Safety Regulation Group

Civil Aviation Authority

CAP 722

Unmanned Aircraft System Operations in UK Airspace – Guidance

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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

1 Introduction

1.1 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.

1.2 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.

2 Revisions in this Edition

2.1 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.

3 Impending Changes to Regulation

3.1 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.

3.2 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 should 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, the term 'UAV' has been gradually phased out from this document and replaced with the simple term 'unmanned aircraft' (UA). 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.

Foreword

1 Aim

1.1 CAP 722, "Unmanned Aircraft System Operations in UK Airspace – Guidance", is compiled by the Civil Aviation Authority's Flight Operations Policy Department (FOP). It is intended to assist those who are involved in the development of UAS to identify the route to certification, in order to ensure that the required standards and practices are met by all UAS operators.

1.2 Overall, the purpose of the document is to highlight 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. Whilst UAS flights beyond the limits of visual control (defined herein) are currently restricted to segregated airspace, the ultimate aim is to develop a regulatory framework which will enable the full integration of UAS activities with manned aircraft operations throughout UK airspace.

1.3 In advance of changes to this document, updated information is contained on the CAA website at www.caa.co.uk/uas.

2 Content

2.1 CAP 722 is wholly dependent on contributions from responsible agencies; however, while it does not replace civil or military regulations, it is intended to draw together independent civil and military guidance, so as to establish best practice for all UAS activities. Wherever possible consolidated guidance will be simplified and harmonised with other European nations.

2.2 It is acknowledged that not all areas of UAS operations have been addressed, thus additional comment is welcomed from industry and government sectors. These should be addressed to FOP.

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3 Availability

3.1 In order to ensure a wide distribution and to ensure that subsequent amendments and updates are readily available, CAP 722 is available on-line at www.caa.co.uk/CAP722. Paper copies are available from the CAA's publishers. Please see inside cover for contact details. Contact addresses of those who have contributed to the document are also included at the end of each Chapter to enable readers to raise questions or to provide comments concerning the content of the document.

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Abbreviations and Glossary

1 General

1.1 It should be noted that the terminology related to UAS operations continues to evolve and therefore this Glossary is not exhaustive. The terms listed below are a combination of the emerging ICAO definitions, other 'common use' terms which are considered to be acceptable alternatives, and a number of 'legacy' terms. Whilst these legacy terms will continue to be recognised, in the interests of commonality the use of the following terminology is advised.

1.2 The abbreviation ANO refers to the Air Navigation Order. CAP 393 *Air Navigation: The Order and the Regulations* includes the ANO and the Rules of the Air Regulations.

1.3 Some of the following are terms used by the UK Military as defined in the Military Aviation Authority (MAA) Regulatory Publications (MRP). These terms (identified by an asterisk *) are not necessarily applicable to UAS that are subject to civil regulations.

NOTE: The terms 'pilot' and 'Remote Pilot' are being increasingly used worldwide (including ICAO) to describe the person who directly controls an unmanned aircraft and that trend is reflected in this document. It should be noted, however, that within the United Kingdom there are many legal requirements in the Air Navigation Order 2009 applicable to 'pilots'. These references, however, apply only to pilots in the traditional sense – i.e. persons on board and flying the aircraft. There are at present no legal requirements setting out the qualifications needed to control an unmanned aircraft; this work is still to be completed.

2 Abbreviations

AAIB	Air Accidents Investigation Branch
ACAS	Airborne Collision Avoidance System
AIP	Aeronautical Information Publication
ANO	Air Navigation Order
ANSP	Air Navigation Service Provider
AOA	Aircraft Operating Authority*
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
BMFA	British Model Flying Association
BRS	Ballistic Recovery Systems
BVLOS	Beyond Visual Line of Sight
CAA	Civil Aviation Authority
CFT	Certificate for Flight Trials
CPL	Commercial Pilot Licence
CRM	Crew Resource Management

DA	Danger Area
DAP	Directorate of Airspace Policy
EASA	European Aviation Safety Agency
ERF	Emergency Restriction of Flying
EVLOS	Extended Visual Line of Sight
FIR	Flight Information Region
FISO	Flight Information Service Officer
FMC	Flight Management Computer
FOP	Flight Operations Policy
FRTOL	Flight Radio Telephony Operators' Licence
GCS	Ground Control Station
HALE	High Altitude Long Endurance
HMI	Human-Machine Interface
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
JAA	Joint Aviation Authority
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
NAA	National Aviation Authority
RA(T)	Restricted Area (Temporary)
RCS	Radar Cross Section
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System Remotely Piloted Air System*
RPAS Cdr	Remotely Piloted Air System Commander*
RPS	Remote Pilot Station
RTF	Radiotelephony
RTS	Release to Service
SARPs	Standards and Recommended Practices
SRG	Safety Regulation Group
SSR	Secondary Surveillance Radar
SUA	Small Unmanned Aircraft
SUSA	Small Unmanned Surveillance Aircraft

TCAS	Traffic Collision Avoidance System
TDA	Temporary Danger Area
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System(s)
UAS-p	UAS Pilot (legacy term)
UAV	Unmanned Aerial Vehicle(s) (legacy term)
UAV-p	UAV Pilot (legacy term)
UIR	Upper Flight Information Region
VFR	Visual Flight Rules
VLOS	Visual Line of Sight

More detailed explanations of terms are provided on the following pages.

3 Glossary of Terms

Aircraft *(ICAO)*	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.
Command and Control Link (C2) *(ICAO)*	The data link between the remotely-piloted aircraft and the remote pilot station for the purposes of managing the flight.
Detect and Avoid *(ICAO)*	The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.
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).*
Handover	The act of passing piloting control from one remote pilot station to another.
Lost Link *(ICAO)*	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.
Operator *(ICAO)*	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.*
Pilot	The person in direct control of the UA - See also 'Remote Pilot'.
Radio Line-Of-Sight (RLOS)	A direct electronic point-to-point contact between a transmitter and a receiver.
Remote Pilot *(ICAO)*	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.
Remote Pilot Station (RPS) *(ICAO)*	The component of the remotely-piloted aircraft system containing the equipment used to pilot the remotely-piloted aircraft.
Remotely Piloted Air System*	An unmanned air system includes a number of elements such as the ground-based control unit, ground launch system and the Remotely Piloted Air Vehicle (RPAV) and all associated flight safety-critical elements.
Remotely-Piloted Aircraft (RPA) *(ICAO)*	An unmanned aircraft which is piloted from a remote pilot station.
Remotely-Piloted Aircraft System (RPAS). *(ICAO)*	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 *(ICAO)*	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*	RPAS Cdr 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.
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.
UAS-p *(legacy term)*	See 'Pilot'.
UAV Pilot/UAV-p *(legacy term)*	See 'Pilot'.
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 or capable of 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	An Unmanned Aircraft System (UAS) 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.
Visual Line-Of-Sight (VLOS) Operation *(ICAO)*	An operation in which the remote pilot or RPA observer maintains direct unaided visual contact with the remotely-piloted aircraft.

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Section 1 General

Chapter 1 Introduction

1 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 is comprehensive and necessarily prescriptive. The CAA will supplement this CAP with further written advice 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' (ICAO) or 'Sense and Avoid'.

1.3 UAS may not be flown without obtaining the relevant national approvals. (See Section 3, Chapter 1 and Section 4, Chapters 2 and 3.)

2 Scope

2.1 The guidance within CAP 722 concerns unmanned aircraft and UAS as they are defined in the 'Glossary of Terms', and primarily focuses on the aspects connected with Remotely Piloted Aircraft (RPA), whilst acknowledging the potential for autonomous operations in the future. The Guidance is not geared towards the use of armed UAS, guided weapon systems such as Cruise Missiles or similar one-shot devices designed for the delivery of munitions. Similarly the use of Model Aircraft for sporting and recreational purposes is not included; however, guidance on the operation of Model Aircraft is published in CAP 658 "*Model Aircraft*: *A Guide to Safe Flying*" (see www.caa.co.uk/cap658).

3 UAS Classifications

3.1 It is recognised that a need exists to develop a system of UAS classification; however, while the process for developing a group system is ongoing within Europe (EUROCAE[1] Working Group 73) and the USA (RTCA[2]) the process has not yet completed. Until the classification work is concluded, the table below will be used as interim guidance towards a UAS classification group.

1. European Organization for Civil Aviation Equipment
2. Radio Technical Commission for Aeronautics.

Weight Classification Group	Civil Category	Mass (kg)	Broad Military Equivalent	Civil Regulation
1	Small Unmanned Aircraft	20 or less	Micro (< 5 kg)	National
			Mini (< 30 kg)	
2	Light UAS	More than 20 to 150		National
			Tactical	
3	UAS	More than 150		EASA (State Aircraft are National)
			MALE	
			HALE	

4 Point of Contact

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Chapter 2 Legal Considerations

1 Policy

1.1 The Chicago Convention

1.1.1 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.

1.1.2 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.

1.1.3 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.

1.1.4 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".

2 Law

2.1 European Regulation

2.1.1 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 (see paragraph 2.1.6).

2.1.2 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.

2.1.3 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.

2.1.4 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.

2.1.5 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.

2.1.6 Implementing Rules for airworthiness certification and continuing airworthiness have been in force for some years. Implementing Rules for operations, pilot licensing, air traffic management and aerodromes will come into force during the course of 2012 and 2013. Various opt outs and transition periods included in the new Implementing Rules mean that, for some years after they come into force, national regulations will continue to apply in certain circumstances. The CAA's website will contain up to date information concerning this transition.

2.1.7 In the case of the United Kingdom, the National Regulations are as described in paragraph 2.2 below.

2.2 National Regulation

2.2.1 Civil and Military Regulations

2.2.1.1 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 should be treated as a military aircraft.

2.2.1.2 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, firefighting, coastguard or similar activities or services.

2.2.2 The Air Navigation Order 2009 and the Rules of the Air Regulations 2007

2.2.2.1 The main civil requirements are set out in the ANO.

2.2.2.2 The provisions in the ANO and Rules of the Air 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.

2.2.2.3 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.

2.2.2.4 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:

a) an unmanned aircraft of mass 20-150 kg with an exemption from the ANO issued by the CAA (see paragraph 2.3.1); or

b) a 'small unmanned aircraft' as defined in the ANO.

2.2.2.5 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 or with the Rules of the Air. 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.

2.3 Exemptions and Permissions granted by the CAA

2.3.1 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, Rules of the Air) 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).

2.4 Insurance

2.4.1 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 website[1] under "Mandatory Insurance Requirements".

2.4.2 UK legislation which details insurance requirements is set out in Civil Aviation (Insurance) Regulations 2005[2].

2.4.3 The EC Insurance Regulation does not apply to State aircraft or to model aircraft with an MTOM of less than 20 kg.

3 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.
- Ministry of Defence – for United Kingdom military aircraft.
- Department for Transport – for insurance matters.

4 Point of Contact

CAA Legal Department
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6161
Fax: +44 (0) 20 7453 6163

E-mail: legal@caa.co.uk

1. http://www.caa.co.uk/default.aspx?catid=122&pagetype=90&pageid=4510
2. http://www.opsi.gov.uk/si/si2005/20051089.htm

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Section 2 Policy

Chapter 1 UAS Airspace Operating Principles

1 Introduction

1.1 The purpose of this Chapter is to outline the operating principles associated with UAS activities, within UK airspace, and to highlight some of the airspace issues that need to be addressed. 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. It is therefore important to establish what can be achieved outside segregated airspace and to identify the associated constraints on UAS operations.

1.2 It should be noted that the use of Danger Areas (DAs) for the segregation of UAS activities might be subject to specific regulations pertinent to the DA. Information on airspace regulation within DAs should therefore be sought from the relevant Danger Area authority. DAP will assist in identifying the appropriate authority if required.

2 Scope

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

3 Lead Agency

3.1 CAA – Directorate of Airspace Policy (DAP).

4 Policy

4.1 The legal constraints on flying operations, including UAS, within UK airspace are contained within the ANO. The guidance contained within this Chapter is designed to draw the attention of operators to the policies, constraints and regulations that are to be adhered to when conducting UAS operations.

4.2 The European legislation (Regulation 216/2008) specifically excludes unmanned aircraft of 150 kg or less from its scope. Therefore, these aircraft remain under national legislation, which in the UK is set out in the ANO.

4.3 There is no lower weight limit below which the ANO does not apply; however, the extent to which the regulations apply depends on the mass of the aircraft. ANO 2009 Articles 166 and 167 define constraints that are unique to small unmanned aircraft[1] and small unmanned surveillance aircraft; some of these constraints are dependent upon whether the aircraft exceeds 7 kg or if it is used for the purpose of Aerial Work or surveillance. However, ANO 2009 Article 138 applies to all weight categories and stipulates that any person operating an aircraft shall 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 shall not be flown (ANO 2009 Article 232).

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

5 Airspace Principles for UAS Operations in the UK

5.1 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.

5.2 UAS do not have an automatic right to airspace use if safety provision cannot be made, or if such operations would have an unreasonably negative effect 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.

5.3 UAS operators should recognise the expectations of other airspace users. As such, the routine flight of any UAS outside a UK Danger Area or segregated airspace cannot be permitted to increase the risk to existing users and should not deny airspace to them.

5.4 Until UAS can comply with the current requirements of the ANO, including the Rules of the Air, one-off or occasional UAS flights outside Danger Areas may be accommodated through the establishment of Temporary Danger Areas (TDAs) – for policy and procedures related to TDAs, see Annex 1 to this Chapter.

5.5 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 a UA must be transparent to the Aircraft Controller[1]. In other words, the controller must not have to do anything different using radiotelephony (RTF) or landlines than he would for other aircraft under his control nor should 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 shall 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.

6 General Principles for Unmanned Aircraft Operations Outside Segregated Airspace

6.1 For all flights outside Danger Areas or segregated (exclusive use) airspace, the aircraft performance and all communications with the ATS provider must be continuously monitored by the UAS Cdr 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.

6.2 Special equipment (e.g. Secondary Surveillance Radar (SSR) Transponder) mandated for manned aircraft in certain classifications of airspace shall also be mandated as a minimum requirement for UAS intending to fly in such airspace.

1. Includes Air Traffic Controllers and Tactical Controllers.

6.3 Detect and Avoid

6.3.1 An approved method of aerial collision avoidance is required and, therefore, UAS operations will not be permitted in the United Kingdom in non-segregated airspace, outside the direct unaided visual line-of-sight of the pilot, without an acceptable Detect and Avoid system. Details on how Detect and Avoid criteria may be arrived at can be found at Section 2, Chapter 2.

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.

6.3.2 In the absence of an approved Detect and Avoid system, UAS operations outside segregated airspace are to be constrained as detailed at paragraph 6.7.

6.4 An approved method of assuring terrain clearance is required.

6.5 Standard Operating Procedures are required; these would normally be contained within an organisation's UAS Operations Manual. Amongst other things the following procedures should be covered:

- Take-off and landing procedures;
- En-route procedures;
- Loss of control data link; and
- Abort procedures following critical system failure.

6.6 UAS must comply with the Instrument or Visual Flight Rules (IFR or VFR) as they affect manned aircraft.

6.7 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 shall 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 said aircraft, or a maximum range of 500 metres, whichever is less;
- over or within 150 metres of any congested area of a city, town or settlement; or
- within 50 metres of any person, vessel, vehicle or structure not under the control of the Remote Pilot; during take-off or landing, however, the aircraft must not be flown within 30 metres of any person, unless that person is under the control of the Remote Pilot.

6.8 Additional safety requirements that will be considered under permissions and exemptions may include that the aircraft shall not be flown:

- unless it is equipped with a mechanism that will cause the said 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 said aircraft has satisfied himself that such mechanism is in working order before the aircraft commences its flight; or
- unless the person in charge of the said aircraft has reasonably satisfied himself that any load carried by the aircraft is properly secured, that the said 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 should seek independent assessment from an appropriate CAA-approved qualified entity.

7 General Principles for Unmanned Aircraft Operations Inside Segregated Airspace

7.1 For flights within segregated airspace, whilst some of the restrictions detailed at paragraph 6.7 may still apply, an unmanned 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.

7.2 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 UAS operations the following constraints may be imposed:

- Where available, the operator is to make use of an air traffic service 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.

8 Source Documents

[1] CAP 393 Air Navigation: the Order and the Regulations.

[2] MRP RA 1200 Series: Air Safety Management.

[3] MRP RA 2100-2400 Series: Flying.

[4] MRP RA 3000 Series: Air Traffic Management Regulations (ATM).

[5] UK AIP Integrated Aeronautical Information Publication.

9 Point of Contact

ORA 3
K6 G2
CAA House
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Tel: +44 (0) 20 7453 6543
Fax: +44 (0) 20 7453 6565

E-mail: ORA@caa.co.uk

Chapter 1, Annex 1

Temporary Airspace Reservations for Unmanned Aircraft System Operations

1 Scope and Definition

1.1 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 the DA 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.

1.2 The purpose of this document is to provide an overview of the principles involved in establishing temporary airspace for planned UAS operations and of the required notification process. However, it does not cover one-off events, or 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.

2 Policy

2.1 Principles of use

2.1.1 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. TDAs, therefore, must not be considered to be a convenient 'catch all' for short notice UAS activities which 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 DAP along with full promulgation.

2.2 Maximum Duration

2.2.1 Due to their 'Temporary' nature, TDAs will normally only be established to cover UAS activities up to a maximum period of 90 days. The formation of a TDA should 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.

2.3 Application Requirements

2.3.1 Requests for the establishment of TDAs to support UAS operations are to be forwarded to DAP (Attn ORA3). 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 should contain the following information:

a) A clear description of the requirement for the TDA.

b) Details of the volume of airspace required, including coordinates.

c) Details of the required hours of operation.

d) Details of the airspace management procedures that will be employed (ATC, DACS/DAAIS, Flexible Use of Airspace practices, NOTAM procedures, etc.).

e) Details of the TDA Sponsor.

f) Details of the consultation that has taken place.

g) Details of the type(s) of Unmanned Aircraft that will be flown within the airspace, in particular the status of any airworthiness approvals/exemptions.

h) A clear indication that the requirements of the Policy Statement 'Safety Buffer Policy for Airspace Design Purposes' have been considered and accommodated (available via www.caa.co.uk/dappolicystatements).

2.4 TDA Sponsorship

2.4.1 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 DAP Policy Statement 'Danger Areas' (available via www.caa.co.uk/dappolicystatements).

2.5 Decision/Approval

2.5.1 The decision on whether or not to approve the establishment of a TDA rests with the Director, Airspace Policy.

2.6 Implementation

2.6.1 Planned TDAs will normally be implemented and promulgated to airspace users via UK AIP Supplement (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 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.

3 DAP Point of Contact

3.1 Off-Route Airspace 3
Directorate of Airspace Policy
CAA House
45-59 Kingsway
London
WC2B 6TE

Telephone: +44 (0) 207 453 6543

Chapter 2 CAA Policy on Detect and Avoid

1 Scope

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

2 Lead Agency

2.1 CAA – Safety Regulation Group (SRG).

3 Introduction

3.1 A significant increase in both civil and military UAS flying is anticipated, most of which will require access to 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 all 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.

4 Aim

4.1 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 a solution to achieving a capability and level of safety which is equivalent to the existing 'see and avoid' concept. It is also recognised that Detect and Avoid is only one of a number of requirements that will need to be addressed for safe operation of UAS.

5 Policy

5.1 General

5.1.1 The overriding principle when assessing if a proposed UAS Detect and Avoid function is acceptable is that it should not introduce a greater hazard than currently exists. Any proposed function 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.

5.2 Separation Assurance and Collision Avoidance Elements

5.2.1 There are two elements to a Detect and Avoid system as follows:

a) **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 should only manoeuvre the aircraft after receiving ATC approval to do so, in the same fashion as is done for a manned aircraft.

b) **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 also be required in order to cater for collision avoidance scenarios where the Remote Pilot is unable to initiate the manoeuvre in sufficient time (due to C2 latency issues or lost link scenarios).

5.2.2 The 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; and
- Perform equivalent functions, such as maintaining separation, spacing and sequencing that would be done visually in a manned aircraft.

5.3 Research and Development

5.3.1 It is not the role of the CAA to carry out such research and development; this must be performed by the UAS industry. The CAA considers that the way forward is for the UAS industry to investigate potential solutions and for the research and development process to include full and open consultation with the CAA at appropriate stages so that the CAA can provide guidance to the UAS industry on the appropriate interpretation of the applicable rules and regulations.

5.3.2 The CAA strongly recommends that any parties developing Detect and Avoid technology for the use of UAS in non-segregated airspace should set up a programme of regular discussion and review of their research and development activity with the CAA by making contact at an early stage with the Airworthiness Certification Projects Section of the CAA Safety Regulation Group. 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.

5.3.3 If the UAS industry is to produce UAS capable of operating in all classes of airspace, it is essential that Detect and Avoid issues are addressed and that they demonstrate equivalence[1] to the regulatory and airworthiness standards that are set for manned aircraft. In order for the Detect and Avoid function to provide the required level of safety, standards will need to 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. UAS designers will need to demonstrate that they can meet these standards.

1. EASA policy is that the regulatory airworthiness standards should be set to be no less demanding than those currently applied to comparable manned aircraft nor should they penalise UAS by requiring compliance with higher standards simply because technology permits. This line is accepted by the CAA.

6 Factors for Consideration when Developing a Detect and Avoid System for UAS

6.1 The CAA Safety Regulation Group 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 the CAA believes 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.
- 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.
- Autonomy 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.

This list is not exhaustive.

7 Point of Contact

7.1 For enquiries relating to CAA UAS Detect and Avoid standards:

Manager of Certification Projects
Airworthiness Division
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573293
Fax:+44 (0) 1293 573975

E-mail: Department.Certification@caa.co.uk

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Chapter 3 Spectrum Issues

1 Scope

1.1 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; and
- 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.

2 Lead Agency

2.1 CAA – Directorate of Airspace Policy (DAP).

3 Introduction

3.1 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.

3.2 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.

4 Aim

4.1 The aim of this policy statement is to clarify the position of the CAA in respect of 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.

5 Policy

5.1 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; and
- to assist in the identification of suitable dedicated spectrum to support UAS safety-critical functionality.

6 Assignment of Frequencies

6.1 The assignment of frequencies within the UK is the responsibility of Ofcom; however, in the bands below that 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

6.2 Applications for the assignment of frequencies within the bands identified above should be addressed to the CAA contact given in paragraph 8. Applications for the use of frequency other than those listed above should be addressed to Ofcom and a contact point is given in paragraph 9. 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, shall not be operated without an approval from the National IFF and SSR Committee (NISC) (contactable via S&SM, DAP – see CAP 761).

7 Allocation of Spectrum

7.1 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.

8 Use of 35 MHz and 2.4 GHz

8.1 There are no specific frequencies allocated for use by UAS in the UK. However, the most commonly found are 35 MHz and 2.4 GHz.

8.2 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.

8.3 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 should act with appropriate caution in areas where it is expected that there will be a high degree of 2.4 GHz activity.

8.4 In addition, operations close to any facility that could potentially cause interference, such as a radar station, could potentially disrupt communications with the UAS, whatever the frequency in use.

9 Points of Contact

9.1 For enquiries relating to the allocation of spectrum and the allocation of frequencies within dedicated aeronautical bands:

Spectrum & Surveillance Management
K6 G6
CAA House
45-59 Kingsway
London
WC2B 6TE

Primary: John Mettrop
Tel: +44 (0) 20 7453 6531
E-mail: john.mettrop@caa.co.uk

Alternate: Andy Knill
Tel: +44 (0) 20 7453 6529
E-mail: andy.knill@caa.co.uk

9.2 For enquiries related to the allocation of frequencies outside dedicated aeronautical bands:

Ofcom
Riverside House
2a Southwark Bridge Road
London
SE1 9HA

Tel: +44 (0) 20 7981 3131

Website: www.ofcom.org.uk/licensing

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Chapter 4 Radar Surveillance Policy

1 Scope

1.1 There have been no previous CAA regulations governing the surveillance requirements for civil or military 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, depending on the aircraft's potential to inflict damage and injury (see Section 3, Chapter 1 – Approval to Operate). This policy is applicable to all civil UAS (the policy of exemption does not apply to military – see Article 252(1)) operating within the UK Flight Information Region (FIR) and Upper Flight Information Region (UIR), regardless of origin.

2 Lead Agency

2.1 CAA – Directorate of Airspace Policy.

3 Policy

3.1 This surveillance policy is complementary to the Detect and Avoid guidance contained in Section 2, Chapter 2. In broad terms, UAS shall 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 shall be interoperable with all surveillance systems without any additional workload for Aircraft Controllers[1], surveillance systems, manned aircraft pilots or other Remote Pilots. UAS shall 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 shall not reduce the effectiveness of a TCAS II resolution advisory manoeuvre from that aircraft.

3.2 It is recognised that the Radar Cross Section (RCS) and size of certain categories of aircraft will make detection by non-cooperative[2] surveillance systems difficult, especially at low-level. Consequently, cooperative ground and/or air based surveillance systems[3] are traditionally deployed by ANSPs to complement coverage of non-cooperative systems, especially in controlled airspace.

3.3 The primary means of cooperative surveillance within the UK is SSR Mode Select Elementary Surveillance (Mode S ELS). However, within certain areas of 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' capabilities[4] and the SSR carriage

1. Includes Air Traffic Controllers and Tactical Controllers.
2. Primary Surveillance Radar (PSR).
3. Secondary Surveillance Radar (SSR).
4. Described in Section 2, Chapter 2.

policy for such platforms can be reviewed, if necessary on a case-by-case basis, all UAs within non-segregated airspace shall be equipped with, and be able to operate, an SSR Mode S transponder[1]. The only exception to this rule is for Light UAS operating within Visual Line of Sight (VLOS) of the operator and staying below 400 ft for which a transponder is not required.

NOTE: Once compliant with Section 2, Chapter 2, further information on Mode S can be found on the CAA website (www.caa.co.uk/modes).

4 Source Documents

4.1 UK AIP GEN 1.5

ANO 2009

ICAO Annex 10 SARPs

5 Point of Contact

5.1 Head Surveillance and Spectrum Management
Directorate of Airspace Policy
K6 G6
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6530
Fax:+44 (0) 20 7453 6565

E-mail: andy.knill@caa.co.uk

1. Minimum functionality compliant with Scale E2 Schedule 5 of ANO 2009, in accordance with UK AIP GEN 1.5.

Chapter 5 Civil Operator Qualifications

1 Scope

1.1 This Chapter applies to all UAS operations in United Kingdom airspace except those by military UAS. State operated UAS are expected to comply with this Chapter, unless otherwise directed by the authority of the State of the United Kingdom.

1.2 Excluded operations are expected to conform to the relevant regulations such as Military Aviation Authority (MAA) Regulatory Publications in the case of military UAS and military contractors.

1.3 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 CAA Licensing and Training Standards Division, at the request of CAA Airworthiness Division, to which all requests for such approvals should first be submitted.

2 Lead Agency

2.1 CAA, Safety Regulation Group, Licensing and Training Policy Department.

3 Definitions

3.1 Definitions of UAS flight crew used are as defined in the JAA/Eurocontrol Joint UAS Task Force Final Report and in the glossary of this publication.

4 Policy

4.1 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 EASA regulations and ICAO Standards and Recommended Practices (SARPs).

4.2 The fundamental principles of equivalence and transparency have been established to ensure that operation of UAS does not constitute a greater risk to flight safety, the safety of other airspace users and the safety of third parties than current manned aircraft operations. The qualification requirements for Remote Pilots must abide by these principles, and the development of United Kingdom UAS pilot licensing requirements will seek to ensure this.

4.3 The guidance provided in this Chapter has been formulated with regard to anticipated EASA requirements for Remote Pilot qualification, for civil commercial UAS operations in non-segregated airspace with acceptable Detect and Avoid capability. Whilst the guidance offered in this Chapter has been formulated for this most demanding case, it should also be considered for other UAS operations, such as those in segregated airspace, and for non-civil UAS operations.

4.4 Until such time as formal UAS Remote Pilot licensing requirements have been implemented, CAA Licensing and Training Policy Department will determine the relevant requirements on an individual case-by-case basis, in consultation with other CAA departments. In determining whether to permit a person to act as pilot or

commander of a UAS, CAA Licensing and Training Policy Department will consider a number of factors such as pilot experience, maximum air vehicle mass, flight control mode, operational control and safety risk assessment.

4.5 UAS present particular difficulties in the determination of qualification requirements for their crews. Manned aircraft, regardless of the level of flight control automation available, have a common manned flight control mode, for which common pilot qualifications have been formulated. UAS have a number of different flight control modes with differing levels of manual intervention capability, engendering a much higher level of complexity to the determination of Remote Pilot qualification requirements. To determine Remote Pilot qualification requirements on the same basis as manned aircraft may yield requirements that are too inflexible, too onerous and inappropriate for UAS operations. It may be more appropriate to consider requirements sufficient to mitigate risk to other airspace users and third parties, particularly where that risk may have been reduced by other measures such as airspace segregation.

4.6 Further consideration of the factors that may mitigate risk to other airspace users and third parties indicates that Remote Pilot qualification requirements may be resolved into two broad categories. The first is where risk to other airspace users and third parties is reduced through measures such as airspace segregation, VLOS operation or low RPA mass, and the second is where there are no such defined risk mitigating measures. In the first case, CAA Licensing and Training Policy Department may adopt a flexible approach to Remote Pilot qualification requirements, but in the second case the principles of equivalence and transparency will demand a more rigorous approach, similar to existing manned commercial or air transport pilot licensing requirements. For ease of reference the two licensing regimes will be referred to as:

Table 1 UAS Remote Pilot Licensing Regimes

Regime:	Explanation:
Case 0	One or more risk mitigating factors apply, therefore reduced or flexible UAS Remote Pilot qualification requirements apply.
Case 1	No risk mitigating factors apply, therefore equivalent UAS Remote Pilot qualification requirements apply.

NOTE: An acceptable Detect and Avoid system is not considered a risk mitigation factor, but a pre-requisite for Case 1 operations. Consequently, all civil UAS operations without an acceptable Detect and Avoid system, including those undertaken for the development of UAS, are by definition Case 0 operations.

Table 2 Table of Risk Mitigating Factors in UAS Operations

Factor:	Effect:
Airspace Segregation	Airspace segregation ensures separation of the UAS operation from other airspace users and third parties. Risk of collision, airprox or separation infringement is eliminated, except in the case of incursion by other airspace users into segregated airspace, or uncommanded excursion by the aircraft.
Visual Line-of-Sight Operation	Operation within the unaided direct line-of-sight of the aircraft pilot (accepted as within 500 metres horizontally and at a height not exceeding 400 feet vertically above the surface) permits the Remote Pilot to respond to and avoid other airspace users.
Low Aircraft Mass	Aircraft mass below a specified limit reduces risk to other airspace users and third parties, by reducing maximum kinetic energy damage potential below a significant level. This mass limit is determined by CAA Airworthiness Division.

4.7 Maximum Operating Mass

4.7.1 The certification basis of any aircraft has some bearing on the flight crew qualification requirements for that aircraft, and UAS are no exception. UAS are certificated in four categories relating to aircraft mass, and the flight crew qualification requirements are related to these. Table 3 states the anticipated qualification level requirement for pilots of UAS in the relevant mass category.

Table 3 Unmanned Aircraft Mass-Related Licensing Requirements

Operating Mass (maximum)	Case 0	Case 1
7 kg or less	None, or BNUC-S™ or equivalent	BNUC-S™ or equivalent
More than 7 kg to 20 kg	None, or BNUC-S™ or equivalent	CPL(U) or equivalent
More than 20 kg to 150 kg	BNUC™ or equivalent	CPL(U) or equivalent
More than 150 kg	Industry Code of Practice, CPL(U) or ATPL(U) or equivalent	CPL(U) or ATPL(U) or equivalent

NOTE: The CAA has accepted the Basic National UAS Certificate (BNUC™) and the BNUC-S™ (for Small UAS) which, although not a licence, demonstrates pilot competency in the absence of any European-wide standard being available. It is a type-specific certificate for VLOS operations, which takes into account the operating modes and procedures of the UAS.

Remote Pilot qualification requirements for Case 1 operations are formulated with particular regard to the principles of equivalence and transparency. For commercial manned aircraft operations at least a CPL level qualification is required. Commercially operated UAS that share the same airspace with, and pose the same risk as, manned aircraft should require similar level of qualification of the flight crew. However, the requirement for CPL or ATPL level qualification should not be read to imply that Remote Pilots will require manned aircraft piloting experience to qualify.

4.8 UAS Flight Control Mode

4.8.1 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 should be rated according to type or class, CAA Licensing and Training Policy Department will take into consideration the certification of the UAS, and whether the UAS will be flown by Remote Pilots dedicated to the type.

4.8.2 For UAS expected to be flown by Remote Pilots operating more than one type, UAS may be rated as a class rather than a specific type. In determination of the basis of class rating, CAA Licensing and Training Policy Department considers the flight control mode of the UAS to be the most appropriate means of classifying such systems. Classification of UAS according to flight control mode permits the degree of automation or autonomy of a UAS to be considered when formulating requirements for Remote Pilot qualification. Provisional categories of UAS flight control modes are indicated in Table 4. The provisional flight control mode categories in the table are arranged in order of increasing automation or autonomy, and decreasing requirement for traditional manned aircraft piloting competence. Each flight control mode listed in the table is based on a broad description of flight control mode capability, and gives an analogous manned aircraft autopilot mode as a comparison.

4.8.3 For UAS type certificated as a specific type, type-rating training should include training in all the flight control modes under which the UAS type is capable of operating.

4.8.4 For UAS type certificated as a member of a flight control mode class (or classes), class rating training should be undertaken for all flight control modes under which the UAS type is capable of operating. Flight control mode class rating training for one class should be valid for all UAS types within the same flight control mode class.

Table 4 Flight Control Modes for UAS Class Ratings

Class:	Flight Control Mode Class Name:	Example Type:
Class 0	Reference Class – Manned Aircraft	Airbus 320, EH101
Class 1	Direct Command – Remote Pilot	Jindivik, RMA
Class 2	Attitude Command – 'Control Wheel' Steering	
Class 3	Flight Parameter Command – 3-Axis Autopilot	Mirach
Class 4*	Stored Flight Profile Command – Autopilot + Flight Management Computer (FMC)	Global Hawk
Class 5*	Sensor Command – Autopilot + FMC + Sensors	BGM-109
Class 6*	Autonomous Command – Intelligent UA	AI UAV

*Please note that Classes 4, 5 and 6 will require a command override intervention capability.

4.9 Other Factors

4.9.1 Prior to the implementation of formal UAS Remote Pilot licensing requirements, CAA Licensing and Training Policy Department 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.

5 Flight Radio Telephony Operators' Licence

5.1 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.

6 Remote Pilot Training Courses

6.1 Currently there are no approved training courses for UAS flight crew, for either the issue of a licence or the issue of type or class ratings. All enquiries relating to such UAS flight crew training should be made to the point of contact listed below.

7 Point of Contact

7.1 All enquiries and applications should initially be made through the CAA UAS point of contact:

Licensing and Training Policy
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
England
RH6 0YR

Tel: +44 (0) 1293 573759
Fax: +44 (0) 1293 573996

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Chapter 6 Cross Border Operations

1 Scope

1.1 For the purposes of this guide, international boundaries are considered to be coincident with FIR/UIR divisions.

2 Lead Agency

2.1 CAA – Directorate of Airspace Policy (DAP).

3 Policy

3.1 UAS operators who wish to cross an international FIR/UIR boundary to another country must comply with the Regulatory and ATM procedures applicable to the territory over which the UAS is flown, which may differ from UK regulations. While DAP will provide guidance on cross border ATC procedures, guidance on foreign national procedures should be sought from the appropriate State National Aviation Authority (NAA)/MoD.

3.2 Article 8 of the Convention on International Civil Aviation ('Chicago Convention') 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 [*sic*[1]] 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".

3.3 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).

3.4 ICAO Standards regarding the requirements for obtaining authorisation for UAS flight across the territory of another State become applicable on 15 November 2012. This will be in the form of a new Appendix (Appendix 4) to ICAO Annex 2, Rules of the Air.

4 Point of Contact

ORA3
K6 G2
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6543
Fax: +44 (0) 20 7453 6565

E-mail: ORA@caa.co.uk

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

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Chapter 7 UAS Autonomy

1 Scope

1.1 This guidance relates to the autonomy of civil unmanned aircraft systems.

2 Lead Agency

2.1 The lead agencies are as for Section 3, Chapter 2, Certification.

3 Introduction

3.1 The concept of an autonomous UAS is a system that will do everything for itself. 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 and control.

3.2 Definition of Autonomy

3.2.1 Autonomy is the capability of the system to make decisions based upon an evaluation of the current situation (often referred to as situation awareness). The system must take account of situational awareness data that is pertinent to the decision about to be made. Autonomous systems should make a rational evaluation of the choices available and the possible courses of action that could be taken, in light of this situation awareness, in order to make its decision. We expect such a rational system to then make "good" decisions in terms of a human's assessment of those available choices.

3.2.2 To perform in this way, an autonomous system will accept sensor and user inputs as an automatic system would. However, it will operate with more abstract concepts, rather than reacting only to inputs in a fixed manner irrespective of the current situation. As with humans, an autonomous, or decision-making, system should be able to act in a proactive (or goal-directed) or reactive (or responsive) manner when making its decisions.

3.3 Definition of an Autonomous System

3.3.1 An autonomous system is one that perceives its environment and determines if this affects its goals, and it takes action to ensure as far as practicable (and safe) that its goals will be achieved. It reasons about its course of action from a number of alternatives, to achieve these goals without recourse to human oversight and control.

3.3.2 An autonomous system goal is multi-faceted and more abstract than a task or script executed in an automated system. A task is likely to be a list of actions to be executed in a fixed order. A goal is expressed at a higher level of abstraction.

3.4 Decision-making by Autonomous Systems

3.4.1 The decisions made by an autonomous system are made on a rational basis. In addition, to ensure consistent behaviour that will encourage human trust the system's decision-making should be repeatable. That is, the system should exhibit the same behaviour each time it is exposed to identical circumstances and it should not produce large changes in behaviour for small changes in inputs. An obvious exception to this is where the input to the system results in a "yes/no" decision, such as a point of no return (e.g. deciding to return to the departure airfield instead of

continuing to the destination due to a very small difference in the amount of fuel remaining). Such behaviours can be evaluated using sensitivity analysis, relating system inputs to output.

3.5 Delegation to an Autonomous System

3.5.1 The autonomy concept encompasses systems ranging in capability from those that can operate without human control or direct oversight ("fully autonomous"), through "semi-autonomous" systems that are subordinate to a certain level of human authority, to systems that simply provide timely advice and leave the human to make all the decisions and execute the appropriate actions.

3.5.2 It is envisaged that the most cost-effective combination will be one where the human pilot (Remote Pilot) and the autonomous system work together as a team, with the human as the ultimate authority. If command and control communications between the Remote Pilot and UA is lost the system has to be able to reason independently of the pilot and must revert to a pre-determined safe scope of operation.

3.6 Sub-systems and Autonomous Capability

3.6.1 An autonomous system can be comprised of various decision-making sub-systems, each responsible for its domain of authority, and overseen by an autonomous management system. This approach addresses the inherent complexity of autonomous operations by decomposing the autonomous capability into smaller, more easily designed and managed components that can be treated – and assessed – as individual systems in their own right. Consequently autonomous capability may be made up from autonomous flight management, Detect and Avoid, route management, power management and prognostic health management systems for example, collaborating with the human Remote Pilot.

3.7 Learning Systems

3.7.1 A learning system is one that is able to monitor its own behaviour and modify or change its responses to situations, and so optimise its behaviour in future occurrences of those situations.

3.7.2 It is expected that systems with a learning capability will only be able to meet the requirements for repeatability described in paragraph 3.4 if the learnt behaviours have been independently evaluated prior to their creation and subsequent execution by the system.

3.8 Systems Exhibiting Unexpected or Emergent Behaviours

3.8.1 Systems that exhibit decision-making or behaviours that are not consistent and repeatable would not be able to be certificated under the assumptions described above.

3.9 UAS Autonomy

3.9.1 An industry objective is that eventually autonomous UAS will be able to operate without human intervention across all flight sectors:

- Ground manoeuvring, including ground collision avoidance;
- Take-off and climb;
- En-route;
- Descent and landing;
- Ground operation at the destination; and
- Handling of emergencies in any of these sectors.

4 Policy

4.1 General

4.1.1 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 have been presented with enough information to have continuous situational awareness. It should 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.

4.2 Human Authority Over Autonomous UAS

4.2.1 CAA policy (Section 2, Chapter 5) is that all UAS must be under the command of a Remote Pilot. Dependent on the level of autonomy, a Remote Pilot may simultaneously assume responsibility for more than one UAS, particularly when this can be accomplished safely whilst directing the activities of one or more other Remote Pilots.

4.3 Safe Operation with Other Airspace Users

4.3.1 Consistent with Section 2, Chapter 1, paragraph 5, 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.

4.4 Compliance with Air Traffic Management Requirements

4.4.1 Consistent with Section 2, Chapter 1, paragraph 5.5, 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 sight.

4.5 Emergencies

4.5.1 The decision-making function of any autonomous UAS must be capable of handling the same range of exceptional and emergency conditions as a manned aircraft, as well as ensuring that failure of the decision-making function itself does not cause a reduction in safety. Ultimately this would require referral to the Remote Pilot where available.

5 Factors for Consideration when Certificating Autonomous Systems

5.1 Data Integrity

5.1.1 An autonomous system bases its reasoning on its view of the world, and this view comes from sensors measuring aspects of the environment (e.g. airspeed), data stored on board in databases (e.g. a flight plan or waypoints database) or as a result of information arriving across a communications network with which the system is communicating (e.g. ATM datalink).

5.1.2 In a manned aircraft the pilot is presented with sensor data (airspeed, altitude, rate of climb/descent) and the human interprets the data and its credibility before taking action. Unlike a piloted aircraft, the autonomous system is part of the overall flight management system, and obtains this data direct from sensors, databases or messages without the critical human oversight provided by the pilot. Consequently UAS are vulnerable to incorrect or corrupted data.

5.1.3 There are two approaches to addressing this risk: ensuring that data quality assurance is part of the certification process, or providing the autonomy system with the capability to reason about the data it receives in order to detect and discard what is inconsistent or incorrect.

5.2 Security

5.2.1 An autonomous system must be demonstrated to be protected from accepting unauthorised commands, or from being "spoofed" by false or misleading data. Consequently, autonomous systems have a high degree of dependence on secure communications, even if they are able to reason about false or misleading commands.

6 Points of Contact

6.1 Civil Aviation Authority

For enquiries relating to CAA UAS design standards:

Manager of Certification Projects
Airworthiness Division
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573293
Fax: +44 (0) 1293 573975

E-mail: Department.Certification@caa.co.uk

6.2 EASA

6.2.1 For EASA contact details, see the EASA web site www.easa.europa.eu.

Chapter 8 Human Factors in UAS Operations

1 Introduction

1.1 It is recognised by the CAA that Human Factors represent an important aspect in the safe and efficient operation of aircraft. The fundamental concepts of Human Factors in aviation are covered by CAP 719. It is important to recognise that the human is an integral element of any UAS and therefore a number of unique Human Factors issues associated with remote operation will also be introduced. This guidance outlines a number of Human Factors recommendations to influence the design and development of UAS flown routinely in UK airspace.

2 Lead Agency

2.1 CAA Safety Regulation Group, Flight Operations Policy Department.

3 Policy

3.1 A system of systems approach should 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 should involve a detailed analysis of the human requirements and should 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; and
- Human Error Assessment.

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

4 Remote Operation

4.1 The physical separation of the Remote Pilot introduces a number of issues that need to be considered such as:

- 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.

4.2 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).

5 Authority and Control

5.1 The Remote Pilot is ultimately responsible for the safe conduct of the aircraft. He 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 (see Section 2, Chapter 7) 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.

5.2 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 should 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.

5.3 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.

6 Ergonomics

6.1 The RPS will be the major interface between the Remote Pilot and aircraft. The advice contained in this Chapter 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; these will be handled elsewhere. The ergonomic standards shall 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.

6.2 The ergonomic requirements of 'hand held' (VLOS) remote pilot stations must also be considered and careful consideration should 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.

7 Flight Crew Awareness

7.1 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 shall provide the operator with appropriate information to monitor and control its operation. Provision shall be made for the operator to be able to intervene and override the system (e.g. abort take-off, go around).

8 Transfer of Control Between Remote Pilots

8.1 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 to the following elements:

- Offer of control;
- Exchange of relevant information;
- Acceptance of control; and
- Confirmation of successful handover.

8.2 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; and
- Positions of any relevant RPS control settings in order to ensure that those of the accepting RPS are correctly aligned with the transferring RPS.

8.3 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.

9 Crew Resource Management

9.1 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 Crew Station design promotes good team co-ordination.

10 Fatigue and Stress

10.1 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 should be given to the following:

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

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

11 Degradation and Failure

11.1 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; and
- operating procedures are designed to be intuitive, not ambiguous and reinforced by training as required.

12 Source Documents

12.1 CAP 719 Fundamental Human Factors Concepts

CAP 737 Crew Resource Management (CRM) Training

CAP 789 Requirements and Guidance Material for Operators

DEF-STAN 00-250

DEF-STAN 00-970 Part 9

ISO 9241

ISO 13407

13 Future Trends

13.1 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.

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Section 3 Civil Operations

Chapter 1 Approval to Operate

1 Lead Agency

1.1 CAA – Safety Regulation Group (SRG), Flight Operations Inspectorate (General Aviation) (FOI(GA)).

2 Introduction

2.1 All civil aircraft fly subject to the legislation of the Air Navigation Order 2009 (ANO) and the associated Rules of the Air Regulations 2007. 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.

2.2 Changes, updates and further information are published from time to time on the CAA website (www.caa.co.uk/uas).

3 Approvals, Permissions and Exemptions

3.1 The CAA may issue an exemption or permission for UA to operate if the applicability criteria detailed in Table 1 below 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 should submit a safety case and discuss these issues directly with the CAA.

Table 1 Prerequisites for Operating a UA

Aircraft Mass	Airworthiness Approval?	Registration?	Operating Permission?	Pilot Qualification
20 kg and less	No	No	Yes (Note 1)	Yes (Note 1) BNUC-S™ or equivalent (Note 2)
More than 20 kg, up to and including 150 kg	Yes (Note 3)	Yes (Note 3)	Yes	Yes, BNUC™ or equivalent (Note 2)
More than 150 kg	EASA Permit to Fly or UK Permit to Fly in accordance with 'B conditions' (Note 3)	Yes	Yes	Yes, BNUC™, CPL(A) or equivalent (Note 2)

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.

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

a) 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.

b) 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.

c) 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 should submit a safety case including a risk assessment of the operation.

3.3 Applications should be supported by the submission of an operations manual based on the guidance contained within Annex 1 to this Chapter.

3.4 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.

4 Meaning of Aerial Work

4.1 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.

4.2 The article should be carefully consulted to determine if indeed 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 website (www.caa.co.uk/uas).

4.3 Flying operations such as research or development flights conducted ‘in house’ may, in some circumstances, not be considered as aerial work provided there is no valuable consideration given or promised in respect of that particular flight.

5 Operations

5.1 Visual Line of Sight (VLOS)

5.1.1 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 500 m may be impractical.

5.2 Extended Visual Line of Sight (EVLOS)

5.2.1 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).

5.2.2 The operator should submit a safety case including a risk assessment for the operation. Factors taken into consideration should 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.

5.3 Beyond Visual Line of Sight (BVLOS)

5.3.1 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. 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 (refer to Section 2, Chapters 1 and 2). Note that collision avoidance applies to all flights conducted under IFR and to flights made with an ATC clearance, as well as to flights under VFR.

6 Registration

6.1 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.

7 Pilot Qualifications

7.1 Evidence of pilot competency is required when making an application for permission to operate a UA but currently there are no pilot licences for the operation of UA (refer to Section 2, Chapter 5). The CAA has accepted the Basic National UAS Certificate (BNUC^{TM}) and Basic National UAS Certificate – Small Unmanned Aircraft (BNUC-S^{TM}), as evidence of Remote Pilot competency. These certificates are type-specific qualifications which take into account the specific operating capabilities of the UA.

8 Insurance

8.1 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).

9 Areas of Operation

9.1 Congested Areas

9.1.1 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 safety case and suitable operational procedures 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 operations manual.

9.2 Site Survey Assessment

9.2.1 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 should 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.

9.2.2 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; and
- minimum separation distances from persons, vessels, vehicles and structures.

10 Overflight of People

10.1 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 degree of airworthiness certification and appropriate operational procedures such as Ballistic Recovery Systems (BRS) (e.g. parachutes).

10.2 The safety case for the overflight of people should include an assessment of the Kinetic Energy Limits and the method of flight termination (e.g. BRS). Two crash scenarios should be considered in determining the impact kinetic energy of the UA, as follows:

a) a free-fall from 400 ft for all UA; and

b) 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).

10.2.1 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. Should the object in fact exhibit 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.

10.2.2 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).

10.3 Further detail on the CAA Policy for Light UAS can be found in a CAA Paper available on the CAA website (www.caa.co.uk/uas "UK CAA Policy for Light UAV Systems"). See also Section 3, Chapter 2 of this CAP.

11 Operational Limitations

11.1 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.

11.2 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 (see paragraphs 5.1 and 5.2 of this chapter);
- 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 shall 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; and
- unless in accordance with the operations manual submitted to the CAA.

11.3 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:

a) in Class A, C, D or E airspace unless the permission of the appropriate ATC unit has been obtained;

b) 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

c) 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.

11.4 The CAA may also impose additional limitations as it thinks fit; such constraints 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); and
- participation in any public flying display (except with the written permission of the CAA).

12 Operations Manuals

12.1 The inclusion of an operations manual covering the procedures to be followed for all envisaged operations of the UAS is a key requirement to enable the CAA to accurately assess the application and the safety case, before deciding whether to grant an exemption or permission.

12.2 Guidance for the compilation of UAS operations manuals can be found at Annex 1 to this Chapter.

13 Application Process

13.1 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. This may be as simple as preparing a safety case for a one-off flight. For regular operators, the submission of an operations manual for approval will allow them greater freedom to operate regularly without the need to seek further approval from the CAA.

13.2 It is vital to be clear 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 should apply for an exemption or permission.

13.3 Applications for an exemption or permission should be made using the application form (www.caa.co.uk/SRG1320). There are two methods for submission of applications for UA with an operating mass of 150 kg or less as listed below. All submissions for UA over 150 kg should be submitted, in the first instance, directly to the CAA (see b) below).

a) Submission via an organisation approved as a Qualified Entity (QE) under BCAR A8-22 (refer to Section 3, Chapter 2, paragraph 4.1.1). The QE will validate the submission and then forward a recommendation for the granting of a permission to the CAA FOI(GA).

The following companies currently hold A8-22 QE status for UAS:

EuroUSC
Registered Office:
Steynings House
Summerlock Approach
Salisbury
Wiltshire
SP2 7RJ

Contact: Light UAS Manager

Tel: +44 (0) 208 133 2651

E-mail: admin@eurousc.com

Website: www.eurousc.com

Updates to this list will be published on the CAA website at www.caa.co.uk/uas.

b) Submission directly to the CAA FOI(GA)

E-mail: ga@caa.co.uk

14 Source Documents

[1] CAP 393 Air Navigation: The Order and the Regulations.

[2] CAP 032 UK Aeronautical Information Publication.

15 Point of Contact for Applications for Exemptions or Permissions

FOI(GA)
SRG
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573526 or +44 (0) 1293 573525
Fax: +44 (0) 1293 573973

E-mail: ga@caa.co.uk

Chapter 1, Annex 1
Application for Small Unmanned Aircraft Operating Permission – Operations Manual Template

The following table provides an outline of the sort of areas and details that an operator should consider including in a SUA Operations Manual to provide all the information and instructions necessary to enable the operating staff to perform their duties safely and effectively. The template is not exhaustive and may be adjusted as necessary to suit the particular arrangements of an individual operator.

Section	Subject	Comment
Part A		
	Introduction	
1	Contents	*Brief list of the OM contents.*
2	Introductory Statement including outline of operations	*Include statement of compliance with any permission and the requirement that operational instructions contained within the manual are to be adhered to by all personnel involved in the operation.*
3	Definitions	*Include any common acronyms if necessary.*
4	Document control and amendment process	*To ensure OM remains in date and that different versions are not being used. Amendments should be sent to the CAA. Suggest including a Version number and date on the cover of the OM.*
	Organisation	
5	Structure of organisation and management lines	*Organogram and brief description.*
6	Nominated personnel	*As appropriate, e.g. Operations Manager, Technical Manager, Chief Pilot, Other Pilots(?).*
7	Responsibility and duties of the Person in Charge of the SUA	*Articles 86, 87 and 166 of the ANO 2009 may provide some useful text for this section as determined by the operator (despite relevance to manned aircraft in the case of Articles 86 and 87).*
8	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.*
9	Brief technical description of SUAs and roles	*Full technical description can be in technical manuals or added as an Appendix.*
10	Area of operation	*Geographic scope etc. Likely operating areas - e.g. building sites, open countryside, roads etc.*

Section	Subject	Comment
11	Operating limitations and conditions	*Minimum and maximum operating conditions in compliance with the ANO and conditions of any CAA permission.*
	Operational Control	
12	Supervision of SUA operations	*A description of any system to supervise the operations of the operator.*
13	Accident prevention and Flight Safety programme	*Include any reporting requirements.*
14	Flight team composition	*Make up of the flight team depending on type of operation, complexity, type of aircraft etc.*
15	Operation of multiple types of SUA	*Any limitations considered appropriate to the numbers and types of SUA that a pilot may operate if appropriate.*
16	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.*
17	Crew health	*A statement and any guidance to ensure that the 'crew' are appropriately fit before conducting any operations.*
18	Logs and records	*Requirements for logs and records of flights for the SUA and by the pilots.*
Part B		
	Operating Procedures	
1	**Flight planning / preparation**	
1.1	Determination of the intended tasks and feasibility	
1.2	Operating site location and assessment	a) the type of airspace and specific provisions (e.g. Controlled Airspace) b) other aircraft operations (local aerodromes or operating sites) c) hazards associated with industrial sites or such activities as live firing, gas venting, high-intensity radio transmissions etc. d) local by-laws e) obstructions (wires, masts, buildings etc.) f) extraordinary restrictions such as segregated airspace around prisons, nuclear establishments etc. (suitable permission may be needed) g) habitation and recreational activities h) public access

Section	Subject	Comment
1.2 contd.	Operating site location and assessment	*i) permission from landowner* *j) likely operating site and alternative sites* *k) weather conditions for the planned event* *using available information from at least aeronautical charts, the UK Aeronautical Information Service (www.ais.org.uk), digital imagery (Google Earth/Maps etc.), Ordnance Survey maps etc.*
1.3	Risk management	*Identification of the hazards, risk assessment, mitigating procedures.*
1.4	Communications	*Contact numbers for other local aircraft operations.*
1.5	Pre-notification	*If the flight is to be performed within an Aerodrome Traffic Zone, or near to any aerodrome or aircraft operating site, then their contact details should be obtained and notification of the intended operation should 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.*
1.6	Site permission	*Reference to document confirming landowner's permission.*
1.7	Weather	*Methods of obtaining weather forecasts. Consideration of SUA limitations.*
1.8	Preparation and serviceability of equipment and SUA	*Pre-use checks and maintenance.*
2	**On site procedures and Pre-flight checks**	
2.1	Site survey	*Visual check of operating area and identification of hazards.*
2.2	Selection of operating area and alternate	*Size, shape, surrounds, surface, slope. Landing zone for an automatic 'home' return should be identified and kept clear.*
2.3	Crew briefing	*To cover the task, responsibilities, duties, emergencies etc.*
2.4	Cordon procedure	*Adherence of separation criteria.*
2.5	Communications	*Local and with adjacent air operations if appropriate.*
2.6	Weather checks	*Limitations and operating considerations.*
2.7	Refuelling	*Or changing / charging of batteries.*
2.8	Loading of equipment	*Security.*

Section	Subject	Comment
2.9	Preparation and correct assembly of the SUA	*In accordance with the manufacturer's instructions.*
2.10	Pre-flight checks on SUA and equipment	*May be covered in other technical manuals.*
3	**Flight procedures**	*These procedures may be contained in the 'operator's manual' or equivalent but should cover all necessary matters including safety.*
3.1	Start	
3.2	Take-off	
3.3	In flight	
3.4	Landing	
3.5	Shutdown	
4	**Emergency Procedures**	
4.1	Appropriate to the SUA and control system	*Should consider all those events that might cause the flight of the SUA to fail or be terminated. Security of radio-control links and provision for flight termination in the event of any critical system failure should be considered.*
4.2	Fire	*Risk and preventative measures should be considered relevant to the type of SUA power sources and fuel.*
4.3	Accidents	*Considerations, responses etc.*
4.4	Loss of control datalink	
Part C		
	Training	
1	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.*
Part D		
	Appendices	
1	Copy of CAA Permission	*This will provide immediate reference to the conditions under which the operations are to be conducted when applicable.*
2	Other documents	*As considered necessary.*

Chapter 2 Certification

1 Scope

1.1 This Chapter covers design and production standards applicable to the civil certification of the whole UAS, including components of UAS remote from the aircraft that support or can affect the airworthiness of the UAS.

2 Lead Agency

2.1 With the creation of EASA (reference paragraph 5 [1]) in September 2003, certification of a UAS with an operating mass of greater than 150 kg is the responsibility of EASA (with some exceptions – see paragraph 2.2). General queries and applications for certification for a UAS regulated by EASA should be addressed directly to EASA.

2.2 UAS not covered within the scope of EASA are excluded by various articles of European Council Regulation 216/2008, as follows:

2.2.1 Article 1 excludes aeronautical products, parts and appliances, as well as personnel and organisations involved in the design, production or maintenance of such products, part or appliances while carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services. The UK interpretation of military, customs, police search and rescue, firefighting, coastguard or similar services is given in CAP 562, Leaflet B-60, which can be viewed on the CAA website (www.caa.co.uk/CAP562).

2.2.2 Article 4(4) and Annex II excludes aircraft specifically designed or modified for research, experimental or scientific purposes, and likely to be produced in very limited numbers. This exclusion does not apply to the testing of designs or modifications that are ultimately to be embodied in a UAS to be used for other than experimental or scientific purposes.

2.2.3 Article 4(4) and Annex II exclude unmanned aircraft with an operating mass of 150 kg or less.

2.3 Responsibility for the airworthiness regulation of civil UAS that are outside the scope of EASA remains with the NAAs which, for the UK, is the Airworthiness Division of the Civil Aviation Authority, Safety Regulation Group.

3 Policy

3.1 UAS Subject To EASA Regulation

3.1.1 Applications or enquiries relating to the certification of UAS within the scope of EASA should be addressed directly to EASA.

3.1.2 In November 2005, EASA issued A-NPA 16/2005 – Policy for Unmanned Aerial Vehicle (UAV) Certification (reference paragraph 5 [2]). This A-NPA makes reference to the joint JAA/Eurocontrol Task-Force study to develop a concept of regulation for UAS (reference paragraph 5 [3]). The A-NPA requested comment on different approaches to the certification of a UAS. In August 2009, EASA issued Policy Statement E.Y013-01 – Airworthiness Certification of Unmanned Aircraft Systems (UAS) (reference paragraph 5 [4]). This policy establishes general principles for type-certification of a UAS. The concept to be adopted is a decision for EASA, and the references are provided here solely for background information.

3.2 UAS Subject to National Airworthiness Regulations

3.2.1 Paragraph 2.2 identifies the UAS that are not regulated by EASA and will be regulated by the UK authorities - the MoD for those UAS deemed to be military under the definition within the ANO, and the CAA for all other UAS. For UAS with an operating mass (without fuel) in excess of 20 kg the CAA will apply the General UAS Certification Policy as described in paragraph 3.4. A UK civil UAS with an operating mass of 150 kg or less may be eligible to fly in accordance with the Light UAS Policy as described in paragraph 3.3.

3.2.2 For a civil UAS with an operating mass not exceeding 20 kg (without fuel), no airworthiness certification is required. However, an operational permission may be required for such aircraft – see Section 3, Chapter 1.

3.2.3 The airworthiness approval for any UAS between 20 kg and 150 kg should be a Certificate of Airworthiness (or a permit to fly). However, to facilitate the development of UAS of 150 kg or less, the CAA has produced the Light UAS Policy as described in paragraph 3.3.

3.2.4 Above 150 kg MTOM the airworthiness approval should be a Certificate of Airworthiness or a permit to fly ("B" Conditions[1] may be applied to facilitate test flying). Organisations undertaking design and/or manufacture of civil UAS above 150 kg will be required to hold Organisation approvals conforming to Chapter A8-21 of BCAR Section A[2] – Airworthiness Procedures where the CAA has Primary Responsibility for Type Approval of the Product.

3.2.5 The Light UAS Policy is an interim alternative to the general certification procedures and standards provided the UAS meets the defined applicability criteria and operates within the constraints stipulated by the CAA. If a light UAS is to be operated outside these constraints, the applicant should discuss these issues directly with the CAA at the earliest opportunity to determine whether mitigating measures can be applied that would allow an exemption to be issued. Failing this, insistence upon compliance with the General UAS Certification Policy would be expected.

3.3 The 'Light UAS' Policy

3.3.1 UAS with an aircraft component operating mass of 150 kg or less may be eligible for operation in accordance with this policy.

3.3.2 Light UAS have mass and speed characteristics similar to those of model aircraft used for recreational purposes. The CAA has reviewed the safety record of model aircraft and concluded that UAS can be operated safely under a similar level of regulation, provided that the UAS in question has no greater capability than the majority of the existing model aircraft fleet and is subject to procedures and limitations that are at least as demanding as those applied to model aircraft.

3.3.3 UAS that do not exceed the defined maximum speed and kinetic energy levels representative of the existing model aircraft fleet may be exempted from compliance with certain requirements provided that operational restrictions at least as demanding as those applied to model aircraft are complied with. The applicable operational limitations include: operating within VLOS (not more than 500 metres from the pilot); not operating at a height exceeding 400 ft above the surface, and not over or within a defined distance of any person, vehicle or structure not directly involved in the operation of the UAS. (Further details of the Light UAS Policy can be obtained from reference paragraph 5 [5].)

1. 'B Conditions' means the conditions so entitled set out in ANO paragraph 2 of Part A of Schedule 3.
2. See CAP 553 - www.caa.co.uk/CAP553

3.3.4 The granting of the exemptions and permissions needed to allow the operation of a UAS within these constraints will be subject to receipt by the CAA of a positive recommendation from an organisation approved for that purpose. Such recommendations will be made following appropriate examination of design and manufacture and witnessing of a successful programme of function and reliability flight-testing. Series examples of a light UAS will not automatically qualify for an exemption but will be subject to individual approvals to ensure consistency in build standards and flight characteristics. Modification to a light UAS is prohibited for the same reason, unless the UAS is subject to re-examination/re-assessment and a further recommendation from an approved organisation is submitted to the CAA for issue of a new exemption.

3.4 General UAS Certification Policy

3.4.1 Any UAS with an operating mass of greater than 20 kg (without fuel) will be regulated under this policy, unless the CAA has granted an exemption under the Light UAS Policy.

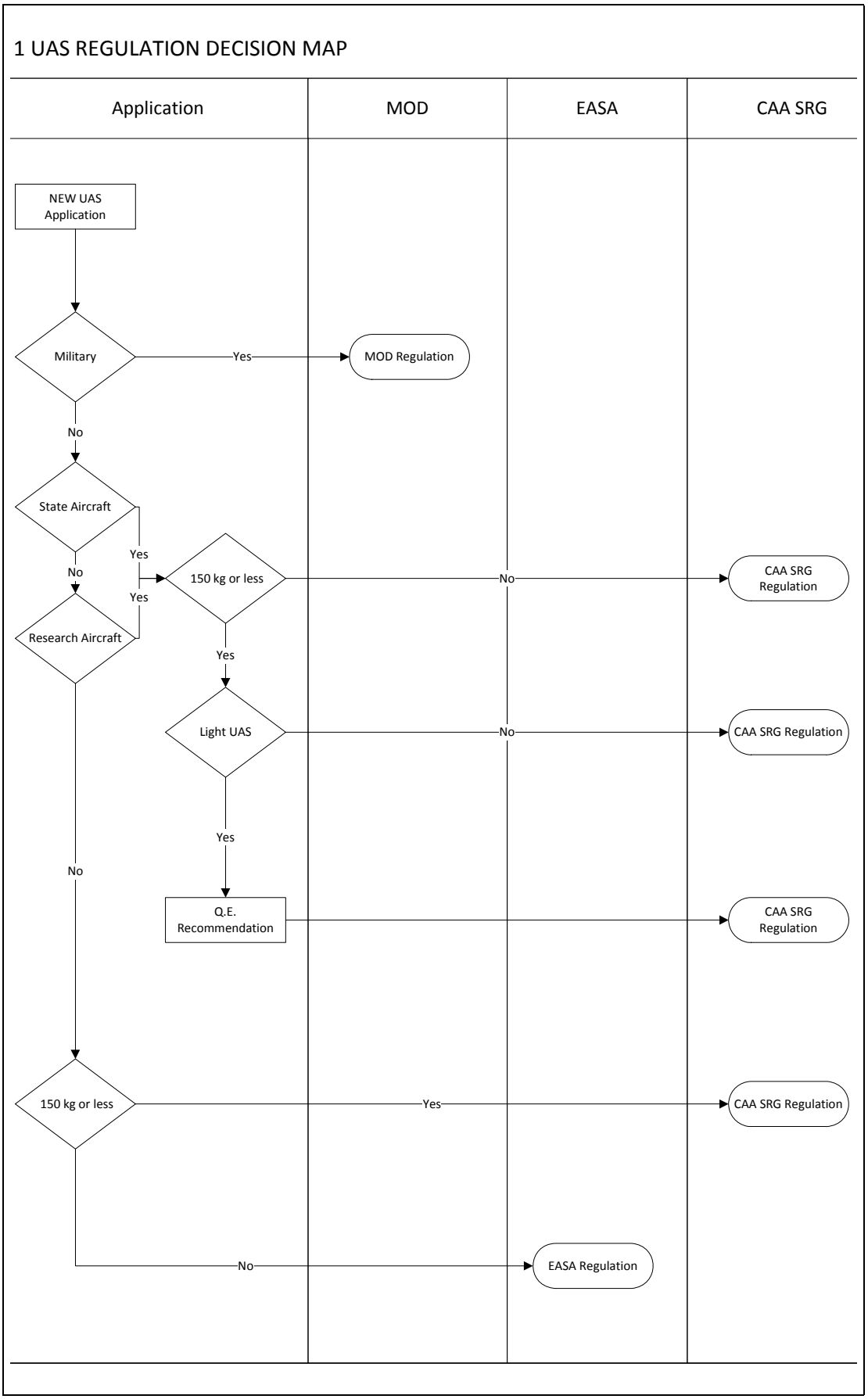
3.4.2 Under the General UAS Certification Policy – CAA Paper *Aircraft Airworthiness Certification Standards for Civil UAVs* (reference paragraph 5 [6]), organisations undertaking design and/or manufacture of civil UAS (that is to fly other than in accordance with the Light UAS Policy) will be required to hold Organisation approvals that conform to EASA Part 21 requirements or similar requirements acceptable to the CAA. Initial application for design or production activity should be made to the Applications and Approvals Department as detailed in paragraph 6.2.

3.4.3 As detailed in the General Policy, airworthiness design requirements appropriate to each type of UAS seeking certification will be derived from the existing codes of requirements as currently applied to manned aircraft. Demonstration of compliance with the applicable requirements will allow the issue of a Type Certificate. Certificates of Airworthiness will be issued to individual UAS following acceptable demonstration of compliance to the Type Certificate standard and when the CAA is satisfied that the UAS is fit to fly.

3.4.4 Where any function of a UAS is essential to, or can prejudice, continued safe flight and landing of the UAS, that function, and the equipment performing that function (including equipment remote from the UAS), shall be considered as part of the aircraft for the purposes of the validity of the Certificate of Airworthiness. As such, that function will have to comply with the applicable airworthiness requirements.

3.4.5 The UAS, including the RPS, should be designed taking into account Human Factors issues. CAP 719 *Fundamental Human Factors Concepts* (reference paragraph 5 [7]) and Section 2, Chapter 8 of this CAP 722 give guidance in this area.

1 UAS REGULATION DECISION MAP



4 Qualified Entities

4.1 Light UAS (Over 20 kg but no more than 150 kg)

4.1.1 The Light UAS Policy encompasses accredited bodies known as Qualified Entities to carry out airworthiness assessments on behalf of the CAA. The standards to be met by UK Qualified Entities are published as Chapter A8-22 of BCAR Section A – Airworthiness Procedures where the CAA has Primary Responsibility for Type Approval of the Product.

5 Source Documents

[1] Regulation (EC) No. 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency.

(Available to download from the EASA website: www.easa.europa.eu)

[2] EASA A-NPA 16/2005 – *Policy for Unmanned Aerial Vehicle (UAV) Certification*

(Available to download from the EASA website: www.easa.europa.eu)

[3] The Joint JAA/Eurocontrol initiative on UASs. UAV Task-Force Final Report.

(Available to download from the EASA website: http://easa.europa.eu/rulemaking/r-archives.php as Appendix to A-NPA 16/2005.)

[4] EASA Policy E.Y013-01 – *EASA Policy on Unmanned Aircraft certification*

(Available to download from the EASA website http://www.easa.europa.eu/certification/policy-statements.php)

[5] CAA Paper "*UK-CAA Policy For Light UAV Systems*"
D.R. Haddon/C.J. Whittaker; June 2004.

(Available to download from the CAA website www.caa.co.uk/uas)

[6] CAA Paper "*Aircraft Airworthiness Certification Standards for Civil UAVs*"
D.R. Haddon/C.J. Whittaker; August 2002.

(Available to download from the CAA website www.caa.co.uk/uas)

[7] CAP 719 *Fundamental Human Factors Concepts*

(Available to download from the CAA website www.caa.co.uk/CAP719)

6 Points of Contact

6.1 For enquiries relating to CAA UAS design standards:

Manager of Certification Projects
Airworthiness Division
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573293
Fax: +44 (0) 1293 573975

E-mail: department.certification@caa.co.uk

6.2 For enquiries relating to CAA approval of design and production organisations:

Applications and Approval Department
Airworthiness Division
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 768374
Fax: +44 (0) 1293 573860

E-mail: a&a@caa.co.uk

6.3 For EASA contact details, see the EASA website www.easa.europa.eu.

Chapter 3 Registration

1 Scope

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

2 Lead Agency

2.1 CAA – Aircraft Registration Section.

3 Policy

3.1 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.

3.2 As mentioned earlier in the document, exceptions are made for small unmanned aircraft. A small unmanned aircraft is defined in the Order as 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. None of the registration requirements apply to small unmanned aircraft.

3.3 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.

3.4 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 website[1] under "Mandatory Insurance Requirements".

4 Source Documents

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

5 Point of Contact

5.1 Guidance on the Registration of civil unmanned aircraft in the UK should be sought from:

CAA, Aircraft Registration Section
Head of Aircraft Registration
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6666
Fax +44 (0) 20 7453 6670

E-mail: aircraft.reg@caa.co.uk
Web: www.caa.co.uk/aircraftregister

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

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Chapter 4 Maintenance and Inspection

1 Scope

1.1 This Chapter addresses continuing airworthiness requirements including maintenance applicable to civil UAS and components of a UAS that can affect its airworthiness.

2 Lead Agency

2.1 CAA – Safety Regulation Group (SRG), Survey, Airworthiness.

3 Policy

3.1 UAS on the UK Civil Register will be required to hold valid Certificates of Airworthiness. For civil UAS subject to EC regulations the CAA, as the UK competent authority, will issue the airworthiness certificate. For civil UAS not subject to EC Regulations Certificates of Airworthiness will be subject to the provisions of the ANO.

3.2 Continuing airworthiness requirements, including maintenance, appropriate to each type of UAS issued with an airworthiness certificate will be in accordance with the requirements that currently apply to manned aircraft.

3.3 Organisations undertaking continuing airworthiness and maintenance tasks on civil UAS will be required to hold appropriate approvals and licences under EC Regulations or the ANO as applicable.

4 Source Documents

[1] Regulation (EC) No. 216/2008 of the European Parliament and of the Council of the 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency.

[2] Commission Regulation (EC) No. 2042/2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks.

- Annex I – Part M Continuing airworthiness requirements.
- Annex II – Part 145 Approval of maintenance organisations.
- Annex III – Part 66 Certifying Staff, aircraft maintenance licence.
- Annex IV – Part 147 Training organisation requirements.

[3] The ANO.

5 Point of Contact

5.1 For enquiries relating to the continuing airworthiness and maintenance requirements for UAS:

Chief Surveyor's Office
Survey
Airworthiness
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573367
Fax: +44 (0) 1293 573984

E-mail: chiefsurveyorsoffice@caa.co.uk

Chapter 5 Security Issues

1 Scope

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

2 Lead Agency

2.1 In the UK the government has responsibility for aviation security. The CAA provides advice to the government and industry on these issues.

3 Policy

3.1 It is CAA Policy that "any UAS outside a UK Danger Area will not increase the risk to existing users and will not deny airspace to them". This policy requires a level of safety and security equivalent to that of manned aviation.

3.2 Current policy also states that a UAS must have adequate security to protect the system from unauthorised modification, interference, corruption or control/command action.

4 Factors for Consideration when Developing Security for UAS

4.1 Holistic Approach

4.1.1 When considering security for the UAS it is important to approach it from a holistic viewpoint, 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 which could ultimately affect safety.

4.1.2 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.

5 Security Aspects to be Addressed

5.1 The security aspects are required to address particular possible weaknesses of a UAS such as employees, location, accessibility, technology, management structure and governance.

5.2 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, 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 shall 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.

5.3 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 system (including the communications link) and the UA itself. The requirements should be ultimately traced to the overall policy requirements given in paragraph 3.2 above.

6 Security Process

6.1 The security of the UAS is in support of overall UAS safety and with this in mind any agreed security design, evaluation and accreditation process should be integrated (where necessary) with the existing certification, approval and licensing processes utilised for manned vehicles.

6.2 The security design, evaluation and accreditation process should consider as a factor the operational scenario, including but not limited to:

- Applicable flight rules;
- Air vehicle capabilities and performance including kinetic energy and lethal area;
- Operating environment (type of airspace, overflown population density); and
- Opportunities for attack and desirability.

6.3 The operational scenarios, along with other applicable factors, should 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.

6.4 Risk management techniques should 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.

6.5 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.

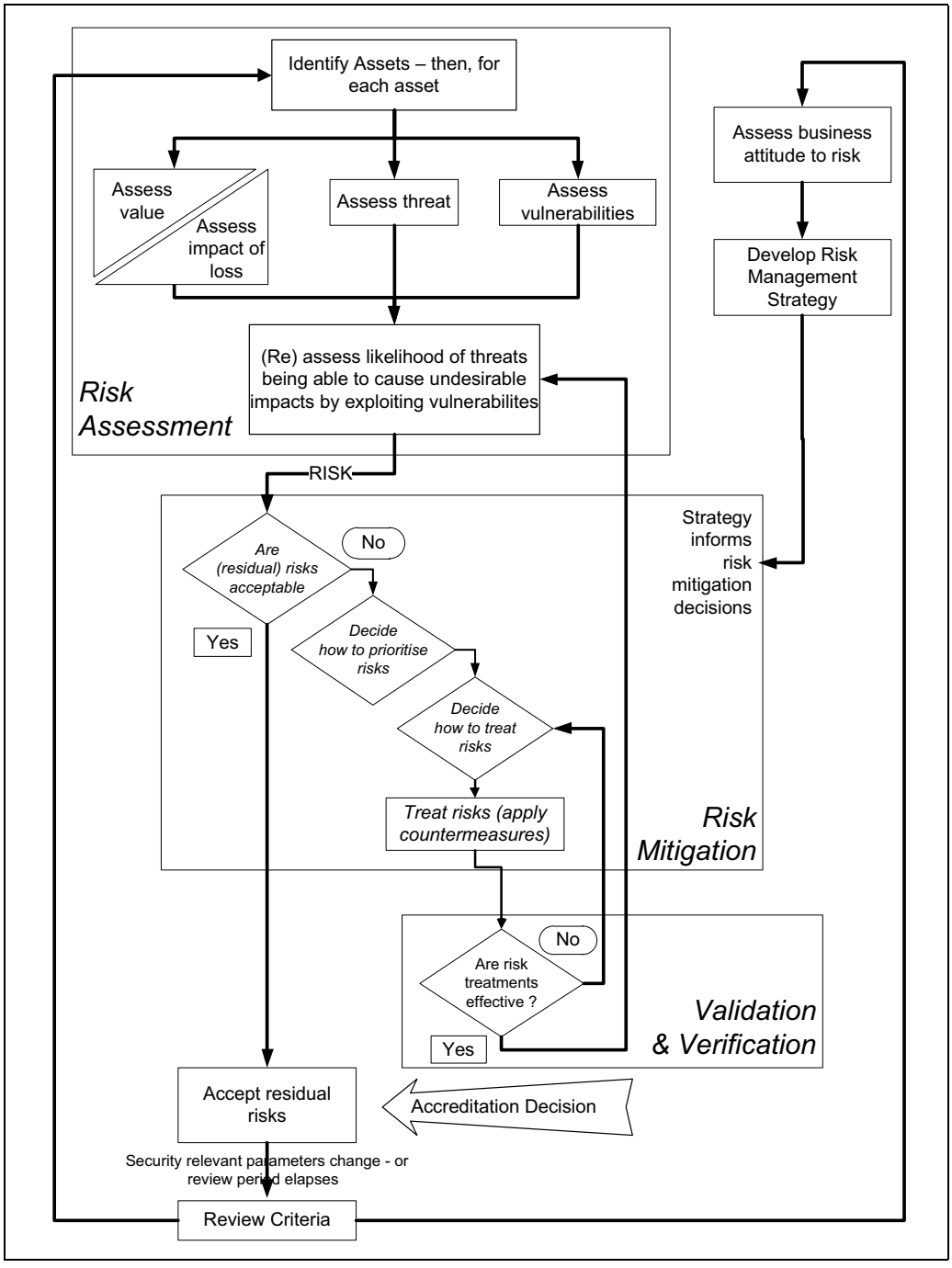

Figure 1 Possible Security Approach

6.6 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.

7 Current UAS Security Work

7.1 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.

8 Point of Contact

8.1 For enquiries relating to UAS security:

Manager of Certification Projects
Airworthiness Division
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573293
Fax: +44 (0) 1293 573975

E-mail: department.certification@caa.co.uk

Chapter 6 ATM Procedures

1 Introduction

1.1 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.

1.2 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 should be made to the address below.

2 Scope

2.1 This Chapter provides guidance on the policy associated with the provision of Air Traffic Services within UK airspace.

3 Lead Agency

3.1 CAA – Safety Regulation Group (SRG), Aerodrome and Air Traffic Standards Division (AATSD).

4 Policy

4.1 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).

4.2 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).

4.3 Not all aircraft within the same geographic area will necessarily be in communication with the same ATSU or operating under the same rules.

4.4 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.

4.5 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.

4.6 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 CAA SRG (AATSD) 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 tolerable and is as low as reasonable practicable through ATS and/or other measures.

4.7 Where it is intended to operate a UAS in segregated airspace such a safety assessment should 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 safety case) 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.

5 Source Documents

5.1 Further information about the various levels of ATS and the services available from ATS units can be found in the following documents:

[1] Air Traffic Control - CAP 493 *Manual of Air Traffic Services Part 1*.

[2] Flight Information Service - CAP 410 *Manual of Flight Information Services*.

[3] Air/Ground Communication Service – CAP 452 *Aeronautical Radio Station Operator's Guide*.

[4] CAP 774 *UK Flight Information Services*.

5.2 Further information about the classification of airspace and flight rules can be found in CAP 32 UK Aeronautical Information Publication.

5.3 Further information about radiotelephony procedures can be found in CAP 413 Radiotelephony Manual.

5.4 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*.

6 Point of Contact

6.1 Guidance on civil ATM procedures for UAS should be sought from CAA – Safety Regulation Group (SRG), Aerodrome and Air Traffic Standards Division (AATSD).

Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

E-mail: ats.enquiries@caa.co.uk

Chapter 7 Emergency ATM Procedures

1 Scope

1.1 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.

2 Lead Agency

2.1 Preplanned arrangements for emergency manoeuvring of UAS, including manoeuvre into emergency orbit areas, emergency landing areas, 'cut-down' points and ditching areas, should be developed in consultation with CAA Directorate of Airspace Policy (DAP), who will coordinate with CAA Safety Regulation Group (SRG) and associated ANSPs.

3 Policy

3.1 In accordance with the overarching principle that UAS operation is expected to be transparent to ATS providers, the ATM handling of emergencies involving UAS should be expected to follow the same process as that for manned aircraft with the controller/Flight Information Service Officer (FISO) / 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 should, 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.

3.2 UAS operators should, 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 should 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 should be reflected in the UAS operator's safety assessment.

4 Source Documents

4.1 Further information about ATS arrangements for dealing with aircraft emergencies can be found in the following documents:

[1] Air Traffic Control – *CAP 493 Manual of Air Traffic Services Part 1*.

[2] Flight Information Service – CAP 410 *Manual of Flight Information Services*.

[3] Air/Ground Communication Service – CAP 452 *Aeronautical Radio Station Operator's Guide*.

[4] CAP 774 *UK Flight Information Services*.

4.2 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*.

5 Point of Contact

5.1 Guidance on other Emergency ATM procedures for civil UAS should be sought from:

CAA – Directorate of Airspace Policy (DAP)
ORA 3
K6 G2
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6543
Fax: +44 (0) 20 7453 6565

E-mail: ORA@caa.co.uk

Chapter 8 Breaches of ATC Regulations

1 Scope

1.1 Guidance relating to breaches of civil ATC regulations should be sought from CAA – Safety Regulation Group (SRG), Aerodrome and Air Traffic Standards Division (AATSD).

1.2 Breaches of Aviation Regulation legislation should be reported directly to:

Aviation Regulation Enforcement (ARE)
Civil Aviation Authority
Room 505
CAA House
45-59 Kingsway
London
WC2B 6TE

Tel: +44 (0) 20 7453 6193
Fax: +44 (0) 20 7453 6175

E-mail: AREMailbox@caa.co.uk

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Chapter 9 Incident/Accident Procedures

1 Scope

1.1 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.

1.2 This Chapter outlines the principles that should 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. The requirements for investigation of occurrences involving UK military UAS are contained within the appropriate military regulations.

2 Definitions

2.1 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.

2.2 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.'

2.3 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.

2.4 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.'

3 Lead Agencies

3.1 Accident / Serious Incident Investigation: Air Accidents Investigation Branch (AAIB).

Mandatory Occurrence Reporting: CAA – Safety Regulation Group (SRG), Safety Data.

4 Policy

4.1 Any accident, or serious incident, as defined under Regulation (EU) No. 996/2010, to a UAS with a design or operational approval occurring in UK airspace should be reported to the AAIB.

4.2 Any accident, or serious incident, to a UAS with a design or operational approval occurring in another nation's airspace should be reported to the equivalent national investigation authority of the country concerned.

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

4.3.1 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; and
- any turbine-powered aircraft which has a Certificate of Airworthiness issued by the CAA.

4.3.2 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, should 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.

4.3.3 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; and
  - 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.

5 Source Documents

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

[2] Air Navigation Order 2009 – Article 226.

[3] CAP 382 (The Mandatory Occurrence Reporting Scheme).

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

[5] ICAO Annex 13 – Aircraft Accident and Incident Investigation.

6 Points of Contact

6.1 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

6.2 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

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Chapter 10 Aerodrome Operating Procedures

1 Scope

1.1 The ANO does not require UAS operations to take place from aerodromes licensed by the CAA. This Chapter applies to those UAS operations that do take place at licensed aerodromes.

1.2 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 should be made to the address below.

2 Lead Agency

2.1 CAA – Safety Regulation Group (SRG), Aerodrome Standards Department (ASD).

3 Policy

3.1 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.

3.2 The operation of UAS at a licensed aerodrome shall 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.

3.3 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 should 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.

3.4 Aerodrome and UAS operating procedures may be subject to audit by the CAA.

4 Source Documents

4.1 Information about the licensing and operation of aerodromes can be found in the following documents:

[1] CAP 168 Licensing of Aerodromes.

[2] CAP 738 Safeguarding of Aerodromes.

5 Point of Contact

5.1 Guidance on aerodrome procedures for UAS should be sought from CAA – Safety Regulation Group (SRG), Aerodrome and Air Traffic Standards Division (AATSD).

Head of Aerodrome Oversight
Safety Regulation Group
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Tel: +44 (0) 1293 573279
Fax: +44 (0) 1293 573971

E-mail: aerodromes@caa.co.uk

Section 4 Military Operations

Chapter 1 Certification, Registration and Maintenance

1 Scope

1.1 This guidance provides an overview of the requirements involved in certification, registration and maintenance of UK military Remotely Piloted Air Systems (RPAS).

2 Lead Agency

2.1 Military Aviation Authority (MAA) Certification and Regulation Division.

3 Policy

3.1 UK military in-service RPAS[1] (includes the control station telemetry equipment) are to be treated as UK military aircraft and are subject to the regulations contained in the MAA Regulatory Publications (MRP) that cover all aspects of military aviation. The Regulatory Articles (RA) 1000–1300 Series describes the Safety Management System adopted by the Ministry of Defence (MoD) for the management and regulation of military aircraft airworthiness. It sets out the policy and associated arrangements agreed by the MAA Safety Advisory Council (MSAC) and applies to all UK Military aircraft, including RPAS.

3.2 All military RPAS are to be registered as UK military aircraft, either generically by type or by individual airframe, depending on their physical characteristics. New military registered air systems and major changes to existing air systems, including RPAS, are to be certified in accordance with RA 1500. The MoD Release to Service (RTS) is the release document that authorises service flying on behalf of the Service Chief of Staff. UK military registered RPAS are to be operated within the limitations contained within its specific RTS, Certificate for Flight Trials (CFT) or Military Flight Test Permit (MFTP) and supported by a safety case. When military registration is deemed necessary to a civil owned RPAS the military status of the RPAS is recognised by the issue of a Certificate of Usage (CoU) by the MoD.

3.3 It is MoD policy that military RPAS are to be maintained in accordance with the same policy and procedures as applicable to manned aircraft. Project Team Leaders are responsible for the development and publication of specific procedures to support and maintain the airworthiness of their aircraft.

4 Source Documents

[1] MRP RA 1200 Series and RA 2100–2400 Series

[2] MRP RA 1000–1300 Series and RA 1500 – Certification of UK Military Registered Air Systems

[3] Manual of Maintenance Airworthiness Processes (MMAP)

1. The term UAS has not been adopted by the MoD.

[4] Def Stan 00-970 Design and Airworthiness Requirements for Military Aircraft

[5] Def Stan 05-57 Configuration Management of Defence Materiel

[6] MRP RA 1121: Military Registration of Civil Owned Aircraft

[7] MRP RA 5000 Series: Design and Modification Engineering (DME) Regulations

[8] MRP RA 4800 Series: Continuing Airworthiness Engineering (CAE) Maintenance Approved Organization Scheme (MAOS) Military Regulation

5 Points of Contact

5.1 Regulation & Certification:

MAA-RegCert-Hd
Juniper L0 Wing 2 #5003
MoD Abbey Wood North
Bristol
BS34 8QW

Tel: +44 (0) 30 679 80360

E-mail: maa-reg-hd@mod.uk

5.2 Certification:

MAA-Cert-DepHd
Juniper L1 Wing 4 #5004
MoD Abbey Wood North
Bristol
BS34 8QW

Tel: +44 (0) 30 679 82543

E-mail: maa-cert-Dephd@mod.uk

Chapter 2 Non In-Service RPAS Operations

1 Scope

1.1 All non-RTS RPAS flying is termed non in-service and must be flown under a Certificate for Flight Trials (CFT), a Military Flight Test Permit (MFTP) or a Certificate of Usage (CoU) which are staffed by an appropriate MoD Project Team (PT). In all these circumstances the activity is regulated by the MAA. This normally includes all RPAS engaged in Research and Development, Clearance and Production flying, in-service Return-to-Works (RTW) activities and Military Registered Civil-Owned Aircraft (MRCOA), which also applies to RPAS.

1.2 The MAA Air Traffic Management Division is responsible for the regulation and approval of ATC/Range Air Control staff (and associated equipment) providing services within air Danger Areas operated by QinetiQ on behalf of the MoD.

1.3 All MoD PTs must inform the MAA before any contract involving RPAS flying is let.

1.4 RPAS operated by the MoD are deemed to be in-service when operated by the Army, Royal Navy, Royal Air Force and, under certain circumstances, contractors when they will be flown under an RTS.

2 Lead Agency

2.1 Military Aviation Authority, Operations Group, Flight Test Division.

3 Policy

3.1 All RPAS flying operations will be subject to an appropriate level of approval similar to that applied to manned flying operations.

3.2 This will include approvals for: the company, the designated Head of Flying, all supporting engineering activity, all operating site(s) or airfield(s), the UAV-p, ATC provision and specific approval for all RPAS types to be flown.

3.3 Under normal circumstances and until appropriate national airspace procedures have been promulgated, flights will only be permitted within MAA approved Danger Areas or segregated airspace. These Danger Areas and segregated airspace must provide adequate radar services (or such processes that are agreed to be considered equivalent) such that the Rules of the Air Regulations requirement for the 'Commander' of the aircraft to avoid aerial collisions can be fully acquitted. This will also generally involve the installation of an approved Flight Termination System (FTS) and Identification Friend or Foe (IFF) system.

3.4 All non in-service RPAS are treated as UK military aircraft and placed on the UK military register. They are operated subject to MAA regulation including the Manual of Flying Orders for Contractors if appropriate. These contractor regulations also require RPAS operators to produce flying orders and procedures that mirror the requirements placed on the in-service operators and that cover, as a minimum, the specifics listed in Section 4, Chapter 3.

4 Source Documents

[1] MAA Regulatory Publications (MRP)

5 Point of Contact

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Chapter 3 In-Service RPAS Operations

1 Scope

1.1 In-service RPAS operations cover all types of RPAS that have an RTS and are subject to the control of an Aircraft Operating Authority (AOA).

2 Lead Agency

2.1 Military Aviation Authority (MAA) Operations Group – Flight Test Division.

3 Policy

3.1 UK military in-service RPAS are to be treated as UK military aircraft. They are therefore to be subject to the regulations contained in the MRP RA 1200 Series and RA 2100–2400 Series. These regulations require AOAs to produce flying orders that cover, as a minimum:

- Provision of an equivalent level of compliance with the Rules of the Air.
- Permitted areas of operation.
- Provision of the minimum facilities required for safe operation.
- Weather minima.
- Briefing requirements, to include safety of the operating crew and other personnel.
- Flight authorisation.
- Pre-flight, in-flight and post-flight checks.
- Operating crew responsibilities.
- Emergency procedures.
- Range Air Controllers duties, if appropriate.
- Flying procedures including take-off and landing procedures.
- Accident and incident reporting and investigation procedures.
- Action to be taken in the event of loss of control data link to RPAS.
- Abort procedures following critical system failure.
- Detailing the training, competency, currency, medical requirements and crew duty considerations for all personnel involved in the operation of RPAS.

4 Source Documents

[1] MRP RA 1200 Series: Air Safety Management

[2] MRP RA 2100–2400 Series: Flying

5 Point of Contact

5.1 The point of contact for general enquiries regarding in-service Operations is:

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E Block Spur 10
MoD Ensleigh
Bath
BA1 5AB

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Chapter 4 ATM Procedures

1 Scope

1.1 The regulations concerning military ATS are contained within MRP RA 3000 Series: Air Traffic Management. Regulations for Role-Specific RPAS are detailed in MRP RA 2000. These regulations apply to all those concerned with the operation of UK Service aircraft, but they do not absolve any person from using best judgement to ensure the safety of aircraft and personnel.

2 Lead Agency

2.1 Military Aviation Authority (MAA) Operations Group – Air Traffic Management.

3 Policy

3.1 It is MoD policy that RPAS must show a level of compliance with regulations equivalent to that for manned aircraft. In the absence of an approved means of complying with the Rules of the Air (R307) appropriate to the class of airspace, RPAS flying within UK airspace will not be permitted access to non-segregated airspace. RPAS being flown within segregated airspace (Danger Area, other operational area, temporary segregated airspace, etc.) within the UK will be provided with a level of safety, in respect of collision avoidance, that is equivalent to that provided to a pilot of a manned aircraft. Flight in segregated airspace other than a designated Danger Area will be considered on a case-by-case basis, and will require close liaison with DAS and DAP. RPAS flight within segregated, controlled airspace (ICAO Classes A-E) shall take place under IFR for UK military aircraft, as Operational Air Traffic. From the air traffic controllers' perspective, the provision of an ATS to an RPAS must be transparent. This includes all stages of the flight from pre-notification to landing; there should be no difference in RTF, landline communications or transponder data procedures nor should the controller have to apply different rules or different criteria.

4 Source Documents

[1] MRP RA 1200 Series: Air Safety Management

[2] MRP RA 2100–2400 Series: Flying

5 Point of Contact

5.1 The point of contact for general enquiries regarding ATM procedures is:

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