSU or operating under the same rules.
- 3.6 It is important that those managing UAS operations are familiar with the relevant rules and procedures applicable within any airspace through which the aircraft will be flown.
- 3.7 UAS operation is expected to be transparent to ATS providers. The pilot will be required to respond to ATS guidance or requests for information, and comply with any ATC instruction, in the same way and within the same timeframe that the pilot of a manned aircraft would. These instructions may take a variety of forms, for example, to follow another aircraft or to confirm that another aircraft is in sight.
- 3.8 International regulations and standards require that any new system, procedure or operation that has an impact on the safety of aerodrome operations or ATS shall be subject to a risk assessment and mitigation process to support its safe introduction and operation. Where an agency intends to operate a UAS in UK

airspace it will be required to provide with a safety assessment demonstrating that associated hazards to other airspace users have been identified, that the risks have been assessed and either eliminated or reduced to a level which is at least tolerable and is as low as reasonably practicable through ATS and/or other measures.

- 3.9 Where it is intended to operate a UAS in segregated airspace such a safety assessment must reflect measures intended to reduce the risk of mid-air collision between UAS and between UAS and manned aircraft. The safety assessment (which may also be presented in the form of a safety case or ATS sub-section of a broader UAS OSC) would be expected to include safety arguments concerning ATS and/or other measures to reduce the risk of accidents resulting from unplanned incursions into the segregated airspace by manned aircraft and unplanned excursions from the segregated airspace by the UAS.

Source Documents

- 3.10 Further information about the various levels of ATS and the services available from
- ATS units can be found in the following documents:
 - CAP 493 Manual of Air Traffic Services Part 1.
 - CAP 797 Flight Information Service Officer Manual.
 - CAP 452 Aeronautical Radio Station Operator's Guide.
 - CAP 774 UK Flight Information Services.
- 3.11 Further information about the classification of airspace and flight rules can be found in CAP 32 UK Aeronautical Information Publication.
- 3.12 Further information about radiotelephony procedures can be found in CAP 413 Radiotelephony Manual.
- 3.13 Further guidance on the conduct of safety assessments relating to ATS aspects of UAS operations can be found in CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers.

Chapter 4

Emergency ATM Procedures

Scope

- 4.1 The guidance below outlines the requirements for an operator of a UAS in UK airspace to include robust provision for ATM aspects of the efficient handling of relevant UAS emergencies.
- 4.2 Pre-planned arrangements for emergency manoeuvring of UAS, including manoeuvre into emergency orbit areas, emergency landing areas, 'cut-down' points and ditching areas, must be developed in consultation with CAA Airspace Regulation, who will coordinate with associated ANSPs and other elements within the CAA Safety and Airspace Regulation Group (SARG).

Policy

- 4.3 In accordance with the overarching principle that UAS operation is expected to be transparent to ATS providers, the ATM handling of emergencies involving UAS will be expected to follow the same process as that for manned aircraft with the air traffic controller/Flight Information Service Officer / Air-Ground radio operator providing assistance to the Remote Pilot in order to recover and/or land the UAS without injury to life and, where possible, without damage to property. However, the absolutely overriding objective in any emergency situation is the safety of human life. ATM procedures for dealing with UAS emergencies must, therefore, focus on assisting the Remote Pilot to resolve the situation without endangering other airspace users or people on the ground. Although the ATS provider can offer assistance, ultimate responsibility for concluding a UAS emergency safely must rest with the Remote Pilot.
- 4.4 UAS operators must, as a minimum, develop procedures which provide for the emergency notification of the relevant ATM agencies in the event that guidance of a UAS is lost or significantly restricted. Such notification must include the last known position, altitude and speed of the aircraft and sufficient additional information, such as endurance, which would enable other airspace users and aerodrome operators to be alerted to the hazard. Such notification arrangements must be reflected in the UAS operator's safety assessment.

Source Documents

- 4.5 Further information about ATS arrangements for dealing with aircraft emergencies can be found in the following documents:
- CAP 493 Manual of Air Traffic Services Part 1.

- CAP 797 Flight Information Service Officer Manual.
- CAP 452 Aeronautical Radio Station Operator's Guide.
- CAP 774 UK Flight Information Services.

4.6 Further guidance on the conduct of safety assessments relating to ATS aspects of UAS operations can be found in CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers.

Chapter 5

Breaches of ATC Regulations

Scope

- 5.1 Guidance relating to breaches of civil ATC regulations must be sought from CAA – Safety and Airspace Regulation Group (SARG), Airspace, ATM and Aerodromes (AAA).

Point of Contact

- 5.2 Breaches of Aviation Regulation legislation must be reported directly to:

Investigation and Enforcement Team
Civil Aviation Authority
Room 505
CAA House
45-59 Kingsway
London
WC2B 6TE

E-mail: jetmailbox@caa.co.uk

Chapter 6

Aerodrome Operating Procedures

Scope

- 6.1 The ANO does not require UAS operations to take place from aerodromes licensed by the CAA. This Chapter applies to those UAS operations that take place at licensed aerodromes.
- 6.2 It is not possible to anticipate all of the issues and queries relating to aerodrome operations that will inevitably arise during the future development and operation of UAS. Any enquiries for further guidance or to establish the UK policy on a particular issue must be made to the CAA.

Policy

- 6.3 The aerodrome licence holder is required to demonstrate how the safety of those aircraft requiring the use of a licensed aerodrome will be assured when UAS operations are permitted at the aerodrome.
- 6.4 The operation of UAS at a licensed aerodrome must be conducted in accordance with safety management requirements set out in the Aerodrome Manual of the aerodrome. This Manual, which forms a core element of the aerodrome's Safety Management System (SMS), contains the safety policies, accountabilities, responsibilities and procedures to facilitate the safe operation of the aerodrome.
- 6.5 It is essential that those managing UAS operations are familiar with the relevant rules and procedures applicable at the aerodrome from which they operate. The aerodrome licence holder must provide an operating manual or other documents pertaining to the operation of UAS at that aerodrome, to ensure that risks from all aspects of the intended UAS operation are assessed and mitigated.
- 6.6 Aerodrome and UAS operating procedures may be subject to audit by the CAA.

Source Documents

- 6.7 Information about the licensing and operation of aerodromes can be found in the following documents:
- CAP 168 Licensing of Aerodromes.
 - CAP 738 Safeguarding of Aerodromes.

Chapter 7

Incident and Accident Procedures

Scope

- 7.1 The safe operation of UAS is as important as that of manned aircraft, and third-party injury and damage to property can be just as severe when caused by either type of aircraft. Proper investigation of each accident, serious incident or other occurrence is absolutely necessary in order to identify causal factors and to prevent repetition. Similarly, the sharing of safety related information is critical in reducing the number of occurrences. The limited operational experience with UAS in civil applications makes such investigation particularly relevant.
- 7.2 This Chapter outlines the principles that must be employed with regard to the reporting and further investigation of occurrences involving the operation of all civilian unmanned aircraft within UK airspace; it also covers occurrences involving UK-registered unmanned aircraft that take place within the airspace of other nations.

Definitions

- 7.3 The current UK definitions of 'Accident' and 'Serious Incident' originate from Regulation (EU) No. 996/2010, which in turn are directly linked to the ICAO Annex 13 definitions.
- 7.4 An **Accident** is defined as: 'An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked or, in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:
- a) a person is fatally or seriously injured as a result of:
 - being in the aircraft, or,
 - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or,
 - direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the

passengers and crew; or

- b) the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to a single engine (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes) or minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or
- c) the aircraft is missing or is completely inaccessible.'

7.5 A **Serious Incident** is defined as: 'An incident involving circumstances indicating that there was a high probability of an accident and associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked or, in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.'

NOTE: The difference between an accident and a serious incident lies only in the result.

7.6 A **Reportable Occurrence** is defined as: 'Any incident which endangers or which, if not corrected, would endanger an aircraft, its occupants or any other person.'

Policy

7.7 Any person involved (as defined under Regulation (EU) No. 996/2010) who has knowledge of the occurrence of an accident or serious incident in UK airspace must report it to the AAIB. Such persons include (but are not limited to) the owner, operator and pilot of a UAS.

7.8 All other occurrences must be reported under the CAA Mandatory Occurrence Reporting Scheme (MOR Scheme – details are contained in CAP 382).

7.9 The following aircraft categories are specifically covered by the MOR Scheme (i.e. all occurrences must be reported):

- any aircraft operated under an Air Operator's Certificate granted by the CAA;
- any turbine-powered aircraft which has a Certificate of Airworthiness issued by the CAA.

- 7.10 Although these categories would appear to exclude the vast majority of UAS applications, all occurrences related to UAS operations which are considered to have endangered, or might have endangered, any aircraft (including the subject unmanned aircraft) or any person or property, must still be reported to the CAA via the MOR Scheme. This applies equally to all UAS categories, regardless of the aircraft's mass or certification state. It also includes UK registered UAS operating outside UK airspace.
- 7.11 Appendix B to CAP 382 lists the types of occurrence that are likely to fall into the definition of a 'reportable occurrence'. Whilst some of the listed occurrences would clearly only apply to manned aviation, many will apply equally to UAS, in particular those associated with the operation of the aircraft; there are also failure modes that are UAS specific. In addition to those listed in CAP 382, other, more UAS-specific, reportable occurrences include events such as:
- Loss of control/datalink – where that loss resulted in an event that was potentially prejudicial to the safety of other airspace users or third parties.
 - Navigation failures;
 - Pilot station configuration changes/errors:
 - between Pilot Stations;
 - transfer to/from launch control / mission control stations;
 - display failures.
 - Crew Resource Management (CRM) failures/confusion;
 - Structural damage/heavy landings;
 - Flight programming errors (e.g. incorrect speed programmed);
 - Any incident that injures a third party.

Source Documents

The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996.

Air Navigation Order 2009 – Article 226.

CAP 382 (The Mandatory Occurrence Reporting Scheme).

Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation.

ICAO Annex 13 – Aircraft Accident and Incident Investigation.

Points of Contact

Accident / Serious Incident:

Air Accidents Investigation Branch
Farnborough House
Berkshire Copse Road
Aldershot
HANTS
GU11 2HH
24 hour Accident/Incident reporting line: +44 (0) 1252 512299

(Administration/general enquiries)

Tel: +44 (0) 1252 510300

Fax: +44 (0) 1252 376999

E-mail: enquires@aaib.gov.uk

Mandatory Occurrence Reporting:

Safety Data
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR
Tel: +44 (0) 1293 573220
Fax: +44 (0) 1293 573972
E-mail: sdd@caa.co.uk

Chapter 8

Leasing

Introduction

- 8.1 CAP 722 does not address the leasing of communication links. This will be addressed separately once the ICAO RPAS Panel reaches a conclusion on this subject. Until an ICAO position on leasing communication links is reached, it will only be possible to take limited certification credit for communication links between the control station(s) and air vehicle(s).

Aim

- 8.2 The aim of this chapter is to clarify the position of the CAA with respect to the leasing, chartering, code sharing, interchanging and franchising of UAS.

Policy

- 8.3 Where an AOC holder wishes to lease, charter, code share, franchise or interchange a UAS it is strongly recommended that they communicate with the CAA in order to obtain the most appropriate and detailed guidance.
- 8.4 Further guidance can be found in the “Aircraft Leasing – Approval Requirements under the EASA Air Operations Regulation” document which can be found on the CAA website.
- 8.5 It is anticipated that at some point in the future there will be a desire for commercial organisations to be able to lease UAS or parts thereof. If UAS are being operated commercially then any leasing arrangements will need to meet the relevant operational rules.

Lead Agency

- 8.6 At this time, with the exception of wet leasing of third country aircraft, in the UK the CAA has responsibility for oversight of aircraft leasing.
- 8.7 The issuance of approvals for wet leasing of third country aircraft is currently the responsibility of the Department of Transport.

Appendices

APPENDIX A**Operational Factors for SUA Flights within Congested Areas**

Operational Factors for SUA Flights within Congested Areas

A1 In order to fly a SUA in a congested area, SUA operators must establish safety and operational control measures that prevent the SUA from endangering the general public. Operators are advised to ensure that their existing risk assessment and operating procedures address the enhanced measures required for congested areas. The procedures must address all relevant aspects of the congested areas they intend to operate within, taking into account any special circumstances or local conditions. Such measures may include but not be limited to:

- Segregation. Segregating the activities from public interference by placing physical barriers and cordons, or using other built/natural features that effectively separate the SUA operation from the general public.
- Crowd control. Marshalling or other active crowd control measures that restrict access to the area within which the SUA is operating.
- Utilisation of other agencies. Liaising with the Police, local authorities and other controlling agencies/organisation to gain official road closures, traffic cessation or site access restrictions.

Note: These measures will ideally be proportionate to the risk posed by the SUA, bearing in mind the limited flight times and size and weight of the aircraft. Temporary restrictions may suffice in some cases. Restrictions that would be suitable for a full-size aircraft such as a helicopter in most cases would not be applicable to a SUA.

- Wind and turbulence. Taking account of changes of wind strength and direction at varying heights above the surface. Windshear, 'rotor' and 'curl-over' effects may be present at any point on the planned flight path caused by interactions between buildings and strong winds or when transitioning from flight over land to over water.

- Radio Frequency (RF) interference. Pilots must take account of the possible reduction in operating range in an urban environment due to the heavy use of communications equipment (mobile telephone, Wi-Fi etc.) and other sources of electromagnetic spectrum/RF interference. Mitigation for the consequences of weak or lost GPS signal due to masking by buildings must be considered along with the general RF saturation level. The use of a spectrum analyser is recommended to assist in assessing the level of local electromagnetic and RF congestion in the 2.4 GHz or 35 MHz frequency range.
- Emergency procedures. SUA emergency procedures planned to be implemented during controller/transmitter/loss of GPS guidance failure modes must be able to be put into effect without breaching the minimum separation distances or flying directly overhead persons/vehicles. An automatic 'Return-to-Base' feature must not cause a hazard to anyone off the nominal flight path; this may limit the SUA to mainly vertical flight paths directly above the launch point.
- Test flights. It is desirable to conduct limited test flights (hover controllability check) and other systems tests at the launch point before committing to the full flight profile. The integration and correct set-up of the camera and gimbal-mounted will also be checked at this time to avoid unnecessary calibration flights.

A2 The procedures and limitations on the use of the SUA that will be used to establish these control measures must be stated in the Volume 1 of the UAS OSC.

Site Survey Assessment

A3 The use of non-established sites for flying UA requires an assessment of the suitability of that site to be made prior to commencing operations. Such an assessment must be made using a site visit and available information from at least the aeronautical charts, as well as other sources of information such as the UK Aeronautical Information Service (www.ais.org.uk), digital imagery (Google Earth/ Maps etc.), Ordnance Survey maps etc.

A4 Typical elements of an assessment that could affect the safety of the flight would include:

- the type of airspace and specific provisions (e.g. Controlled Airspace);
- other aircraft operations (local aerodromes or operating sites);
- hazards associated with industrial sites or such activities as live firing, gas venting, high-intensity radio transmissions etc.;
- local by-laws;

- obstructions (wires, masts, buildings etc.);
- extraordinary restrictions such as segregated airspace around prisons, nuclear establishments etc. (suitable permission may be needed); habitation and recreational activities;
- public access;
- permission from landowner;
- likely operating site and alternative sites;
- weather conditions for the planned flight;
- minimum separation distances from persons, vessels, vehicles and structures.

Overflight of People

- A5 In the absence of airworthiness certification, the overflight of persons not under the control of the pilot is restricted and described in the conditions of the Permission issued by the CAA. For UA of 20 kg and below, ANO 2009 Articles 166 and 167 define the separation distances that must be applied. For UA operations over 20 kg, the overflight of persons may be allowed subject to the assessment of the UAS Operating Safety Case and / or airworthiness certification and appropriate operational procedures such as Ballistic Recovery Systems (BRS) (e.g. parachutes).
- A6 The safety case for the overflight of people must include an assessment of the Kinetic Energy Limits and the method of flight termination (e.g. BRS). Two crash scenarios must be considered in determining the impact kinetic energy of the UA, as follows:
- a free-fall from 400 ft for all UA;
 - additionally, for a UA capable of high forward speed, a maximum impact speed (set as 1.4 x maximum achievable steady speed in level flight).
- A7 Assuming negligible aerodynamic drag, an object dropped from 400 ft will hit the surface at 95 kt and the kinetic energy at impact will be 95 kJ if the mass of the object is 80 kg. If the object exhibits significant aerodynamic drag (without reliance upon any on-board parachute deployment system), the impact velocity will be less and a higher mass may be permissible without exceeding a calculated 95 kJ.
- A8 In the second scenario and with a maximum speed of 70 kt, 95 kJ equates to a mass of 75 kg. The mass can be increased up to a maximum of 150 kg, provided the maximum achievable steady level flight speed is sufficiently low that the energy limit is not exceeded (e.g. at 150 kg a maximum speed of 49 kt is permitted).

Operational Limitations

- A9 A permission or exemption for UA conducting aerial work or equipped to undertake any form of surveillance or data acquisition will include a number of operational limitations.
- A10 For SUAs, these limitations will normally include a prohibition on flight:
- at a height exceeding 400 feet above ground level;
 - at a distance beyond the visual range of the Remote Pilot, or a maximum range of 500 metres;
 - over, or within 150 metres of, any congested area of a city, town or settlement;
 - within 50 metres of any person, vessel, vehicle or structure not under the control of the person in charge except that during the take-off or landing the SUA must not fly within 30 metres of any person other than the person in charge of the SUA or a person in charge of any other SUA or a person necessarily present in connection with the operation of such a UA;
 - unless it is equipped with a mechanism that will cause the SUA to land in the event of disruption to or a failure of any of its control systems, including the radio link, and the person in charge of the SUA has satisfied himself that such mechanism is in working order before the UA commences its flight;
 - unless the person in charge of the SUA has reasonably satisfied himself that any load carried by the UA is properly secured, that the SUA is in an airworthy condition and that the flight can safely be made taking into account the wind and other significant weather conditions;
 - unless the operator maintains records of each flight made pursuant to the permission and makes such records available to the CAA on request;
 - unless a site safety assessment has been completed by the operator and these site safety assessments are made available to the CAA on request;
 - unless the permission of the landowner on whose land the SUA is intended to take off and land has been obtained;
 - unless in accordance with the operations manual submitted to the CAA.
- A11 SUAs with a mass of more than 7 kg may be subject to additional operational limitations to those stated above, in accordance with ANO 2009 Article 166(4); these operational limitations will normally include a prohibition on flight:
- in Class A, C, D or E airspace unless the permission of the appropriate ATC unit has been obtained;

- within an aerodrome traffic zone during the notified hours of watch of the ATC unit (if any) at that aerodrome unless the permission of any such ATC unit has been obtained; or
- at a height exceeding 400 ft above the surface unless it is flying in airspace described in sub-paragraphs (a) or (b) and in accordance with the requirements thereof.

A12 The CAA may also impose additional limitations as it thinks fit; such limitations will normally include a prohibition on:

- flights that have not been notified to the local Police prior to the flights taking place;
- flights where the maximum achievable steady speed in level flight is greater than 70 knots;
- aerobatic flight;
- tasks that involve aerial inspection of, or flight close to, any object or installation that would present a risk to safety in the event of damage due to any impact by the UA (e.g. chemical/gas storage areas);
- participation in any public flying display (except with the written permission of the CAA).

APPENDIX B**UAS OSC Volume 1 - Operations Manual Template**

UAS OSC - Volume 1 - Operations Manual

{Enter company name}

UAS Operating Safety Case**Volume 1 – Operations Manual**

Version X.x Dated XX Xxx XX

{Conditions:

This document must be an original work representing the applicant Company.

The Company must take responsibility for its own safety case, whether the material originates from this template or otherwise.

Any significant changes to the Company's OSC will require further assessment, by the CAA or approved organisation, prior to further operations being conducted.

All text in {curly brackets} is guidance only and must be deleted from the Company's OSC}

Safety Statement

{The person responsible ²⁴ for the safe conduct of all of the Company's operations must make and sign this statement. The statement must include, as a minimum, a statement that the company is safe to operate in the proposed environment, that the system(s) to be employed can be operated safely and a commitment to operate within the bounds of this UAS OSC, the Operations Manual and any CAA permission granted. Where necessary it must also include a commitment to conduct further mitigation actions detailed within this UAS OSC. A commitment to safety, as a priority, must be detailed.}

²⁴ e.g. Accountable Manager, CEO, Company Director, etc

Acronyms and Abbreviations

{Detail all acronyms or abbreviations used throughout the document- there is no need to further expand any acronym or abbreviation within the document body}

Contents

{The contents of this document must contain those items listed below as a minimum}

Title Page

Safety Statement

Amendment Record

Acronyms and Abbreviations

1. Introduction

2. Safety Policy

3. Organisation

4. Operations

1. Introduction

{This section must be used to outline the scope of the document, its intent and the overarching strategy of the company.}

2. Safety Policy

{The company's safety policy, safety management system, safety targets, etc. must be detailed.}

3. Organisation

{This section must give full details of the organisation that is subject to the application – all areas detailed below must be covered as a minimum. Where examples are given they do not outline the full requirement. }

3.1 Structure of organisation and management lines

{Organogram and brief description.}

3.2 Nominated personnel

{Scalable as appropriate, e.g. Accountable Manager, Operations Manager, Technical Manager, Chief Pilot, Other Pilots These are not official posts in the sense of an organisation applying for an Air Operating Certificate and multiple functions may be filled by the same person. Each function must however be covered in brief and any internal audit/quality function must be fulfilled by a separate person, e.g. camera operator.}

3.3 Responsibility and duties of the Person in Charge of the SUA

{Articles 86, 87 and 166 of the ANO may provide some useful text for this section as determined.}

3.4 Responsibility and duties of support personnel in the operation of the SUA

{Operators may use an assistant to help with the operation of the aircraft. Give a brief description of this person's responsibilities and duties.}

3.5 Areas of operation

{Brief description of geographic scope and expected distance from people and structures, etc. Likely operating areas e.g. building sites, open countryside, roads etc.}

3.6 Type of operation

{Include details of the operations e.g. VLOS, day/night, weather, etc.}

3.7 Supervision of SUA operations

{A description of any system to supervise the operations of the operator/operator team}

3.8 Accident prevention and Flight Safety programme

{Include any reporting requirements (see CAP 722)}

3.9 Flight team composition

{Make up of the flight team depending on type of operation, complexity, type of aircraft etc.}

3.10 Operation of multiple types of SUA

{Any limitations considered appropriate to the numbers and types of SUA that a pilot may operate if appropriate.}

3.11 Qualification requirements

{Details of any qualifications, experience or training necessary for the pilot or support crew for the types of SUA and the roles employed by the operator}

3.12 Crew health

{A statement and any requirements, procedures, guidance etc. (or references) to ensure that the operating team – the ‘crew’ – are appropriately fit, capable and able to conduct the planned operations before conducting any operations}

3.13 Logs and records

{Requirements for logs and records of pilots and other data considered useful for the tracking and monitoring of the activity}

3.14 Details of the operator training programme

{Training and checking requirements for pilots and support crew as determined by the operator to cover initial, refresher and conversion syllabi. Include any independent assessment of pilot competency and currency requirements}

3.15 Accident/incident and investigation policy

{Provide company accident/incident response and investigation policy}

3.15 Copy of CAA Permission

{This will provide immediate reference to the conditions under which the operations are to be conducted when applicable – a copy of the permission must be attached}

3.16 Other documents

{As considered necessary but must include copy of insurance document – copies of any documents must be attached}

4. Operations

{This section must be used to give details of the operating environment and procedures subject to the application – all areas detailed below must be covered as a minimum. Where examples are given they do not outline the full requirement. }

4.1 Role Training and currency

{Detail any training undertaken, beyond basic BNUC-S / RPQ, that prepares the pilot for flying in a particular environment, e.g. urban. Provide details of any company minimum experience requirements, currency requirements, skills tests or manufacturer courses that support the case for an appropriate level of competency and knowledge for the proposed operations. These may include in-house or outsourced training.}

4.2 Area of operation

{Full detail of expected areas of geographic operations. Including operating areas e.g. building sites, open countryside, roads etc.}

4.3 Operating limitations and conditions

{Minimum and maximum operating conditions in compliance with the ANO and conditions of any CAA Permission}

4.3 Methods to determine the intended tasks and feasibility

{Process undertaken to determine feasibility of intended task}

4.5 Operating site planning and assessment.

{Airspace operating environment considerations and procedures (e.g. Controlled Airspace), operations near other aircraft operations (local aerodromes or operating sites), operations near industrial sites or such activities as live firing, gas venting, high-intensity radio transmissions etc., local byelaw considerations, obstructions (wires, masts, buildings etc.), extraordinary restrictions such as segregated airspace around prisons, nuclear establishments, habitation and recreational activities, public access, permission from landowner, likely operating site and alternative sites, weather considerations, etc.}

4.9 Communications

{Awareness and links with other users, aircraft operators and air traffic service providers}

4.10 Pre-notification

{ If a flight is to be performed within an Aerodrome Traffic Zone, or near to any aerodrome or aircraft operating site then their contact details must be obtained and notification of the intended operation must be provided prior to take-off. It may be necessary to inform the local police of the intended operation to avoid interruption or concerns from the public.}

4.11 Site permissions

{Procedures document to describe how to gain landowner's or authority permission}

4.12 Weather

{Methods of obtaining weather forecasts. Consideration of SUA limitations}

4.13 On site procedures

- Site Survey {Methods of surveying operating area and identifying hazards and any risk assessment}
- Selection of operating area and alternate {Methods of identifying and selecting area including: size, shape, surrounds, surface, slope, etc. Landing zone for an automatic 'home' return must be identified and kept clear}
- Crew briefing {Procedures to brief crew for e.g. task, responsibilities, duties, emergencies etc.}
- Cordon Procedure {Adherence of separation criteria}
- Communications {Procedures to maintain contact with crew, local and with adjacent air operations if appropriate}
- Weather Checks {Awareness of weather impacts on limitations and operating considerations}
- Refuelling {to include changing / charging of batteries}
- Loading of equipment {detail of procedure taken to ensure security of loaded equipment}

4.14 Assembly and functional checks

{Checks conducted on completion of assembly of the system}

4.15 Pre-flight checks

{Checks conducted immediately prior to flight}

4.16 Flight Procedures

{Start, take-off, in flight, landing, shutdown}

4.17 Post flight and between flight checks

{Detail the checks or inspections conducted both after flight and between consecutive flights}

4.18 Emergency Procedures

{Include lost link, flyaway, fire (air vehicle and ground station), etc. Preventative measures must also be detailed}

4.19 Give details of any additional safety, training or operational requirements that individual clients specify for the proposed operations.

{Include any additional types of training or qualification that individual clients mandate. Also include any specific assessment, audit or quality procedures that the client imposes for sub-contractors, where these enhance or supplement those of your own organisation.}

APPENDIX C**UAS OSC Volume 2 - Systems Template**

UAS OSC - Volume 2 - Systems

{Enter company name}

UAS

Operating Safety Case

Volume 2 – Systems

Version X.x Dated XX Xxx XX

{Conditions:

This document must be an original work representing the applicant Company.

The Company must take responsibility for its own safety case, whether the material originates from this template or otherwise.

Any significant changes to the Company's UAS OSC will require further assessment, by the CAA or approved organisation, prior to further operations being conducted.

All text in {curly brackets} is guidance only and must be deleted from the Company's UAS OSC}

Acronyms and Abbreviations

{Detail all acronyms or abbreviations used throughout the document- there is no need to further expand any acronym or abbreviation within the document body}

Contents

{The contents of this document must contain those items listed below as a minimum}

Title Page

Amendment Record

Acronyms and Abbreviations

1. Systems

{This section must be used to give technical descriptions and details of each system that is subject to the application – all areas detailed below must be covered as a minimum. Where examples are given they do not outline the full requirement}

1.1 Details of design and manufacturing organisation(s) and any recognised standards to which the equipment has been designed, built and tested

{The designer and manufacturer may be the same company, or may be conducted by the operator. Details of any standards that may or may not be aviation related and may add to the safety argument. Where known this must include test and evaluation evidence}

1.2 The design flight envelope

{Full description of the flight envelope including duration, communications range, maximum height, speeds to maintain safe flight, glide distances (where appropriate), OAT limitations, etc., etc. Include effects on flight envelope with differing payloads}

1.3 Air vehicle characteristics

{Full characteristics to be given including dimensions and mass with and without fuel, with and without any payloads, etc.}

1.4 Design features

{Detail the main design features of the air vehicle, propulsion layout, intended payload etc.}

1.5 Construction

{Detail the build nature of each air vehicle, materials used, method of construction etc}

1.6 Electrical power provision and distribution

{Detail the electrical power provision and distribution, include battery type and number, generator specifications, equipment ratings, load shedding where appropriate, etc.}

1.7 Propulsion system

{Detail the propulsion system(s) used, power output, type of propeller/rotor, etc.}

1.8 Fuel System

{Detail the fuel system arrangement, type of fuel, fuel delivery, etc.}

1.9 Flight Management System (FMS) and Flight Control System

{Detail of how the air vehicle is controlled, control linkages, control rigging, include any automatic stabilisation, etc.}

1.10 Navigation and Guidance

{Detail the system used for navigation and guidance, include any automatic piloting, telemetry etc.}

1.11 Other avionics

{Detail any other avionics fitted to the system}

1.14 Landing aids

{Detail the landing system and any landing aids fitted to the system}

1.15 Payloads

{For each air vehicle give a technical description of the payload expected to be installed or carried}

1.16 Emergency recovery or safety systems

{Detail any systems fitted to the air vehicle or ground control station that contribute to safe flight or handling including their modes of operation e.g. ballistic parachutes, propeller guards etc.}

1.17 Modifications to the system

{Detail any modifications that have been made post initial design}

1.18 Change Management (modifications)

{Detail how the organisation manages and records changes to the original design}

1.19 Command and Control C2

{How status, control and positioning signals are relayed between the ground station and air vehicle. Also, details of frequencies, types/methods of securing (pairing, encryption etc.) used etc.}

1.20 Whole system Single Points of Failure (SPOF)

{For each element of the whole system, identify where SPOF may exist}

1.21 Ground Control Station

{Where a home computer, laptop, tablet or similar device is utilised give details of the type of operating system and other technical specifications. Give detail of process for firmware and software updates}

1.22 Lifting, maintenance schedules and inspections

{Give full detail of the maintenance regime of each system, including maintenance log description, maintenance procedures and processes}

1.23 Spares

{Describe the process by which any spares are procured and validated}

1.24 Repair

{Where repairs to the system are necessary describe the repair philosophy}

1.25 Known failure modes

{For the whole system identify known failure modes and detail preventative strategy}

1.26 Failsafe features

{Detail any failsafe features in the design of the system}

1.27 Transportation requirements

{Detail how the system is transported between sites. Include all carry cases, transport description etc.}

APPENDIX D**UAS OSC Volume 3 - Safety Assessment Template**

UAS OSC - Volume 3 - Safety Assessment

{Enter company name}

UAS

Operating Safety Case

Volume 3 – Safety Assessment

Version X.x Dated XX Xxx XX

{Conditions:

This document must be an original work representing the applicant Company.

The Company must take responsibility for its own safety case, whether the material originates from this template or otherwise.

Any significant changes to the Company's UAS OSC will require further assessment, by the CAA or approved organisation, prior to further operations being conducted.

All text in {curly brackets} is guidance only and must be deleted from the Company's UAS OSC}

Acronyms and Abbreviations

{Detail all acronyms or abbreviations used throughout the document- there is no need to further expand any acronym or abbreviation within the document body}

Contents

{The contents of this document must contain those items listed below as a minimum}

Title Page

Amendment Record

Acronyms and Abbreviations

1. Hazard and Risk Assessment
2. Self Assessment
3. Summary

1. Hazard Identification and Risk Assessment

{Conduct hazard identification and risk assessment of your intended operations. Tables 1 to 4 may be used; alternatives may also be used but may require justification for their use. The assessment must cover all elements of the operation including a technical risk assessment of the system(s). Give details of those persons present and contributing to the risk assessment process.}

		Severity				
		Catastrophic 5	Hazardous 4	Major 3	Minor 2	Negligible 1
Probability	Frequent 5	Unacceptable	Unacceptable	Unacceptable	Review	Review
	Occasional 4	Unacceptable	Unacceptable	Review	Review	Acceptable
	Remote 3	Unacceptable	Review	Review	Acceptable	Acceptable
	Improbable 2	Review	Review	Acceptable	Acceptable	Acceptable
	Extremely Improbable 1	Review	Acceptable	Acceptable	Acceptable	Acceptable

Table 1 – Risk Matrix

Unacceptable – The risk is unacceptable and major mitigation measures are required to reduce the level of risk to as low as reasonably practicable.

Review – The level of risk is of concern and mitigation measures are required to reduce the level of risk to as low as reasonable practicable. Where further risk reduction/mitigation is not practical or viable, the risk may be accepted, provided that the risk is understood and has endorsement of the responsible person within the organisation (e.g. accountable manager).

Acceptable – Risk is considered acceptable but must be reviewed if it recurs.

Severity of Consequences		
Definition	Meaning	Value
Catastrophic	Results in accident, death or equipment destroyed	5
Hazardous	Serious injury or major equipment damage	4
Major	Serious incident or injury	3
Minor	Results in minor incident	2
Negligible	Nuisance of little consequence	1

Table 2 - Risk Severity Classifications

Likelihood of Occurrence		
Definition	Meaning	Value
Frequent	Likely to occur many times	5
Occasional	Likely to occur sometimes	4
Remote	Unlikely to occur but possible	3
Improbable	Very unlikely to occur	2
Extremely Improbable	Almost inconceivable that the event will occur	1

Table 3 - Risk Likelihood Classifications

Unique No	Identified Hazard	Associated Risk	Existing Mitigation	Current Risk Level	Further Mitigation	Revised Risk Level	ALARP Y/N	Owner

Table 4 – Hazard Log

2. Self Assessment

{Using the evidence given in the document thus far, conduct a self assessment of the intended operations; this must be undertaken using a claim, argument and evidence process. Ultimately this section must support that the company is safe to operate in the proposed environment and that the system(s) to be employed can be operated safely; there must be no area of intended operations that are not covered in some way by this section.

There is no mandatory requirement to use complex techniques (e.g. Goal Structured Notation).

The following explanation is provided for clarity:

Claim – an assertion that is made (e.g. ‘The UAS operator(s) is suitably experienced and qualified for the intended operations’)

Argument – this describes the argument to support the claim (e.g. The UAS operator(s) holds a ‘xxxxxxxxx’ operator’s certificate, is independently assessed in all modes of flight by ‘xxxxxx’ association and has ‘xxx’ hours experience on this system ‘xxx’ hours of which have been in the intended operating environment, etc.)

Evidence – this references the evidence to support the argument. (So, to support the claim ‘the UAS operator(s) is suitably experienced and qualified for the intended operations’- the operator’s log, operator’s certificate, etc., could be provided or referred to. It is important that any referenced evidence is either already embedded in the UAS OSC, is attached as an enclosure to the UAS OSC or a working hyperlink is provided that leads to the evidence.

Representation in a tabular format is deemed sufficient (but not mandatory) for the claim, argument, evidence self assessment.

This section will contribute to the Safety Statement made in Volume 1 of the UAS OSC.}

3. Summary

{Summarise the whole document (i.e. all three volumes) drawing out key elements that outline why the company's intended operations are safe to be conducted. A statement of intent to operate to the principles and guidelines given in this UAS OSC must also be given.}

APPENDIX E

Requirements for Approval as a UK NQE

1. Full Category

Scope

- E1 A UK National Qualified Entity (UK NQE) for Small Unmanned Aircraft (SUA) is an organisation (person) approved by the CAA to carry out assessments of the operators of SUA not exceeding 20 kg mass, and who is authorised to submit reports and recommendations to the CAA in respect of the operator. Article 244 of the Air Navigation Order 2009 (ANO 2009) is the authority for providing for this capability. This Appendix sets out the requirements to be met by organisations seeking UK national approval as a Full Category UK NQE.
- E2 With regard to the assessment of potential SUA operators, Full Category UK NQE applicants will be required to demonstrate their organisation's ability and procedures to assess the competence of SUA remote pilots, based on both a theoretical knowledge/general airmanship examination (subjects and areas that are to be assessed are set out below) and a practical flight assessment. In addition, Full Category UK NQE applicants are required to demonstrate that they have appropriate procedures for the assessment of a potential SUA operator's operations manual (UAS OSC Volume 1) and to make recommendations for the award of a permission to operate to the CAA.

Eligibility

- E3 Any natural or legal person (organisation) shall be eligible as an applicant for an approval under these requirements.

Application

- E4 Initial applications for approval as a Full Category UK NQE are to be made in writing to uavenquiries@caa.co.uk using [Form SRG 1322](#).
- E5 When applying, the applicant must undertake to pay an annual charge. The initial application charge for one calendar year for a Full Category UK NQE is £1290 (to be paid on application). The application will not be processed until the initial charge has been received. The approval charge for subsequent years (renewal) will be at the lower rate of £602 per annum.
- E6 Amendments that result in a change to the approval of the organisation will be subject to approval by the CAA and a variation charge of £129 will be incurred.

Issue of Approval

- E7 An organisation shall be entitled to be approved as a Full Category UK NQE by the CAA when it has demonstrated compliance with the applicable requirements.

Requirements for the Grant of Approval

General Requirements

- E8 Where an organisation that is seeking approval as a Full Category UK NQE is also involved in the commercial operation of SUA, or any other SUA operations for which a CAA Permission is required, there must be a distinct division between the operations and the UK NQE activities such that the objectivity of the recommendations and reports made under the UK NQE approval is not called into question.
- E9 The entity and the staff responsible for the assessment tasks must have the knowledge and competence to conduct the assessments and must be free of any pressure and incentive which could affect their judgment or the results of their investigations.
- E10 The entity must demonstrate the capability to adequately perform the technical and administrative tasks linked with the assessment process, including the use of personnel, facilities and equipment appropriate to the task.
- E11 The staff responsible for assessment must have:
- sound technical and vocational training;
 - satisfactory knowledge of the requirements for the assessment tasks they carry out and adequate experience of such processes;
 - the ability to administer the declarations, records and reports that demonstrate that the relevant assessments have been carried out and the conclusions of those assessments.
- E12 The impartiality of the assessment staff must be guaranteed. Their remuneration must not depend on the number of assessments carried out or on the results of such assessments.
- E13 The Full Category UK NQE and the staff of the organisation shall not disclose information supplied by the operator to any person other than the UK CAA.

Specific Requirements

- E14 The organisation shall demonstrate, on the basis of the information submitted in the exposition, that it has the capability to discharge the organisation's obligations:
- with regard to:

- general approval requirements;
- facilities;
- working conditions;
- equipment and tools;
- processes and associated materials;
- number and competence of staff;
- general organisation and coordination.
- with regard to management and staff:
 - an accountable manager has been nominated by the organisation, and is accountable to the CAA. The responsibility of that manager within the organisation shall consist of ensuring that all tasks are performed to the required standards and that the organisation is continuously in compliance with the data and procedures identified in the exposition;
 - a person or group of persons have been nominated to ensure that the organisation is in compliance with these requirements, and that they are identified, together with the extent of their authority. Such person(s) shall act under the direct authority of the accountable manager. The persons nominated shall be able to show the appropriate knowledge, background and experience to discharge their responsibilities;
 - staff at all levels have been given appropriate authority to be able to discharge their allocated responsibilities and that there is full and effective coordination within the organisation in respect of the assessment of organisations that operate or intend to operate SUA.
- with regard to staff who make reports to the CAA and are authorised by the organisation to sign the documents issued under the privileges of the Full Category UK NQE approval:
 - the knowledge, background (including other functions in the organisation) and experience of the authorised staff are appropriate to discharge their allocated responsibilities;
 - the organisation maintains a record of all authorised staff, which shall include details of the scope of their authorisation; and
 - authorised staff are provided with evidence of the scope of their authorisation.

Exposition

- E15 The organisation shall submit to the CAA an exposition providing the following information:
- A statement signed by the Accountable Manager confirming that the exposition and any associated manuals which define the approved organisation's compliance with these requirements will be complied with at all times.
 - The title(s) and names of nominated personnel accepted by the CAA.
 - The duties and responsibilities of the nominated personnel including matters on which they may deal directly with the CAA on behalf of the organisation.
 - An organisational chart showing associated chains of responsibility of the nominated personnel.
 - A list of staff authorised to submit reports to the CAA.
 - A general description of manpower resources.
 - A general description of the facilities located at each address specified in the organisation's certificate of approval.
 - A general description of the scope of work relevant to the terms of approval.
 - The procedure for the notification of organisational changes to the CAA.
 - The distribution and amendment procedure for the exposition.
 - The procedures and criteria that the organisation shall apply to determine whether or not a recommendation should be made to the CAA that a 'standard' Permission be granted to an operator of an SUA, and how any recommendations for limitations and conditions that should apply to that permission will be determined.
 - Arrangements for a formal, periodic internal safety-review that shall be convened at least once in any three calendar month period.
- E16 The exposition shall be amended as necessary to maintain an up-to-date description of the organisation, and copies of any amendments shall be supplied to the CAA. Where such amendments change the approval of the organisation the amendments will be subject to approval by the CAA.

Changes to the NQE Organisation

- E17 After the issue of the UK NQE approval, each change to the organisation that is significant to the showing of compliance, conformity or to training of remote pilots and assessment of organisation's operational suitability shall be approved by the CAA.

- E18 A change of the location of the facilities, scope of work or methods of training and assessment of the UK NQE organisation are deemed to be substantial changes and therefore necessitate an application to the CAA.
- E19 An application for approval for any change shall be submitted to the CAA and before implementation of the change the organisation shall demonstrate that it will continue to comply with these requirements after implementation.

Transferability

- E20 Approval as a Full Category UK NQE is not transferable, except as a result of a change in ownership. A change of ownership is considered a significant change and necessitates application to the CAA.

Terms of Approval, Investigations and Findings

- E21 The terms of approval shall identify the scope of work for which the holder is entitled to exercise the privileges of the UK NQE approval. Those terms shall be issued as part of the UK NQE approval. Each change to the terms of approval shall be approved by the CAA. An application for a change to the terms of approval shall be made in a form and manner established by the CAA. The organisation shall comply with the applicable requirements of this document.
- E22 The organisation shall make arrangements that allow the CAA to make any investigations necessary to determine compliance and continued compliance with these requirements. The organisation shall allow the CAA to review any report and make any inspection and perform or witness any flight and ground test necessary to check the validity of the compliance statements submitted.
- E23 When objective evidence is found by the CAA showing non-compliance of the holder of a Full Category UK NQE approval with the applicable requirements, the finding shall be classified as follows:
- A level-one finding is any non-compliance with these requirements that could lead to uncontrolled non-compliances and which could affect the safety of an SUA operation.
 - A level-two finding is any non-compliance with these requirements that is not classified as level-one.
- E24 After receipt of notification of findings:
- In the case of a level-one finding, the holder of the UK NQE approval shall demonstrate corrective action to the satisfaction of the CAA within a period of no more than 21 working days after written confirmation of the finding.

- In the case of a level-two finding, the corrective action period granted by the CAA shall be appropriate to the nature of the finding but in any case initially shall not be more than six months. In certain circumstances and subject to the nature of the finding, the CAA may extend the six month period subject to a satisfactory corrective action plan.

E25 In the case of level-one or level-two findings, the UK NQE approval may be subject to a partial or full suspension or revocation. The holder of the UK NQE approval shall provide confirmation to CAA of receipt of the notice of suspension or revocation of the UK NQE approval in a timely manner.

Duration and Continued Validity

E26 The period of validity of a Full Category UK NQE approval shall extend for one calendar year from the date the approval is granted, unless:

- the organisation fails to demonstrate compliance with the applicable requirements or any changes to the requirements, criteria or assessment standards that may subsequently be published by the CAA;
- the CAA is prevented by the organisation from performing its investigations; or
- there is evidence that the organisation cannot maintain satisfactory control of the activities under the UK NQE approval; or
- the organisation no longer meets the eligibility requirements for the UK NQE approval; or
- the certificate has been surrendered or revoked.

E27 Upon surrender or revocation, the certificate shall be returned to the CAA.

Privileges

E28 A Full Category UK NQE shall be entitled (within its terms of approval) to report to the CAA that an operator of an SUA has demonstrated the capability to safely operate such aircraft within the specified weight category (class) and that the student meets all of the three critical elements that comprise acceptable evidence of pilot competency. Where this report also includes an assessment of the student's operations manual as satisfactory, a Full Category UK NQE's report (recommendation) may be immediately accepted by the CAA for the grant in full of a Permission for aerial work.

Obligations of the Holder

E29 The holder of a Full Category UK NQE approval shall, as applicable:

- ensure that the exposition and the documents to which it refers are used as basic working documents within the organisation;

- maintain the organisation in conformity with the data and procedures approved for the UK NQE approval;
- ensure that required manuals or instructions for the assessment of operators are reviewed periodically and approved either by the organisation or the CAA as appropriate;
- record all details of work carried out.

Small Unmanned Aircraft – Remote Pilot Theoretical Knowledge / General Airmanship Syllabus

Subject	Areas to be Covered
Air Law/Responsibilities	Terminology CAP 393: Air Navigation Order: Relevant articles and definitions Standardised European Rules of the Air (SERA) Regulations: General overview Avoidance of collisions ('See and Avoid') CAP 722: Policy Overview Incident and Accident Reporting: CAP 382 (general requirements) CAP 722 (specific requirements) Airprox reporting Investigation handling/assistance Insurance: Aircraft and third-party liability
UAS Airspace Operating Principles	Airspace overview: Flight Information Region (FIR) Airspace Classifications: Differing considerations Controlled Airspace Specific airspace types: Aerodrome Traffic Zone (ATZ) Control Zone (CTR) gliding/parachuting sites Airspace reservations: Danger Areas Prohibited Areas

Subject	Areas to be Covered
	Restricted Areas Temporary Airspace Reservations
UAS Airspace Operating Principles (continued)	Obtaining information/approvals: UK Aeronautical Information Publication (AIP) Aeronautical Information Circulars (AICs) Notices to Airmen (NOTAMs) Chart interpretation Whom to contact SUA Operations: Visual Line Of Sight (VLOS) Segregated Airspace
Airmanship and Aviation Safety	Good airmanship principles: Aircraft safe to operate Remote Pilot fit to operate aircraft Proper planning and preparation Hazard identification Flight Safety: Avoiding collisions 'See and Avoid' with respect to manned aircraft Perception: Distance Height Speed Awareness Planning Go/No Go decisions Remote Pilot logbooks Overflight of people, crowds and gatherings: Third-party liability
Human Factors	Good airmanship Medical fitness: Crew health precautions Alcohol, drugs, medication Medical restrictions
Human Factors (continued)	Fatigue: Flight duration/flight workload Time of Flight

Subject	Areas to be Covered
	Working Hours Outdoors and lone working: Effects of weather Remote and lone working Crew/colleague management Depth perception Blind spot Scan technique Decision process Public/Third parties Stress/Pressure from 'customers'
Meteorology	Introduction to obtaining and interpreting weather information: - weather reporting resources - reports, forecasts and meteorological conventions appropriate for typical SUA flight operations Local weather assessments Operational envelope: Effects on the SUA: Wind Urban effects Gradients Masking Icing Temperature Precipitation Turbulence Visibility factors Clouds: Cumulonimbus (CB) hazards (including lightning)

Subject	Areas to be Covered
Navigation/Charts	Basic Map reading (OS): 1:50,000 and 1:25,000 Aviation Charts: 1:500,000 and 1:250,000 Interpretation Specialised Charts (e.g. London helicopter routes) Understanding of basic terms: <ul style="list-style-type: none"> - Nautical mile - Feet - km - Elevation - Altitude GPS principle: How it works and limitations
Aircraft Knowledge	Basic principles of flight: Fixed-wing, rotor and multi-rotor Command and Control: Datalink frequencies/spectrum Manual intervention/override Flight control modes Limitations: Operational envelope Stability Mass Centre of gravity Effect of payload on flight Operating Guides: Flight procedures/basic drills Emergencies Maintenance of system: Scheduled and repairs Security of aircraft/attached items Manufacturer's recommendations Assessment 'Safe to Be Flown?'
Operating Procedures	Pre-Planning: Consideration of intended task Site assessment: Establishing a safe operating environment: Hazard identification Risk assessment Mitigating measures

Subject	Areas to be Covered
	Site Owner's Permission Situational awareness: Location Airspace Aerodromes Obstructions Public
Operating Procedures (continued)	Communications: Operating alone Liaison with Air Traffic Control Operating with other air users Pre-flight: Pre-flight checklist Security of attachments/payload Airworthiness Failsafe check Battery condition Weather In Flight: In-flight monitoring Battery status Visual Line of Sight Deconfliction/separation Post-flight: Post-flight actions Debrief/logging of flight details Post-flight maintenance Emergency Actions: Loss of control/flyaway Malfunctions Designated landing area not clear Aircraft deconfliction Collision Avoidance Security: Public access to aircraft and control

2. Restricted Category

Scope

- E30 A UK National Qualified Entity (UK NQE) for Small Unmanned Aircraft (SUA) is an organisation (person) approved by the CAA to carry out assessments of the operators of SUA not exceeding 20 kg mass, and whom is authorised to submit reports and recommendations to the CAA in respect of the operator. Article 244 of the Air Navigation Order 2009 (ANO 2009) is the authority for providing for this capability. Set out below are the requirements to be met by organisations seeking UK national approval as a Restricted Category UK NQE.
- E31 Any natural or legal person ('organisation') shall be eligible as an applicant for an approval under these requirements.
- E32 The applicant must have held a CAA Permission for Aerial Work (ANO Articles 166/167) for a minimum period of one year prior to seeking approval as a Restricted Category UK NQE. Eligibility in meeting these criteria will be verified via the CAA records system.

Application

- E33 Initial applications for approval as a Restricted Category UK NQE are to be made in writing to uavenquiries@caa.co.uk using [Form SRG 1322](#). The applicant shall state in Section 5 that they are applying for Restricted Category UK NQE status. This form will be updated during 2015 to reflect the change to a two-category UK NQE system.
- E34 When applying, the applicant must undertake to pay an annual charge. The initial application charge for one calendar year for a Restricted Category UK NQE is £430 (to be paid on application). The application will not be processed until the initial charge has been received. The approval charge for subsequent years (renewal) will be at the lower rate of £344 per annum.
- E35 Amendments that result in a substantial change to the approval of the organisation will be subject to approval by the CAA and a variation charge of £129 will be incurred.
- E36 If a Restricted Category UK NQE wishes to change to a Full Category UK NQE, the applicable charge will be the difference between the charge for the Restricted Category UK NQE and the Full Category UK NQE.

Issue of Approval

- E37 An organisation shall be entitled to be approved as a Restricted Category UK NQE by the CAA when it has demonstrated compliance with the applicable requirements.

Requirements for the Grant of Approval

General Requirements

- E38 An existing permission holder that is seeking approval as a Restricted Category UK NQE must make a distinct division between their general commercial operations and their Restricted Category UK NQE activities such that the objectivity of the recommendations and reports made under the UK NQE approval is not called into question.
- E39 The entity and the staff responsible for the assessment tasks must have adequate knowledge and competence of the operations of the class of SUA that is to be assessed. The person responsible for conducting the practical flight assessment may also offer suitable training to the student prior to conducting the assessment, however this shall not be mandatory and the student has the right to only undertake the practical flight assessment.
- E40 The entity must demonstrate the capability to adequately perform the technical and administrative tasks linked with the assessment process, including the use of personnel, facilities, equipment and record-keeping appropriate to the task. In addition, arrangements shall be made for a formal, periodic internal safety review/meeting that shall be convened at least once in any three calendar month period (quarterly).
- E41 The entity must keep the following records for a period of two years:
- A record of each student's practical flight assessment and any recommendation made to the CAA.
 - A record of each quarterly formal, periodic internal safety review/meeting and any subsequent follow-up actions.
- E42 The requirements set forth above shall be set out in a separate 'UK NQE Exposition' section included in the Permission holder's existing operations manual. This should include the named person(s) authorised to undertake the practical flight assessments and who are authorised to submit reports to the CAA.
- E43 As part of the operations manual, the Exposition shall be amended as necessary to maintain an up-to-date description of the organisation, and copies of any amendments shall be supplied to the CAA. Where such amendments change the approval of the organisation, the amendments will be subject to approval by the CAA.
- E44 The Restricted Category UK NQE and the staff of the organisation shall not disclose information supplied by the operator to any person other than the UK CAA.

Transferability

- E45 Approval as a Restricted Category UK NQE is not transferable, except as a result of a change of ownership. A change of ownership is considered a significant change and necessitates application to the CAA.

Terms of Approval, Investigations and Findings

- E46 The terms of approval shall identify the scope of work for which the holder is entitled to exercise the privileges of a Restricted Category UK NQE approval. Those terms shall be issued by the CAA as part of the UK NQE approval.
- E47 The organisation shall make arrangements that allow the CAA to make any investigations necessary to determine compliance and continued compliance with these requirements. The organisation shall allow the CAA to review any report and make any inspection and perform or witness any flight and ground test necessary to check the validity of the compliance statements submitted.
- E48 When objective evidence is found by the CAA showing non-compliance of the holder of a Restricted Category UK NQE approval with the applicable requirements, the finding shall be classified as follows:
- A level-one finding is any non-compliance with these requirements that could lead to uncontrolled non-compliances and which could affect the safety of an SUA operation.
 - A level-two finding is any non-compliance with these requirements that is not classified as level-one.
- E49 After receipt of notification of findings:
- In the case of a level-one finding, the holder of a Restricted Category UK NQE approval shall demonstrate corrective action to the satisfaction of the CAA within a period of no more than 21 working days after written confirmation of the finding.
 - In the case of a level-two finding, the corrective action period granted by the CAA shall be appropriate to the nature of the finding but in any case initially shall not be more than six months. In certain circumstances and subject to the nature of the finding, the CAA may extend the six month period subject to a satisfactory corrective action plan.
- E50 In the case of level-one or level-two findings, the Restricted Category UK NQE approval may be subject to a partial or full suspension or revocation. The holder of the approval shall provide confirmation to the CAA of receipt of the notice of suspension or revocation of the approval in a timely manner.

Duration and Continued Validity

- E51 The period of validity of a Restricted Category UK NQE approval shall extend for one calendar year from the date the approval is granted, unless:
- the organisation fails to demonstrate compliance with the applicable requirements or any changes to the requirements, criteria or assessment standards that may subsequently be promulgated by the CAA.
 - the CAA is prevented by the organisation from performing its investigations; or
 - there is evidence that the organisation cannot maintain satisfactory control of the activities under the UK NQE approval; or
 - the organisation no longer meets the eligibility requirements for their UK NQE approval; or
 - the certificate has been surrendered or revoked.
- E52 Upon surrender or revocation, the certificate shall be returned to the CAA.

Privileges

- E53 A Restricted Category UK NQE shall be entitled to report to the CAA that, following a practical flight assessment, the operator of an SUA has demonstrated the capability to safely and competently operate such an SUA within the specified weight category (class).

Obligations of the Holder – Practical Flight Assessment

- E54 Restricted Category UK NQEs are to ensure that their students are able to satisfactorily demonstrate at least the following skills during the practical flight assessment:
- Pre-flight actions including:
 - Mission planning, airspace considerations and site risk-assessment.
 - Aircraft pre-flight inspection and set-up (including flight controller modes and power-source hazards).
 - Knowledge of the basic actions to be taken in the event of an aircraft emergency or if a mid-air collision hazard arises during the flight.
 - In-flight procedures including:
 - Maintaining an effective look-out and keeping the aircraft within Visual Line of Sight (VLOS) at all times.
 - Performing accurate and controlled flight manoeuvres at representative heights and distances (including flight in 'Atti' (non-GPS assisted) mode or equivalent where fitted).

- Real-time monitoring of aircraft status and endurance limitations.
- Demonstration of the 'return-to-home' function following deliberate control-link transmission failure. Fixed-wing aircraft may demonstrate an equivalent procedure that results in a suitable automated, low-impact descent and landing.
- Post flight actions including:
 - Shutting down/making-safe the aircraft.
 - Post-flight inspection and recording of any relevant data relating to aircraft general condition, aircraft systems, aircraft components and power-sources, controller functionality and crew health and fatigue.

E55 It is not strictly necessary for the holder of a Restricted Category UK NQE to verify any of the other acceptable alternative evidence of pilot competency. Acceptable evidence of these critical elements should be furnished to the CAA by the individual applicant when he or she applies for a Permission for Aerial Work.