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Renewables & Unmanned Aircraft Systems - Guidelines for Operations (RUGO)

Guidelines for Renewable Energy Duty Holders in the Management, Procurement and Operations of Unmanned Aircraft Systems in Renewables

Issue 1 | January 2020

Acknowledgements

RenewableUK acknowledges the time, effort, experience and expertise of all those who contributed to this original Issue 1, January 2020 document (full list in Annex K), led by a RenewableUK Task and Finish Group of industry representatives from its membership base.

Disclaimer

The contents of these guidelines are intended for information and general guidance only, do not constitute advice, are not exhaustive and do not indicate any specific course of action. Detailed professional advice should be obtained before taking or refraining from action in relation to any of the contents of this guide or the relevance or applicability of the information herein.

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Foreword

Unmanned Aircraft Systems (UASs) are increasingly being used to support renewable energy projects. This presents new risks, for example in relation to interactions with other aircraft, people and assets, but also new opportunities, such as improving safety and operational efficiency.

As opportunities and benefits from the application of UAS capabilities expand, the regulatory and operational framework inevitably becomes complex. RenewableUK, the trade association focused on building the future energy system powered by clean electricity, has produced these high-level guidelines for organisations who use or are considering the use of UASs in support of projects in the wind, wave and tidal energy sectors.

This document has been prepared by a group of industry representatives, with RenewableUK providing the overall steering function and secretariat. It has been shared with the wider membership, stakeholders, regulators (CAA, HSE and MCA), to provide opportunity for comment during drafting.

Readers are kindly requested to inform RenewableUK if they notice any inaccuracies or out of date information, and to suggest any additional topics or material for inclusion.

Note on terminology

For consistency in this document we use the term Unmanned Aerial Vehicle (UAV) to refer to the aircraft (the 'drone') and Unmanned Aircraft System (UAS) to refer to the whole system, including the UAV itself and, for example, the remote pilot, the communication system, and ground-based supporting systems.

In other documents, the terms Small Unmanned Aircraft (SUA) and Small Unmanned Surveillance Aircraft (SUSA) may be used for UAV, and Remotely Piloted Aircraft System (RPAS) for UAS. There are no real differences of meaning for most practical purposes.

External contractors providing UAS services are referred to as (UAS) Service Providers in this document.

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Chapter 1: Introduction

1.1 Background

Unmanned Aircraft Systems (UASs) are increasingly being used to support renewable energy projects. This presents new risks, for example in relation to the interaction between Unmanned Aerial Vehicles (UAVs), and other aircraft, people and assets. It also presents new opportunities, such as improving safety in hazardous locations and operational efficiency, for example, by reducing working at height or reducing down time.

With the increasing use of UASs, legislation, regulatory arrangements, standards and practices are rapidly evolving. The International Organisation for Standards (ISO) and other standards bodies (e.g. British Standards Institute (BSI)) are developing standards and some industry bodies in other sectors (e.g. Oil & Gas UK (O&GUK)) have produced their own guidelines. To date, there has been no single point of reference for renewable energy. In discussion with members, RenewableUK (RUK) identified that high level guidelines, referencing sources of more detailed information and providing some good practice examples, could be useful to stakeholders.

It is aimed at the UK environment but reference to international aspects is made where appropriate. In due course, consideration will be given to expanding the scope to include greater detail on relevant international guidance as information becomes available.

This document has been prepared by a group of industry representatives, with RUK providing the overall steering function and secretariat. Annex K lists the contributors.

Figure 1 – Scope of The Guidance

Topic	Theory	Ground training
UAS equipment types and applications	• All UAV classifications, sizes and levels of sophistication • Current and foreseeable uses (see Section 2) • Within and Beyond Visual Line of Sight (BVLOS) • Free-flying and tethered	• Passenger-carrying UAVs • Power-generating systems using tethered UAVs or kites
Application sectors	• Wind and marine energy	• Other renewable energy projects, e.g. solar, hydro[1]
Lifecycle stages of the renewable energy asset, infrastructure and equipment	• Planning (both project planning and land use planning) • Consenting, regulatory approval/ licensing, notification • Survey • Contracting strategy • Concept and detailed design • Fabrication • Construction, installation and commissioning • Operation and maintenance • Repowering/ upgrade/ modification • Decommissioning	
Lifecycle stages of the UAS	• Procurement, O&M	• Design, manufacture, CE marking
Risk types (who or what may be harmed)	• Operational risks from on-site UAS operations (e.g. collisions, dropped load, interference with aviation operations and electromagnetic interference with communication or control systems) • Environmental hazards (e.g. if a cargo or battery containing hazardous substances, is dropped) • UAS element risks: personnel, equipment, procedures, interfaces, simultaneous operations	• Risks arising from the purpose of the UAS, e.g. risks associated with the data gathered, such as adequacy of image quality, privacy and data protection • Security issues around overflying or obtaining images of certain sites • Contractual, commercial, financial, and insurance liability risks • **NB: These are key risks that the Duty Holder will need to consider for each specific project and UAS application**

1.2 Objectives and Audience

This document provides guidelines on managing operational risks for organisations who use or may use UASs in support of wind, wave or tidal renewable energy projects.

During the planning, design and construction phases of renewable assets, and during upgrade, repowering or decommissioning, the organisations with primary responsibility for risk management are most likely to be the Clients, Developers or Principal Contractors. During operations and maintenance, they are most likely to be the Owner or Operator. Throughout this document, we use the generic term 'Duty Holder' (as used in health and safety legislation) to cover any such organisations (whilst acknowledging that other parties, such as suppliers or maintenance contractors, will also be Duty Holders).

These guidelines are intended for Duty Holders who are managing UAS operations either directly or via an external contractor (referred to as the (UAS) Service Provider in this document). By collating and summarising the issues, the questions that Duty Holders could ask and the types of assurance that they could look for, this document aims to help them integrate UAS operations safely and efficiently into their projects, acting as intelligent customers, and taking an approach appropriate to their specific operational context and its risk profile.

The guidelines are not intended as a primary resource for organisations whose main business is the design, manufacture, supply or operation of UASs. Such organisations will need to consult standards and guidance specific to the UAS sector.

These guidelines should be used in conjunction with the most up to date, relevant legislation, regulatory material, standards and other sources of good practice. Due to rapid industry and technological change, it is not possible for a document such as this to be fully comprehensive or future-proof.

1.3 Scope of The Document

This document focuses on considerations that are specific to UAS operations. It is assumed that the reader already has a safety/ risk management system in place, and is familiar with good business practices and the overarching legislation that applies to all employers.

The document considers all elements of the UAS, including but not limited to: the UAV, the control and communication systems; any launch or landing/ recovery systems; the human operators; maintenance; management and office support. The document covers operations within UK jurisdiction (onshore and offshore) and at any stage of a project or asset lifecycle. Figure 1 sets out the topics considered for this document.

1.4 Structure of The Guidance

Section 2: Provides a generic framework for defining and describing a UAS in terms of, for example: the elements of the UAS itself, its operational context and the various interested parties. This is intended to help Duty Holders develop a clear and comprehensive understanding of their specific UAS, as a prerequisite to identifying and managing the risks.

Section 3: Is a summary of the key factors for Duty Holders to consider when specifying or selecting a UAS.

Section 4: Provides an overview of good risk management practices.

Section 5: Provides more detailed guidelines, structured as FAQs relating to each stage of a Plan-Do-Check Act cycle, to help Duty Holders ensure that they have appropriate risk controls in place for each specific project.

S**ection 6:** Provides a series of supporting Annexes.

1 Excluded because outside of RUK scope

Chapter 2: Defining the system

Duty Holders will need a clear and comprehensive understanding of their specific UAS and its operational context, as a prerequisite to identifying and managing the associated risks. This section provides a generic framework for defining and describing a UAS.

2.1 System Elements

Figure 2 depicts the main elements of a UAS in terms of the equipment, personnel and associated processes and procedures that contribute to safe operations. Further material relating to each element within this document is provided in Figure 3 as follows:

Figure 2 – Elements of UAS Operation

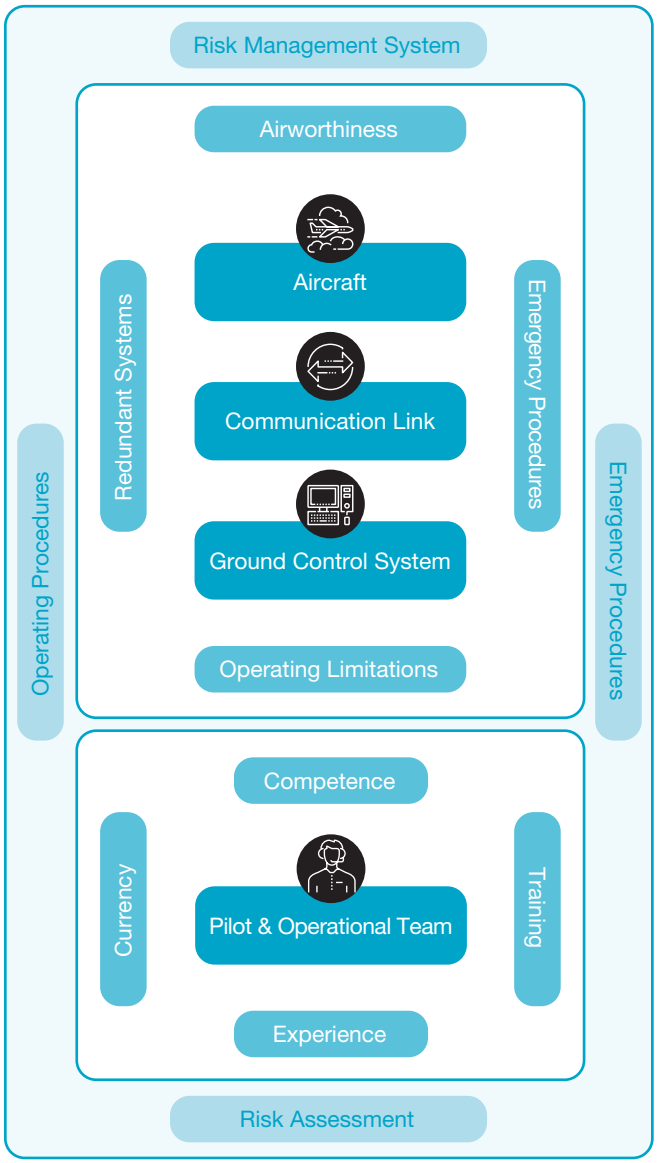


Figure 3 – Elements of UAS Operation: Further Material

System Element	Section of RUGO
Aircraft, Communication Link, Ground Control System	3.1 System Suitability
Operating Limitations	3.1 System Suitability
Airworthiness	3.2 Resilience
Redundant Systems	3.2 Resilience
Safety Systems	3.3 Mitigation
Pilot & Operational Team: Competence, Experience, Training	4.4 Training and Competence
Operating Procedures	4.2 Operating Requirements & Procedures
Emergency Procedures	4.6 Emergency Procedures
Risk Management System	4.1 Risk Management System
Risk Assessment	4.1 & 4.5 Task Specific Risk Assessment

2.2 Applications

Current and foreseeable UAS applications include:

- Site survey
- Monitoring of operations
- Inspection
- Maintenance/ repair
- Logistics – e.g. delivery of items
- Surveillance e.g. for security, record-keeping, accident investigation
- Use in emergencies e.g. for Search and Rescue (SAR)
- Publicity/ communications (e.g. photography, video)
- Offshore applications

2.3 UAS Technologies

Current and foreseeable technology interfaces include:

- Power source (battery, hydrocarbon fuel)
- Communication, Navigation and Surveillance (CNS), e.g. radio, GPS, datalink (ADS-B etc)

- Data management, security and transport

2.4 Contracting Models

Current and foreseeable contracting models may include:

- Procurement, operation and maintenance of the UAS: contracted out or in-house
- Integrated with another contract (e.g. for asset maintenance) or separate

2.5 Operational Environment

A non-exhaustive list of current and foreseeable environmental considerations include:

- Onshore/ offshore/ from a vessel/ from an installation
- Weather (rain, fog, wind, visibility, lightning etc.)
- Sea state
- Ranges and limits (BVLOS or VLOS)
- CNS and Air Traffic Control (ATC) coverage, level of ATC service
- Airspace classification and restrictions
- Electromagnetic environment (potentially affecting, or affected by, the UAS)
- Arrangements for safe transport and storage of UAS equipment (may require consideration of transport of dangerous goods)
- Containment of damaged batteries and any other hazardous materials
- Emergency procedures and recovery
- Human factors (e.g. fatigue)

2.6 Interfaces with External Actors and Systems

Current and foreseeable interfaces include:

- Renewable aviation operators e.g. survey aircraft, service helicopters (many offshore wind farms use helicopters for heli-hoisting and technician transfer activities).
- Other renewable energy operators. Construction and maintenance are likely to result in activities occurring at the same time as UAS operations (Simultaneous Operations (SIMOPS)). Other specialisms and trades may also be active, including but not limited to: cabling, diving, surveying, offshore substation activities and weather monitoring.
- Other airspace users – e.g. commercial, general aviation or military aircraft operators, airports, Air Traffic Management (ATM) service providers, police, air ambulance, other UAS users.
- Maritime industry e.g. vessel operators, service providers.
- Emergency services and public authorities. Dependent on location, UAS activities and flight paths may interact with the operations of the Police, MCA, local authority etc., or lead to unnecessary concerns and alerts about security or safety.
- Landowners/ users. UAS data capture has the potential to infringe privacy. The noise and visibility of UAVs may create annoyance and disturb livestock or wildlife.
- Industrial and infrastructure installations and facilities – e.g. taking into account airspace restrictions for safety and security reasons around sensitive and hazardous sites, both civil and military.
- Interaction with the general public

2.7 Interested Parties

Current and foreseeable interested parties (in addition to those listed in 2.6) include:

- Trade associations e.g. ARPAS UK, O&G UK, Maritime UK. Some of these have or are looking to produce guidelines relevant to UASs – e.g. O&G UK: Unmanned Aircraft Systems (UAS) Operations Management Standards & Guidelines, Issues 1 & 2 (see Annex I for references)
- Insurers
- NGOs and community organisations (e.g. those concerned about wildlife disturbance or noise)
- Global Wind Organisation (GWO)
- G+
- SafetyOn

2.8 Regulators and Authorities

The following are the main regulators and authorities that a UK Duty Holder may need to engage with. Details of their roles and related regulations are given in Annex A, and Annex H lists websites or points of contact for those marked with an asterix *

- Civil Aviation Authority (CAA)*
- Crown Estates (The Crown Estate (TCE) and Crown Estate Scotland (CES))*
- Department for Transport (DfT)*
- Environment Agency (EA)/ Scottish Environmental Protection Agency (SEPA)*
- European Organisation for the Safety of Air Navigation (EUROCONTROL)
- European Aviation Safety Agency (EASA)*
- Health & Safety Executive (HSE)*
- International Civil Aviation Organisation (ICAO)*
- Local authorities (functions including planning, environmental health)
- Maritime & Coastguard Agency (MCA)*
- Ministry of Defence (MoD)*
- Planning authorities (local authorities, national parks authority etc)
- Port authorities
- Utility regulators and providers
- Railway Network authorities and Train Operating Companies (TOCs)

Chapter 3: Considerations for specifying or selecting a UAS

There is a vast array of UAV types on the market and new systems and updates are being introduced at an ever-increasing rate. It can therefore be challenging for Duty Holders to understand the advantages and disadvantages of a particular UAV and other UAS elements. To help Duty Holders, this section outlines the main factors to be considered when specifying or selecting a UAS. They can be grouped into four main areas, as shown in Figure 4, and as follows:

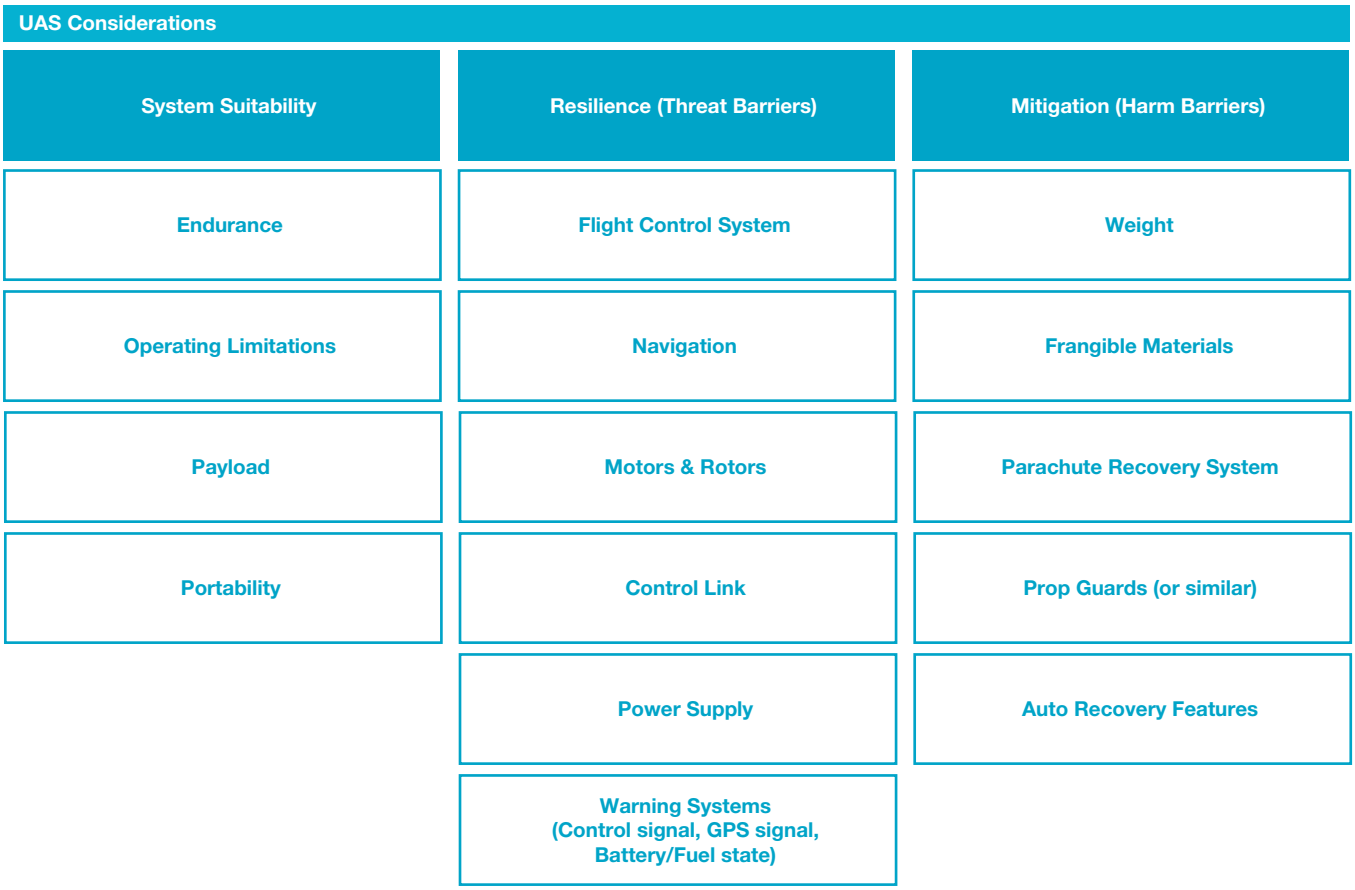
- System Suitability (Section 3.1): Does the UAS have the necessary functionality and performance for the required missions?
- Resilience (Section 3.2): Is the UAS capable of continuing to operate safely and as intended despite certain internal or external failures?
- Mitigation (Section 3.3): In the event of a catastrophic failure, what prevents the UAS from causing serious harm?
- Selection of UAS Operator (Section 3.4). In addition to the type of UAS, the operator is key to the safe and successful operation of the specified task.

3.1 System Suitability

Key factors to consider in assessing the suitability of a UAS for the required range of tasks and environments are:

- UAV endurance (in terms of range or flying hours)
- Operating limitations (or 'operational envelope' in aviation terms), including:
  - Weather limits, especially wind (note that many renewable assets are located in areas where high winds may be encountered) and precipitation (UAV Ingress Protection rating)
  - Maximum distance from the remote pilot/ communications base at which the UAV can operate
- Payload – can the UAV carry the required equipment for the mission?
- UAV portability, noting that some operating areas will be inaccessible by normal vehicle and may require transport by helicopter or boat
- Warning systems: suitability of data connection, UAV health monitoring systems

Figure 4 – Considerations for selecting/ specifying a UAS



Note that the functionality and performance of the UAS may also have an influence on risk. For example, if the UAV needs to be flown in close proximity to structures in order to capture data, higher quality lenses and sensors may enable the data to be captured at a greater distance, thus allowing a greater margin for error against collision with the structure.

3.2 Resilience

As part of risk assessment, Duty Holders need to understand the potential failures of the UAS, and in external interfacing systems, the associated likelihood and consequences. Key questions are therefore:

- Does the UAS have any single points of failure?
- Which system elements, if any, have at least dual redundancy?
- What inspection and maintenance procedures are in place to prevent failures?
- How is Software integrity and security maintained?

In a little more detail, some of the failure considerations for critical system elements are as follows:

Flight Control System: A failure of a main component such as the Inertial Measurement Unit (IMU) may be catastrophic. Some UAVs are fitted with dual or even triple redundant flight control systems.

Navigation: Many operators rely on the use of GPS for such things as enhancing control of the UAV, limiting operating areas (geofencing) and emergency recovery procedures. Redundancy of navigation systems such as GPS is therefore important.

Motors and Rotors: A failed motor or rotor in a single rotor or quad rotor UAV would cause a catastrophic failure. Aircraft with six or more rotors can usually withstand the loss of at least one motor or rotor failure.

Control and Communications: Failed control or communication systems may lead to loss of the UAV. Robust and multi redundancy design is important for these systems. Return to home and collision avoidance systems can assist in certain instances.

Power Supply: UAVs with a mass of 20kg or less are usually powered by batteries. The failure of a battery would be catastrophic if the UAV is fitted with just one. Some multi-battery systems cannot withstand the failure of one battery. Similarly, fuel-powered UAVs may have a single point of failure in the event of fuel exhaustion.

Warning systems: Can the remote pilot monitor the critical operational parameters? Are there visual and audible alerts to the pilot in circumstances such as:

- Poor or no GPS or control signal
- Low battery or fuel
- Presence of electromagnetic interference?

3.3 Mitigation

As the possibility of a catastrophic failure cannot be eliminated, Duty Holders should consider what prevents the UAS from causing serious harm in such an event. These can include recovery systems to return the UAV to a safe location and features that minimise damage in the event of collision.

Recovery Systems:

- What automated safety systems are available if the system is critically disabled? For example, is there a return to home function if battery state falls to a pre-determined level, if there is a lost communication link or GPS signal, or a loss of control?
- Can the UAV detect and avoid objects when returning home automatically?
- Is there a parachute recovery system to slow descent in the event of a power failure or loss of control?
- Are the recovery systems independent of other failures – e.g. will they still work in the event of total power loss?

Mass and speed: Other things being equal, the lower the mass and speed of the UAV, the less harm it will cause in the event of a collision.

Frangibility: Frangible construction and materials will also minimise harm in the event of collision. Materials vary from polystyrene type foam, carbon fibre and plastics, through to aluminium and other metals. However, there is a balance to be achieved between frangibility and the need for the UAV to withstand everyday loads in handling and flight.

Physical Protection: Are there protective guards around rotors or a sphere around the UAV?

3.4 Selection of Drone Operator

In addition to the specific selection of a UAS type to perform specific taskings, the selection of the drone operator is of fundamental importance. In addition to the need for the relevant qualifications and approvals, experience and a track record relevant to the wind industry are key. In Chapter 4 Overview of Good Practice , and Chapter 5 Risk Management FAQs (FAQ 8), guidance is provided to assist in the selection process of an operator, who with the right type of UAS, will meet the specified task in accordance with the Duty Holders requirements. Furthermore, reference to CAP 722A and CAP722B provide further relevant background.

Chapter 4: Overview of good practice

This section provides an overview of good risk management practices.

4.1 Risk Management System

A full understanding of potential hazards and implementation of appropriate controls can only be achieved through a joint risk management approach between the Duty Holder and the UAS Service Provider. Both parties should share relevant aspects of their relevant information (risk assessment, risk register, safety case etc.) in order to enable an integrated approach.

4.2 Operating Requirements and Procedures

The Duty Holder must define any task requirements, work scope and the deliverables required. Roles and responsibilities of both parties must be defined including supervision of flying activities and clear lines of communication. Any operating limitations, from the Duty Holder's perspective, should be specified.
The UAS Service Provider should have a comprehensive Operations Manual in accordance with CAP 722. Duty Holders should look for evidence of the following:

- Permission for Commercial Operations (PfCO) including any Non-Standard Operations (NSO) in place with supporting Operational Safety Case (OSC) with CAA authorisation if necessary
- Operating limitations
- Collection plans (specific method/process for capturing the data) where applicable
- Emergency procedures
- Procedures for deconfliction from manned aircraft (and other UAVs)
- Team composition (including the use of safety observer)
- Accident/ Incident Response Checklist
- Safe transport and storage of equipment
- Containment of damaged batteries/ equipment
- Insurance requirements (Aviation Insurance, Public liability, Professional Indemnity)

4.3 Operating Safety Case

As set out in CAP 722, any operations outside the standard CAA permissions are required to have an Operating Safety Case (OSC). An OSC demonstrates that the UAS Service Provider has a good understanding of their main operating risks and an appropriate risk mitigation strategy. It should describe in particular, how procedures, training, equipment, and safety management systems contribute to safe operation. The OSC will be reviewed by the CAA. Regardless of whether the operation is within the standard permissions as laid down in CAP 722, it may be good practice for any UAS Service Provider operating in higher risk situations to have an OSC.

4.4 Training and Competence

There are significant variations in training and operational experience across commercial operators of UAVs. Duty Holders should consider what is appropriate depending on the complexity of the task and operating environment.

In particular the Duty Holder should consider the following in relation to the Service Provider and their pilots:

- Have the pilots completed any industry-specific training?
- What evidence can they provide of relevant commercial experience in a similar environment/ task complexity? This is relevant to the company providing the service and the individual pilot(s) that will complete the work)
- Does the Service Provider have a system in place to monitor pilots' flying experience (e.g. recent and relevant flight hours, competence, technology and application)? For example, is the pilot proficient at manual flying should GPS signal be lost or suffer interference? Is there evidence that these items have been checked?
- Have the pilots completed accredited minimum safety training (e.g. GWO – https://www.globalwindsafety.org/) appropriate to the operating environment – e.g. if they need to go offshore?

4.5 Task Specific Risk Assessment

Service Providers must be able to risk assess a specific location and associated flight profile. In addition, there should be a documented method statement describing how the flight profiles will complete the desired task. The risk assessment and method statement (RAMS) should be made available to the Duty Holder in advance of any flights taking place. As with the overall Safety Management System, the task specific risk assessment should be a joint process where the Duty Holder and UAS Service Provider ensure that all risks have been identified and

that appropriate controls are in place.
Once on site, the UAS Service Provider must update the risk assessment with any additional hazards that may not have been apparent during the initial assessment. A joint safety brief (sometimes referred to as a toolbox talk) covering the key safety points, emergency procedures and flight profiles should take place prior to each and every flight. An example pre-site survey and operational risk assessment can be found under Annex G.

4.6 Emergency Procedures

Duty Holders should be aware of the emergency procedures contained within the UAS Service Provider's Operations Manual. Evidence of emergency procedure training and currency should be provided by the Service provider if required. The Duty Holder must be satisfied that the emergency procedures in place are considered alongside their own safety management system. Example emergency procedures can be found under Annex F.

Chapter 5: Risk management FAQs

This section provides a framework to help Duty Holders ensure that they have appropriate risk controls in place. Sections 5.1 – 5.4 present, for each stage in a Plan – Do – Check – Act cycle:

FAQs:
'Frequently asked' questions that Duty Holders may have

Guidance:
On what the Duty Holder needs to do

Resources:
References or organisations that provide further information, or that may help Duty Holders carry out any necessary further work. References to documents can be found in Annex I.

5.1 Risk Management FAQs – PLAN Stage

The PLAN stage includes the strategic decision to use UASs, concept and detailed design, and the selection and appointment of a UAS Service Provider.

FAQ 01: Should a UAS be used?

Duty Holders should carry out a high-level identification and assessment of positive and negative impacts, risks and opportunities, with a comparison against alternatives to UAS.

Resources can include internal business processes and procedures for technical, safety and commercial risk assessment and decision-making.

FAQ 02: What are the legal requirements?

There is relevant legislation at international, European, UK and in some cases local levels.

Both aviation-specific legislation (e.g. under the Air Navigation Order (ANO)) and generic health and safety at work legislation (e.g. MHSWR, PUWER) are relevant. Product safety legislation will also be relevant to the procurement of any systems.

Many aspects of legislation are risk-based, i.e. the requirements are proportionate to the risk, as related to broad categories of UAV weight, UAS application or location.

Annex A outlines the regulatory environment and requirements at the time of writing.

To help keep up to date, Duty Holders can subscribe to updates and bulletins from, for example, EASA, CAA and HSE. However, Duty Holders should take competent advice to assure themselves that they have identified relevant legislation and understand how it applies to them.

Resources include:
https://www.easa.europa.eu/newsroom-and-events/connect-with-us
https://www.caa.co.uk/Our-work/Publications/Subscriptions/
http://www.hse.gov.uk/news/subscribe/index.htm
http://www.hse.gov.uk/safetybulletins/index.htm

FAQ 03: What other stakeholders need to be involved?

Additional risk management obligations may arise from the needs and expectations of other interested parties, including but not limited to:

- **Clients: e.g. contractual requirements to comply with certain BS, EN, ISO or other standards, or performance level agreements on reliability/ availability**
- **Other contract parties: e.g. the UAS Service Provider may have certain access or site lighting requirements**
- **Insurers: e.g. to carry out inspection or maintenance at specified intervals**
- **Other airspace users, service providers and aircraft operators**

Further details of operational interfaces with other actors and interested parties are provided in Section 2.6 and 2.7.

FAQ 04: What type of UAS is needed?

Duty Holders should define their operational requirements in terms of, for example, payload, range, endurance, operability in areas with poor GPS signal, wind and other weather limits, portability by vehicle, helicopter or boat.

Requirements can also be defined in terms such as availability, or reliability.

It will be important to consider the whole system (Figure 2) not just the UAV, and the interactions with external systems that support or interface with the UAS.

UAS Service Providers should be able to advise on

suitable UAS types, architectures and technologies. Sections 2.2 and 3 give further information.

FAQ 05: What are the significant hazards?

Key hazards include:

- **Loss of control causing collision with people, other aircraft, vessels, structures, assets or equipment**
- **Adverse weather conditions e.g. wind, rain, fog, snow, ice or lightning**
- **Interference with other operations, e.g. by creating airspace conflict or distracting technicians**
- **Dropped loads**
- **Electromagnetic interference with other systems**
- **Environmental hazard from batteries**

Duty Holders should identify the hazards specific to particular planned operations in their operational context, for example by:

- **HAZID**
- **HAZOP**
- **Bowtie analysis**
- **Learning from experience with UASs and related operations**

RenewableUK Wave & Tidal Health & Safety Guidelines
RenewableUK Offshore Wind & Marine Energy Health & Safety
RenewableUK Onshore Wind Health & Safety Guidelines
Accident and incident data, e.g. AAIB, MORS, G+

FAQ 06: How should UAS risks be assessed and controlled?

Under MHSWR, Duty Holders must carry out 'suitable and sufficient' risk assessment.

The CAA recommends the use of barrier risk models, in particular BowTies, to assist with the identification and management of risk. An illustrative example of a bowtie model is presented in Annex E.

However, BowTie models are just one of many approaches, tools and techniques for hazard analysis, risk assessment and evaluation available. Tools should be selected and adapted, extended or enhanced if required, as appropriate and proportionate to the particular system and its hazards.

Annex E – BowTie
CAA BowTie webpages: https://www.caa.co.uk/Safety-initiatives-and-resources/Working-with-industry/Bowtie/
Guidance on approaches, tools and techniques can be found in, for example:
ISO 31000 Risk Management
JARUS guidelines on Specific Operations Risk Assessment (SORA) Edition 1 2017
RenewableUK Wave & Tidal Health & Safety Guidelines
RenewableUK Offshore Wind & Marine Energy Health & Safety
RenewableUK Onshore Wind Health & Safety Guidelines

FAQ 07: When have risks been sufficiently controlled?

Duty Holders should check that all legislative and other requirements (identified as described in FAQs 2 and 3) have been complied with.

For health & safety risks, tolerability must also be properly considered, in accordance with ALARP principle, i.e. by following the hierarchy of risk control and applying relevant good practice, in accordance with the gross disproportion test.

HSE R2P2

FAQ 08: How should a suitable Service Provider be selected?

Key areas to ask potential UAS Service Providers about include: operational capability, training and competence, equipment and asset management and maintenance, HSEQ management, flight planning, checks and operations, and emergency arrangements.
Duty Holders may want to consider pre-selection interviews/ audits/ inspections.

An example prequalification questionnaire (PQQ) is provided in Annex D.

Internal business sourcing policy

FAQ 09: How should UAS operations be integrated with other activities?

Activities that can interact with UAS operations include helicopter operations, the use of cranes and jack up barges, vessel movements, the construction or removal of structures, and tree felling.

Duty Holders will need to ensure that there will be mutual awareness of and adherence to agreed operational times, airspace limits and deconfliction procedures.

It may be necessary to issue NOTAMs – this is the official process by which aircraft operators are updated on safety-relevant information, such as the intensive UAV activity in particular area. The UAS Service Provider should be able to advise and

administer this process.

A Concept of Operations (CONOPS) and/or Simultaneous Operations (SIMOPS) document may be required, setting out the relationships between the responsible functions, e.g. an Aviation / Marine Co-ordinator / Duty Operations Manager. Specialist aviation expertise will usually be required to develop the CONOPs and provide the Co-ordinator function.

RenewableUK Offshore Renewables Aviation Guidance (ORAG) Issue 2 2019
RenewableUK Integrated Emergency Response – Renewables (IER-R)
NOTAM
PINS

FAQ 10: What arrangements should be in place for emergencies?

Identify the reasonably foreseeable abnormal and emergency situations: e.g. battery exhaustion, battery fire, ditching, loss of control.

Define suitable and proportionate emergency arrangements (including requirements for co-ordination with emergency services and other stakeholders, and any need for emergency exercises), taking account of factors including the likelihood and consequence of each situation (see Section 3) and how personnel would become aware of a potential emergency developing.

Annex E – Bowtie
Annex F
Operations Manual
ERP
ERCOP
Bridging Document (if applicable)

FAQ 11: Who should be informed in the event of an accident or incident involving a UAS?

Depending on the circumstances and the nature of the event, there are a number of bodies that may need to be informed.

In the case of a Fly Away or Loss Of Control the immediate priority is to warn airspace users and other exposed persons in the vicinity and, as deemed necessary by the Remote Pilot, the emergency services. The appropriate ATC unit(s) may be able to advise other aircraft operators, while the Police, MCA as well as other parties on site may be able to warn others. The Emergency Plan (see FAQ 10) should detail the lines of communication in each type of situation.

If the accident/incident is reportable as per EU 376/2014 then the procedure to report to ECCAIRS (European Co-ordination Centre for Accident and Incident Reporting System) is contained in CAP 382 alongside other references and information. CAP 1496 provides user guidance for access to the reporting portal. If the criteria for an Airprox are met there is a requirement for the Remote Pilot to make a report as per CAP 1094.

The AAIB must be informed of any accident or serious incident via their 24-hour reporting hotline, Tel: 01252 512299.

Others that may require informing include CAA, UK Airprox Board, HSE, AAIB, MAIB, MCA, Police, the Client or Principal Contractor. The lines of reporting will depend on the contractual set up and practicalities of communication. The Duty Holder must therefore ensure that reporting arrangements - who should report what, and to whom - are clearly defined, included in contracts and understood by all parties.

CAP382
Airprox scheme: Details of the procedures are given in UK AIP ENR 1.14 and UK AIP (MIL) ENR 1.14.
RIDDOR
ERP
ERCOP
ECCAIRS: aviationreporting.eu
AIRPROX: airproxboard.org.uk
AAIB
CAP 1496
CA1094 Airprox Report

FAQ 12: How should risk performance be monitored and evaluated?

Duty Holders should ensure that the following are put in place at planning stage:

- **A system for reporting accidents, incidents, concerns and improvement suggestions**
- **Systems for effective consultation with, and feedback from, Service Providers and others (including both proactive and reactive elicitation)**
- **Appropriate metrics/ KPIs and criteria against which to evaluate performance trends and acceptability**
- **Appropriate tools to analyse and evaluate underlying factors, root causes, trends**

Internal company protocols and procedures
Annex C – Audit

5.2 Risk Management FAQs – DO Stage

The 'DO' stage comprises operations on the day and on site. It includes construction of the renewable energy asset, its operation and maintenance, the

'construction' phases of any significant modifications, and eventual decommissioning

FAQ 13: What information should be expected from the UAS Service Provider?

Examples include:
- **Daily plans and logs**
- **Prompt reporting of any incidents, accidents or deviations from plan**
- **Operations manual, risk assessments, method statement, licenses and competencies, permission for commercial operations, and insurance documents**
- **Safety briefs, pre-flight briefs and toolbox talks covering the key safety points, emergency procedures and flight profiles take place in accordance with RAMs or operating procedure**

Internal company protocols and procedures
CAP722
CAP393
CAP1687 ANO Amendment Order 2018

FAQ 14: What should Duty Holders do during UAS operations?

Supervision of the UAS Service Provider during operations is recommended and may be a requirement of the CAA permission (supervision in this context does not necessarily mean real-time, on-site supervision, but involves some kind of management oversight).

An accountable manager could be allocated to supervise the undertaking of the commercial UAS operation. The level of supervision and responsible person will be for the Duty Holder to define, but suitable persons could for example be a Duty Operations Manager, Construction Manager, Site Operations Manager or equivalent.

Annex B – Supervision & Management

FAQ 15: What should be done after the UAS operation?

Debriefing sessions for future projects

Lessons learnt captured and disseminated

(Lesson implementation/ improvements are covered in the ACT stage)

FAQ 16: What should be done if an unauthorised UAV/ aircraft enters the project airspace?

The police are the first point of contact, both onshore and offshore, for any unauthorised intrusions by UAVs or other aircraft. Duty Holders should consider suspending or stopping UAV and other operations. Inform CAA.

5.3 Risk Management FAQs – CHECK Stage

The CHECK stage is applicable across all lifecycle steps of the UAS.

FAQ 17: What should be checked or audited?

Regular audits, inspections and spot checks should be carried out. For example, regarding maintenance, the UAS Service Provider should be able to provide a satisfactory Maintenance Plan and regular, completed, inspection and maintenance logs in accordance with the Plan.

Look for evidence that any rectification actions have actually been carried out.

Annex C – Audit

FAQ 18: How should senior management be involved?

Senior management should engage with and oversee how risks are managed, for example by participation in regular Management Reviews, evaluating performance against the defined objectives and targets, and setting priorities for the next period.
Leading health and safety at work. Actions for directors, board members, business owners and organisations of all sizes. Health and Safety Executive INDG417(Rev1) 2017 http://www.hse.gov.uk/leadership/

5.4 Risk Management FAQs – ACT Stage

The ACT stage is applicable across all lifecycle steps of the UAS.

FAQ 19: How should improvements be made and tracked to completion?

Sharing learning through case studies, for example:

- **Sharing with industry and stakeholders**
- **Adjustment of internal processes/ risk assessments**
- **Communication and dissemination of lessons within the organisation and more widely through industry schemes**

ISO 9001
ISO 14001
Internal company HSEQ procedures for Incident and non-conformance reporting
Industry reporting schemes, such as that of G+: https://www.gplusoffshorewind.com/work-programme/hse-statistics

Chapter 6: Summary

The development of and technological advancements in UAS has yet to be fully realized. The use of UAVs to perform previously difficult and costly operations has the benefit of not only reducing costs but providing new ways to undertake tasks whilst also eradicating or reducing high potential risks.

These guidelines illustrate that whilst there are significant risk and cost reduction opportunities in the use of UAS, the procurement, control and management of UAS require careful consideration and, potentially, expert advice and guidance.

The primary focus of this document is to support Duty Holders who may have little or no awareness of the risks, or of the control measures and mitigations required to successfully manage UAS operations. The document identifies and provides key sources of information to enable Duty Holders to be intelligent users of UAS operations. The following annexes provide further detailed information and include some templates that Duty Holders may find useful.

Chapter 7: Annexes A – I

Annex A – Regulatory Environment

A1. International and European Civil Regulatory Approach

This Annex summarises the regulatory framework for UASs. Aspects having a direct implication for Duty Holders are highlighted.

International Civil Aviation Organization (ICAO) Remotely Piloted Aircraft Systems (RPAS) Panel ICAO is responsible for producing Standards and Recommended Practices (SARPs) for the international RPAS (UAS) community.

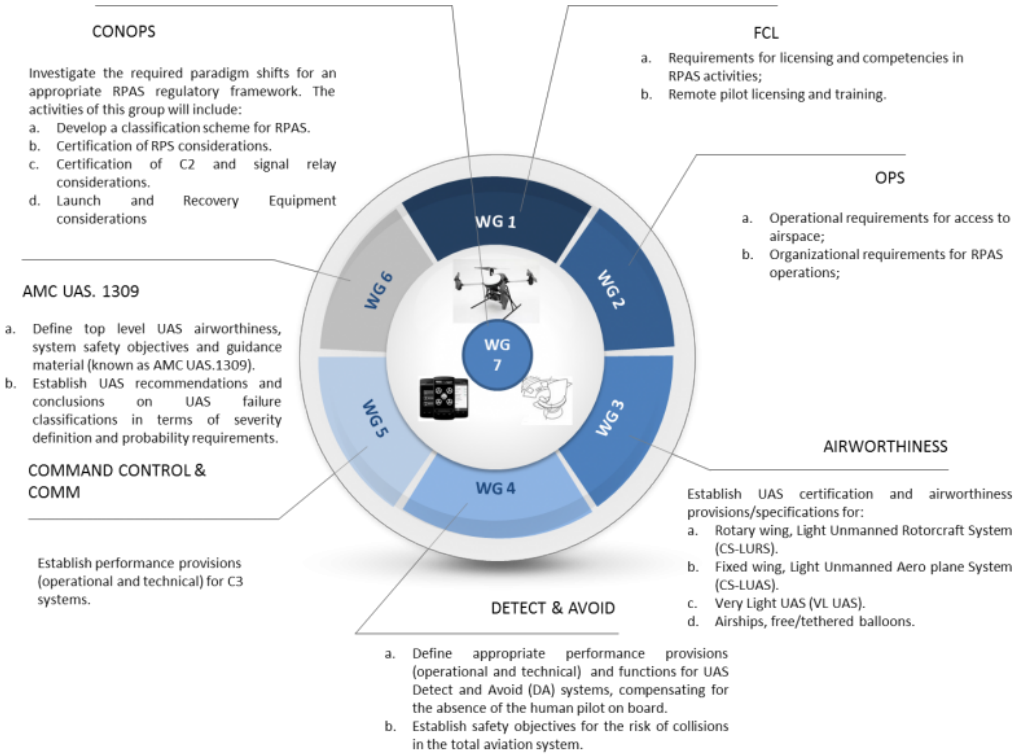
These SARPs are the reference points for states to develop their national civil aviation regulations, which are legally enforceable. ICAO SARPs are not legally binding by themselves but form the basis of national regulations which have legal status.

In this way civil aviation regulations are harmonised all over the world, with slight differences based on the actual implementation in national regulations. These local differences are then reported back to ICAO and published.

ICAO is focussed purely upon the larger Remotely Piloted Aircraft (RPA) at present although there are indications that they are beginning to look at the smaller market due to the cross border and free trade implications of operating these systems, and the new way of assessing the airworthiness of the systems (see below under JARUS). ICAO introduced an RPAS Working Group in 2007 in an effort to gain more of an understanding of the emerging technology and to begin work on SARPs. Out of the working group the RPAS Panel was established, in late 2014, to formalise the work and to ensure that the deliverables were aligned with wider ICAO Aviation System Block Upgrade (ASBU) plan.

The ICAO RPAS Manual has been published; the first SARPs were supposed to be delivered in April 2016. A delay has ensued partly due to the political situation between the Member States but is also affected by the rate of change of the technology itself. The RPASP is structured into seven working groups (Airworthiness, Command and Control, Communication, Licencing, Concept of Operations, Detect and Avoid, and Air Traffic Management (ATM)) with each Member State allowed one Member and as many Expert Advisors as required.

Figure 5 – JARUS Working Groups



Duty Holders should note that the ICAO and RPAS Panel cannot directly place requirements on Duty Holders for commercial UAS operations in the UK – this is prerogative of National Aviation Authorities – the CAA in the case of the UK. The ICAO and RPASP may, however, act to inform national policies and international consensus and alignment, which may be incorporated into CAA requirements. In some aspects, UK CAA requirements on UAS operators may be more onerous than those of other National Aviation Authorities.

Joint Authorities for Rulemaking on Unmanned Systems (JARUS)

JARUS was initiated by the National Lucht en Ruimtevaartlaboratorium (NLR), Netherlands Aerospace Centre, in an attempt to formulate a common set of regulations for UAVs in Europe. The mandate very quickly expanded to include the wider international community and currently has over 45 representatives from National Aviation Authorities (NAAs) worldwide. JARUS replicates the organisational structure of the ICAO RPAS Panel to a large extent and the membership is much the same. The structure of the JARUS Working Groups is shown in Figure 5, to the left.

Duty Holders should note that deliverables from JARUS may act to consolidate and inform international aviation policy e.g. ICAO on RPAS. Therefore, outcomes from JARUS may be adopted by the ICAO and thereafter national legislation. Alignment in structure and working areas is evident in both organisations, but the guidance set out by the two organisations is independent. As per the ICAO and RPASP, these guidance sources act as an important resource for best practice and informing the direction of regulatory alignment for the UAS industry. Duty Holders may wish to review both ICAO and JARUS guidance to inform themselves prior to starting UAS operations.

A2. Future Civil Regulatory Environment

The European Council have recently endorsed the amendment to the aviation 'Basic Regulation' to include, amongst other changes, all masses of UAVs within European Aviation Safety Agency (EASA)'s competence[2]; furthermore, a Notice of Proposed Amendment (NPA) 2017-15 followed by an associated Technical Opinion 01/2018 aims to cement this new regulatory environment for EU Member States by 01/2018 leading to an adopted regulatory environment for EU Member States by May 2019.. This new regulatory environment is based upon three categories (Open, Specific and Certified) and is a risk-based approach that does not discriminate between commercial or hobbyist operations; each category has differing requirements with only the latter requiring full certification (akin to current manned aviation requirements). Hence, the concept that only those UAVs that present a high risk (typically passenger carrying and dangerous goods cargo systems) need to go through the normal Certification process currently mandated for the vast majority of manned aviation. All other UAVs operations would be assessed on the level of risk that the operation presented:

The **Open Category** is 'regulation-light', and to a large extent is either self-regulating or regulated by Local Authorities as opposed to Aviation Authorities. All UAVs with an all up mass of less than 25kg, operating within strict limitations (no higher than 120m, not close to people and built up areas, away from airports, etc.) fall into the Open Category. Simple pilot competency and registration alongside geo-awareness technology is required, but significantly there is no distinction between commercial and private use.

The **Specific Category** covers the vast majority of predicted commercial UAV operations and requires the operator to submit a Safety Case to provide evidence that the residual risks are tolerable. This is a break from traditional Civil Aviation regulation and will require the NAAs to assess the Safety Cases and issue permissions and exemptions for the operations to be conducted.

Figure 6 – UAS Risk Based Categorisation

Open Category (A)	Specific Category (B)	Certified Category (C)
• No RPA, RPS or C2 Design or Airworthiness Approval • Generally Low level (e.g. below 500 feet AGL) • Visual Line of Sight • Outside Aeronautical Protected Spectrum • Not in densely populated areas • State Aviation Safety Regulator establishes criteria	• No regulator design approval (e.g. TC) • Airworthiness approval based on Operational Risk Assessment • Considers aircraft mass, speed, airspace, population, operational complexity and flight rules (IFR/VFR) • Third party validation of hazard assessment and mitigations (by refulator or qualified entity)	• Traditional Type Certificate • Instructions for Continued Airworthiness • Standard Airworthiness Certificate • Generally Beyond Line of Sight • Large or Highly Complex Aircraft and Operational Concept • Aviation Protected Spectrum

2 The previous amendment to the Basic Regulation limited EASA's competence to above 150kg – leaving 150 kg and below to the National Aviation Authorities

The **Certified Category** will follow a similar approach currently mandated for manned aviation: Certification, Approved Organisations, accredited training etc.

The new EASA approach to regulating the UAV environment also calls for Member States to detail Exclusion Zones or Restricted Areas.

Duty holders should note that during the planning and procurement of UAS services they should check the latest applicable regulatory situation to establish if new European or International guidance has been adopted by the CAA into UK legislation. Changes or developments to regulations may not necessarily invalidate current Permissions for Commercial Operations held by operating UAS companies, but these should be reviewed against relevant changes as required. Alignment to wider industry guidance, above the minimum national legislative requirement, may be considered as a commercial, technical and safety advantage in Service Provider selection.

For health and safety risks, it is essential for Duty holders to be aware that the application of 'relevant good practice' - not merely complying with the prescriptive requirements of the law - is considered an essential element in meeting the legal duty (HSWA etc Act 1974) to reduce risks 'so far as is reasonably practicable' (SFAIRP) (see reference to R2P2 under Annex I and http://www.hse.gov.uk/risk/theory/alarp2.htm).

Sources of relevant good practice include:

- HSE Approved Codes of Practice (ACOPs)
- Guidance produced by regulators and other government departments
- Standards produced by Standards-making organisations (e.g. BS, CEN, CENELEC, ISO, IEC)
- Guidance agreed by a body (e.g. trade association or federation, professional institution, governing body) representing an industrial/occupational sector
- Unwritten sources, if they represent the well-defined and established standard practice adopted by an industrial/occupational sector.

A3. UK Civil Regulatory Approach

Strategy

The UK government strategic approach, at present, is wholly based upon introducing and sustaining Beyond Visual Line of Sight (BVLOS) operations in UK airspace. The UK Department for Transport (DfT) are leading the effort on this and have introduced a Pathfinder programme as part of the emerging technologies sector. There are an ever-changing number of Pathfinder work strands (including parcel delivery, agricultural surveying, Search and Rescue, etc.) all aimed at introducing technologies that will allow BVLOS operations and the full integration of UAVs into UK airspace.

The UK CAA have mandated that any insertion of UAVs into UK airspace must be introduced so that it is invisible to other airspace users. This means that the same technologies (ADS-B/C, Mode S, etc.) should be utilised and the UAV will be flown to the same Rules of the Air using the same procedures as manned aviation. Thus, a pilot of a manned aircraft would not know whether they are following a UAV or a manned aircraft. Furthermore, it is the ambition of the UK Civil Aviation Authority (CAA) that any new technologies, introduced by UAVs, that demonstrably improve safety should be transferred to the manned sector (for example Detect and Avoid (DAA)).

Baseline UK Regulatory Position

References:
CAP 393 – The ANO, CAP 722, Basic Regulation Annex II
CAP 1687 Air Navigation Order (Amendments) 2018- Guidance for small unmanned aircraft users.
Articles which apply:7, 20, 23, 91, 92, 93, 94,94A, 94B, 94C, 94D, 94E, 94F, 94G, 95, 239, 241, 257.
Actually in this context, and by reading further in this document, the ethos of above CAP 1687 is discussed and addressed.

"Taking Flight - The Future of Drones in the UK" (DoT / UK Government response to recent events) may be useful.

As a current member state of the European Union the UK civil aviation environment is largely regulated by EASA. Areas outside of EASA remit are regulated by the CAA as the UK's National Aviation Authority (NAA). Due to the international nature of commercial aviation it is anticipated that CAA regulation will remain closely aligned with that of EASA post Brexit.

Until the recent amendment to the Basic Regulation there were certain exceptions and exemptions in the Basic Regulation Annex II; one of these exceptions was that EASA only regulated UAVs of a mass of over 150 kg. This effectively left individual NAAs to write and set regulation as they saw fit. This mass discriminator has generated a diverse set of regulations across Europe that has caused confusion and hindered the open market philosophy. Mindful of these consequences EASA proposed, via the European Council, that the Basic Regulation be amended to give EASA regulatory authority for all masses of UAVs – this has now been achieved as described in para A2.

Due to the recency of the changes in the Basic Regulation and awaiting the publication of the new EASA regulations, the UK CAA has yet to reflect its,

or EASA's, new position in the Air Navigation Order (ANO) or Civil Aviation Publication (CAP) 722.

EASA's new position may be reflected in the ANO in the future to ensure close regulatory alignment, however, until it is UK legislation, the current ANO under CAP393 is applicable. Duty Holders may wish to refer to EASA regulations for a steer towards future UK requirements.

A key difference between the current UK CAA approach and the emerging EASA approach is that the UK CAA requires all commercial operators to apply for and hold a Permission for Commercial Operations (PfCO) prior to conducting operations for commercial gain.

Duty Holders should ensure that any non-UK based Service Providers are familiar with the UK regulatory environment and have the required permission for UK operations.

The current regulation and guidance remains in the UK as follows:

Key Articles in the ANO (CAP 393) apply to UAVs under 20kg:

These are the key articles that Duty Holders may wish to check and examine how the UAS Operator has satisfied these Articles, details may be found in the Operation Manual or PfCO.

Article 241 – This is an overriding article that requires any aircraft operator to not allow an aircraft to endanger any person or property;

Article 94 – This article is directed at Small Unmanned Aircraft (SUA) and provides the limitations in which operators, without exemptions or permissions, must obey. This includes maintaining Visual Line of Sight (VLOS), not flying for commercial purposes, acting responsibly and ensuring that any planned flight can be safely made, access to airspace around aerodromes for UAS under 7kg, etc.

Article 94A - This article details the limitations for SUA with respect to height. Principally this means that no SUA should operate above 400 feet above the surface without permission from the CAA.

Article 94B – This article details the regulations and limitations for operating near aerodromes and airports. It describes operating limitations for the inner and outer zones around protected airfields.

Article 95 – This article describes the limitations and regulations concerning Small Unmanned Surveillance Aircraft (SUSA). The key limitations are for minimum distances to be maintained between crowds or infrastructure in terms of both lateral distance and height.

UAVs over 20kg but less than 150kg
UAVs over 20kg but less than 150kg have to comply with all Articles in the ANO or seek exemptions from the CAA. This can be achieved by completing an Operating Safety Case (template and guidance provided in CAP 722).

The vast majority of UAVs flying in UK airspace are small systems under the VLOS limitations described in Article 94 and 95 of the ANO and further expanded in CAP 722; where the operations are for commercial gain, or, where the operations are outside of the limitations stated the operator must apply for an exemption or a permission from the CAA. To do this they can complete the Operating Safety Case template – this is very similar to the tool currently under development by JARUS WG6 for the "Specific" Category.

Further Changes to UK Regulatory Position

Further changes to the ANO are planned by the DfT:
1. A requirement for all UAV remote pilots, piloting UAVs weighing over 250g to pass a pilot competency test – enforced from 30th November 2019;
2. A requirement for operators of UAVs weighing over 250g to register with the CAA – enforced from 30th November 2019;

Furthermore, a draft Drones Bill was introduced in 2018, which added additional police powers, fixed penalty notices and mandating the use of a Flight Information and Safety System, prior to using a Drone. This Bill was also accompanied by a Consultation Document, covering:

1. Minimum age requirements for UAV operators
2. Enhanced restrictions around aerodromes
3. UAV scenario modelling
4. Police powers
5. Mandating a safety system
6. Counter UAV technology

Duty Holders considering BVLOS operations should be aware of the rapidly developing regulatory framework for these operations. UK government strategy led by the DfT is focusing on the development of this area for broad ranging applications. UAS operations developing in this direction will increasingly be required to ensure compliance with Rules of the Air for manned aircraft, hence the appropriate level of supervision and aviation expertise must be allocated to overseeing such operations.

Annex B – Supervision & Management

This section provides an overview of the key issues to be taken into account by Duty Holders when supervising UAS Service Providers during ongoing support operations. This section sets out guidance on key elements for supervision and management and acknowledges other arrangements or practices that may be in place.

B1. UAS Operations

The use of UASs in renewables projects requires appropriate levels of supervision and integration suitable for the operating environment associated with offshore renewables projects. This is because of the potential remoteness of the Duty Holder's supervisory personnel and systems from the site and key integrations with existing Safety Management Systems and Emergency Procedures. There is thus a need to integrate via the safety management system documentation between the standard Operations Manual and local task Risk Assessments and Method Statements, considering remote (onshore) engineering control of the project, with other contracted assets, e.g. aviation and marine O&M support operations.

To ensure that the UAS operation is properly supervised, Duty Holders must ensure that a satisfactory supervisory capability exists throughout the life of the project. It is good practice that such capability is designed based on the advice of UAS aviation specialists and comprises: communication equipment and information systems; suitably qualified and experienced personnel (SQEP); well-rehearsed SOPs; a base location not overly remote from the operational site; the capacity to integrate the whole operation. This integration capability must include: engineering control of the project; control of marine operations, aviation operations, logistics operations; the capacity to liaise with other stakeholders, including emergency response (e.g. MCA and SAR operators), and other land, sea and airspace users.

B2. Supervision Systems Requirements

To supervise onshore or offshore O&M operations, in which UAS (and other aviation assets) are employed, it will be necessary to have the communications and IT support systems that allow remote Duty Holders to communicate with and supervise:

Site Systems – including engineering control of turbines and devices;
Offshore Service Providers – including helicopter pilots and SOV captains and crews;
Onshore Logistic Support Locations – including heliports, ports, and other logistics locations.

It may be advantageous to co-locate these communications and IT support systems with the project's engineering control centre. This would make it easier for engineers, pilots, ships' captains, and technicians, to coordinate O&M interventions, for example, braking a turbine that is scheduled for O&M visit. Such supervisory systems, although optimized for the primary O&M operation, also allow prompt coordinated responses to unplanned events, such as medical evacuations or SAR operations within the project.

B3. Supervision Personnel Requirements

Control centres need to be manned by suitably qualified and experienced personnel, with sufficient knowledge and skills to be able safely integrate the O&M operations. This includes the need to respond flexibly in response to unscheduled breakdowns and to non-engineering events, such as SAR operations within the area of UAS operations. These personnel must have to hand agreed SOPs for routine operations and for foreseeable contingencies.

Annex C – Audit

C1. Background

Developers, constructors, operators and maintainers who contract the deployment of UAS services by specialist companies need to consider the following points. UASs may be contracted by any of the key stakeholders and could vary from a single task to a dedicated 365 day a year service. Reassurance that the service is safe will primarily rest with the UAS Service Provider, but all stakeholders will wish to be reassured. This could be from the perspective of the project owner to the employer of personnel. Good practice from other industries using contract UAS has seen the development of a structured assessment framework, which can be broken down into 3 phases:

- Pre-contract assessment
- Periodic monitoring
- Regular feedback from operations

Pre-contract assessment and periodic monitoring requires subject matter experts; these may be employees or specialist contractors. Where a number of Duty Holders have an interest in monitoring the UAS a combined audit would be recommended to minimise disruption and cost. This first part of this Annex provides an indication of the procedure that may be followed together with an example of the type of information that would be assessed. The last part of the Annex describes a Watch List that may be used to prompt feedback to Duty Holders.

C2. Audit Objective

The audit objective is to provide assurance of safe and efficient UAS activities based on an independent review of the Service Provider.

The audit is a structured process of collecting information on the efficiency, effectiveness and reliability of all the policies, processes, and procedures utilized by the company in relation to the UAS operators' activities. If any issues are found, a plan for corrective actions is made.

The audit is primarily on behalf of the Duty Holder to ensure safe activities, but should also be beneficial for the Service Provider, by providing an impartial view of their systems, against a defined standard and identifying where improvements could be made.

C3. Audit Process

The pre-selection safety audit should be completed sufficiently in advance to enable the Duty Holder and Service Provider to agree and implement corrective actions (technical, process or procedures) before contract award. This ensures that there are no contractual limitations that could affect safety.

Once a Service Provider has been chosen, either as a general supplier or for a specific project, a continuous monitoring process should be established. Dependant on the level of UAS activity the process review should occur on a regular and defined basis.

C4. Areas of Audit

The following areas should be audited:

- Overall documentation and certifications according to relevant regulations
- Management setup and competence
- Internal training of remote pilots
- Quality and Safety Management Systems
- Continuous Airworthiness Management Organisation
- Operations Manual and Standard Operating Procedures
- Handling of Dangerous Goods
- Ground Handling Operations
- Security plans and setup
- Risk analysis
- Safety records, incidents and accidents

An operational review should be conducted in order to ensure that what the Service Provider intends is actually executed in respect of the remote pilots and daily operations. For example, normal and emergency procedures should be observed by a competent specialist.

C5. Example of Key Aspects in a UAS Audit Questionnaire

An audit questionnaire should be completed by the Service provider prior to an audit with the results used to guide and focus the physical audit.

The audit team will normally consist of a UAS remote pilot with relevant flying experience, a technician

qualified and experienced in UASs, together with an auditor/representative (external or internal) from the Duty Holder.

The scope of the audit should cover UAS operations, UAV condition, support infrastructure, stores and documentation (including flight and operating manuals).

Objective – The objective of the audit should be specified including the scope and intended outcome.

Audit Process – An organisation to be audited should be given sufficient time to complete the pre-audit questionnaire. The audit team should evaluate the response to develop their own detailed audit schedule. The audit should commence with a formal introductory meeting, followed by a structured programme. Findings should be presented during the close-out meeting with an agreement on how corrective or preventive actions are to be implemented. A formal report should be provided within an agreed timescale. Any requirement for a follow up audit should be agreed during the close-out meeting.

Questionnaire – The questionnaire may typically consist of questions about the following topics:

Figure 7 – Questionnaire

Questionnaire completed by…on behalf of....

Senior Management consists of… including:
Manager
Accountable Manager
Flight Ops Director
Chief Remote Pilot
Training manager
Flight Safety Officer
Ground Operations Manager
Technical Director
Chief Engineer
Quality Manager
Safety Manager

Documents to be provided, to include:
UAV Operator's certification
Operations Manual
Operational Safety Case
Maintenance approval
Incident/Accident Reports
Completed Pilot/ Engineer details e.g. qualifications
Quality Assurance Accreditation
Insurance
Safety Policy
Flight Log with evidence of operations in comparable environment

Approvals held:
Regulatory authority
UAV Operators Certificate
Permission for Commercial Operations PfCO
Maintenance Approvals
Quality Assurance Accreditation

Insurance:
Public Liability
Professional Indemnity
UAS hardware cover

UAV Information:
Type
Payload
Owned/leased/shared
Registration
Year of manufacture
Current hours
Primary use
Airworthiness

Personnel
Staff - numbers
Remote operation
Pilot recruitment
Pilot utilisation
Types flown
Hours flown

Technical Staff Utilisation
Shift system
Duty Periods

Selection
New hire onboarding
Training programmes
Type conversion
Personal Safety Training – e.g. HUET, GWO

Engineer and technician training
Basic
Type technical
Continuation

Management Staff General Development
Management skills
Safety
Investigation
Dangerous goods
Engineers

Safety
Safety Management System
Safety Programme
Safety Awareness
Safety Policy
Safety Manual
Safety Meetings
Investigation process
Confidential reporting

Safety Statistics

Licence and Medicals
Operations
Operations manual
Flight Safety Instructions
Charts
SAR cover Hospital/medical cover
EASA OPS compliance

HUMS
PPE
Checklists in use
Weight and balance
Freight handling

Maintenance
Publications
Inspection regime

Facilities
Overhaul and repair
Technical library
Recharging/ refuelling

Aviation Watch List – The following check list lists actions that should be observed prior to, during, and after a flight.

Figure 8 – Example of an Aviation Watch List

Prior to Mobilisation:
- Your qualifications to fly should be checked e.g. PfCO, recent experience
- Risk assessment and method statement in place and approved
- Insurances provided
- Personal protective equipment in place and certified
- Task for today
- Toolbox talk
- Emergency Procedures Reviewed
- Dangerous goods manifest
- Dangerous Air Cargo
- Site-specific training undertaken – e.g. turbine transfer training if necessary

During Work Task:
- You should undertake a pre-flight briefing, including: weather, SIMOPS, communication protocols
- Monitor work environment for new hazards and conduct dynamic risk assessment or Stop Work as necessary
- Monitor for of any divergence from brief and conduct dynamic risk assessment or Stop Work as necessary
- Site Induction in how to move safely around the site
- Buddy checks,
- Monitor fitness for task and conduct dynamic risk assessment or Stop Work as necessary
- Daily Debrief, Daily Progress Report (DPR)

Demobilisation:
- Return of equipment if applicable
- Flight Reference Card completed
- Flight logs updated
- RAMS updated to include any unforeseen occurrences witnessed during flight
- Debrief to supervisor/ management

Flight Reference Cards – Flight Reference Cards shown below, are a mandatory (CAA) requirement that these appear in drone company Operations Manuals and should be completed for every flight / inspection etc.

Figure 9 – Flight Reference Cards	
Risk assessment	On-site assessment form
Pre-site survey	In-flight checklist
Emergency procedures	Post-flight checklist
Record for each flight	Service & maintenance log
Checklists	Battery log
Embarkation checklist	Incident log

Annex D – Example of a Pre-Qualification Questionnaire

This Annex provides an illustrative example of a PQQ format and content.

Duty Holders will need to adapt it to their own needs.

The sub-Annexes (D1, D2 …) give examples of the types of evidence that a Duty Holder might wish to look for in order to support a 'YES' response.

Figure 10 – Example of a pre-qualification questionnaire

Topic	Yes	No	Evidence Annex
Operational Capability:			
VLOS	☐	☐	
ELOS	☐	☐	
BVLOS	☐	☐	
Onshore	☐	☐	
Offshore	☐	☐	
Confined Space/ Underground	☐	☐	
Night Operations	☐	☐	
Congested area	☐	☐	
Pilot Training & Competency:			
Pilots are all fully qualified with a permission for commercial operations (PFCO), trained through a CAA approved NQE	☐	☐	D4
Pilots have all received robust training in how to perform aerial surveys and inspections for all relevant type of onshore and offshore structures	☐	☐	D4
Pilot training is remunerated and updated when required	☐	☐	D4
Pilots have all the required knowledge associated with the environment(s) that they operate in	☐	☐	D4
Pilots have the experience required to successfully perform aerial surveying and inspections	☐	☐	D4
Pilots have all flown the minimum set hours within the last calendar month as defined by their operations manual	☐	☐	D4
Equipment & Asset Management:			
Use of an equipment and asset management system	☐	☐	D7
Equipment used to meet all the necessary safety standards and is suitable to operate within the duty holder environment	☐	☐	D7
Airworthiness certificates for UAVs	☐	☐	D3
Equipment used to survey and inspect structures is supported by relevant technical documentation of each system and sub-system	☐	☐	D7
Use of any specialist equipment, including payloads, has been verified by a technical, safety or other equivalent expert before being used in live operations	☐	☐	D7

Use of UAV tethering hardware	☐	☐	D7
Use of UAV collision avoidance system	☐	☐	D7
General Health & Safety:			
The operator is insured up to an adequate value (Duty Holder to define)	☐	☐	D2
Safety management system and programme in place including safety improvement and review process	☐	☐	D5
Safety policy defined	☐	☐	D1
Safety meetings and awareness training for all employees	☐	☐	D1
Operations Manual available, relevant to required operations	☐	☐	D8
Operational Safety Case available, where required			D8
Personal protective equipment (PPE) provided			
Risk assessments, Bowtie analysis or equivalent tools used	☐	☐	D9
Quality Assurance ISO 9001/14001 accredited?	☐	☐	D6
Flight Planning:			
Comprehensive pre-site survey assessment completed before conducting operations	☐	☐	D9
Comprehensive risk planning and mitigation assessment completed before conducting operations	☐	☐	D9
Privacy and access permission grants from landowners	☐	☐	D9
Flight planning includes GDPR awareness and consideration	☐	☐	D9
Safety officer or equivalent present during all pre-site surveys and risk assessments	☐	☐	D9
Geographic awareness of any nearby civilian and military airports, power lines, transmission masts, cranes or other obstructions	☐	☐	D9
Use of accurate and reliable real time aviation data including NOTAMs, PINS, Weather, No Fly Zones and HIRTA Zones	☐	☐	
Use of a reliable flight planning software	☐	☐	
Use or availability of a reliable Unmanned Traffic Management (UTM) software and/or hardware	☐	☐	
Use of a reliable detection and collision avoidance system	☐	☐	
Use of geo fencing	☐	☐	
Pre-Flight Checklist – to include:			
Batteries fully charged and serviceable	☐	☐	
No unidentified helicopters or other aircraft operating in close vicinity	☐	☐	
Assessment of people, wildlife and vegetation (e.g. hikers, horses, bird flocks)	☐	☐	
Weather validation including check for turbulence	☐	☐	
Notification to local authorities where required	☐	☐	
UAV/ Payload/ GPS serviceable	☐	☐	
Appropriate failsafe configurations set	☐	☐	
Launch, Landing and Emergency Landing areas designated	☐	☐	

Communications channels agreed and checked	☐	☐	
Flight Operations:			
Compliance to EASA OPS Regulations	☐	☐	
Compliance to CAA CAP 393 & 722	☐	☐	
Pilot compliance to CAA-approved Operations Manual	☐	☐	
Minimum 2-person team for UAV control and observation (safety observer)	☐	☐	
Suitable means of communications established, (e.g. radio, mobile) between pilots and observers especially for EVLOS and BVLOS flights	☐	☐	
Check of latest CAA and EASA safety bulletins performed and reviewed by all appropriate staff	☐	☐	
Post Flight Checks:			
Damage check to duty holder site	☐	☐	D11
Recovery system (if applicable)	☐	☐	D11
Secure download of the data from the UAV	☐	☐	D11
Battery handling, charging and storage procedure in place	☐	☐	D11
Flight report and audit trail	☐	☐	D11
Emergency Response & Accident Reporting:			
Emergency response plan defined?	☐	☐	D10
Investigation process defined	☐	☐	D10
Process in place for reporting to CAA Mandatory Occurrence Reports (MOR) and Voluntary Occurrence Reports (VOR) schemes	☐	☐	D10
Confidential reporting	☐	☐	D10
Visibility of safety statistics in the last 5 years	☐	☐	D10
Customer references:			
Evidence of satisfactory performance based on references	☐	☐	D11

Annex D1: Company Organisation & Structure		
a)	Company Name/ Trading As	
b)	Legal Entity	
c)	Registered Address	
d)	Registered Number	
e)	UK Registration Number	
f)	CAA Registration ID	
g)	UK VAT Number	
h)	Date of Registration	
i)	Website	
j)	Primary Company Contact	
k)	CEO/ Managing Director	
l)	UAV Manager/ Chief Pilot	
m)	Operations Manager/ Director	
n)	Accountable Manager	
o)	Safety & Quality Manager/ Director	
p)	Technical & Engineering Manager/ Director	
q)	Commercial Manager/ Director	
r)	Training Manager/ Director	
s)	Number of Pilots	
t)	Number of Observers	

Annex D2: Insurance Cover There may be multiple providers and policies for prof. indemnity, public liability, the hardware itself and even IP for payloads. Service providers should be able to expand the form, e.g. by adding rows, to allow for this.	
Insurance Provider	
Insurer Address	
Valid From	
Valid Until	
Amount of Third Party / Public Liability (£GBP)	
Amount of Professional Indemnity Liability (£GBP)	
Combined Single Limit (£GBP)	
Named Co-Insured Parties	
Attach copy of Insurance certificate to support	
Total number of claims (last 3 years)	

Annex D3: Airworthiness Certificates
Provide scanned copy of relevant certificate(s).

Annex D4: Pilot Management, Training & Experience Records	
How many UAV platforms does the company operate for each UAV pilot? Describe the process of pilot management for utilisation of these different platforms	
Average pilot monthly flying hours	
Minimum permitted monthly flying hours	
Maximum permitted monthly flying hours	
Describe the system that records how flights and flight hours are managed for all pilots	
Describe how pilots are managed for the delegation and selection of jobs (e.g. availability vs. technical competence)	
Describe how pilots remain concurrent with latest safety information? (e.g. safety bulletins issued by the CAA or EASA)	
Describe how the company determines if pilots are medically fit for duty (e.g. implementation of random drugs testing)	
Describe the process of training and the re-integration of the pilot into live operations after prolonged periods (minimum 1 month) no flying	
Describe the process for pilot recruitment and selection criteria	
Describe the process for pilot training conversion	
Describe the process for the integration of newly hired pilots into the company for live operations	

Pilot Name	UAV Manager	Employment	Permissions & Exemptions	Total Hours Operating UAS (On/ Offshore)	Experience Rating

Training Description (Theory & Technical)		Proficiency Check?	Pass Date	In-House / Supplier	Hours Trained
Accountable Manager					
Pilot					
Observer					
Engineer					
… etc					
Provide scanned copy of NQE training completion.					

Annex D5: Safety Management Records, Policy and Emergency Procedures	
Total Accidents in the last 3 years (Duty Holder to decide suitable period)	E.g. 100% records are indicative of positive operator reputation.
Total Incidents in the last 3 years (Duty Holder to decide suitable period)	E.g. Incidents may include very minor events resulting in no damage or harm to anyone. Recording of any incidents if they happen suggests leadership in improving process and safety. Incidents involving UAV misuse are on the increase with 120 Airprox incidents reported in 2018. Reputable Service Providers undertake all flight operations to strict standards authorised by the CAA which are well planned and executed commercial activities. The probability is that the activities contravening present regulatory requirements which resulted in a reported incident are the result of rogue hobbyist pilots.
Has there been an accident or Incident in the last 1 year / 6 months? (Duty Holder to decide suitable period)	
If yes, what were the causes and what harm was done?	E.g. Some accidents and incidents may occur outside the control of the operator, such as rogue operators or hobbyists?
Is there an accident and incident prevention plan?	E.g. Do you use Bowtie Analysis to map out danger scenarios?
Is there an accident and incident review process?	E.g. Lessons learnt repository and process updated implementation?
Describe procedure when the UAV loses C2 (Command & Control) of data links	E.g. Does the UAS land at a designated area, the start point or remain airborne by default?
Describe procedure if a pilot loses contact with their observer	E.g.
Describe procedure if an observer loses sight of the UAV	E.g.
Describe procedure in the event of pilot incapacitation during flight	
Describe the post-incident equipment disposal procedure that minimises environmental impact (no toxicity)	E.g.

Annex D6: Quality Assurance Accreditation
Provide scanned copy of relevant certificate(s).

Annex D7: UAS Asset Management & Maintenance Records

	Asset 1	Asset 2	Asset 3	Asset 4	Asset 5
Asset Type					
Asset Ownership					
Asset Manufacturer					
Model					
Serial Number					
Year of Purchase &					
Registration					
Primary Use					
Airworthiness Approved					
Total Flying Hours					
Total Service History Log					
Battery Logs					
Date/ Location of next Service					
Repaired in accordance with					
technical library or manual?					
Accountable Pilot(s)					
Accountable Manager					

Annex D8: Operations Manual and Operational Safety Case

- Provide copy of relevant document(s):
- Operations Manual
- Operational Safety Case as required
- Documentation of new approvals or exemptions by the CAA for operations beyond the current Operations Manual

Annex D9: Pre-site survey & risk assessment forms

Please provide examples of completed pre-site survey and risk assessment forms.

Annex D10: Accident & incident report form

Please provide example report forms and / or incident register

Reference Documents:

CAA MOR & VOR https://www.caa.co.uk/Our-work/Make-a-report-or-complaint/MOR/Occurrence-reporting/

Guidance http://www.aviationreporting.eu/AviationReporting/documents/Guidancematerial376-2014.pdf

EASA online reporting portal http://www.aviationreporting.eu/AviationReporting/

Annex D11: Customer reference / testimonials

Please ensure when filling this section in that the customer has consented to the sharing of works and sensitive information performed on customer sites and projects, complying fully with GDPR regulations. Alternatively, customer contact details can be provided for direct referral.

Customer Name		**Start date of works**	
Customer Reference Contact Details		**End date of works**	
Customer Site		**Evidence of works**	*Post flight log evidence*

Description of UAS Services

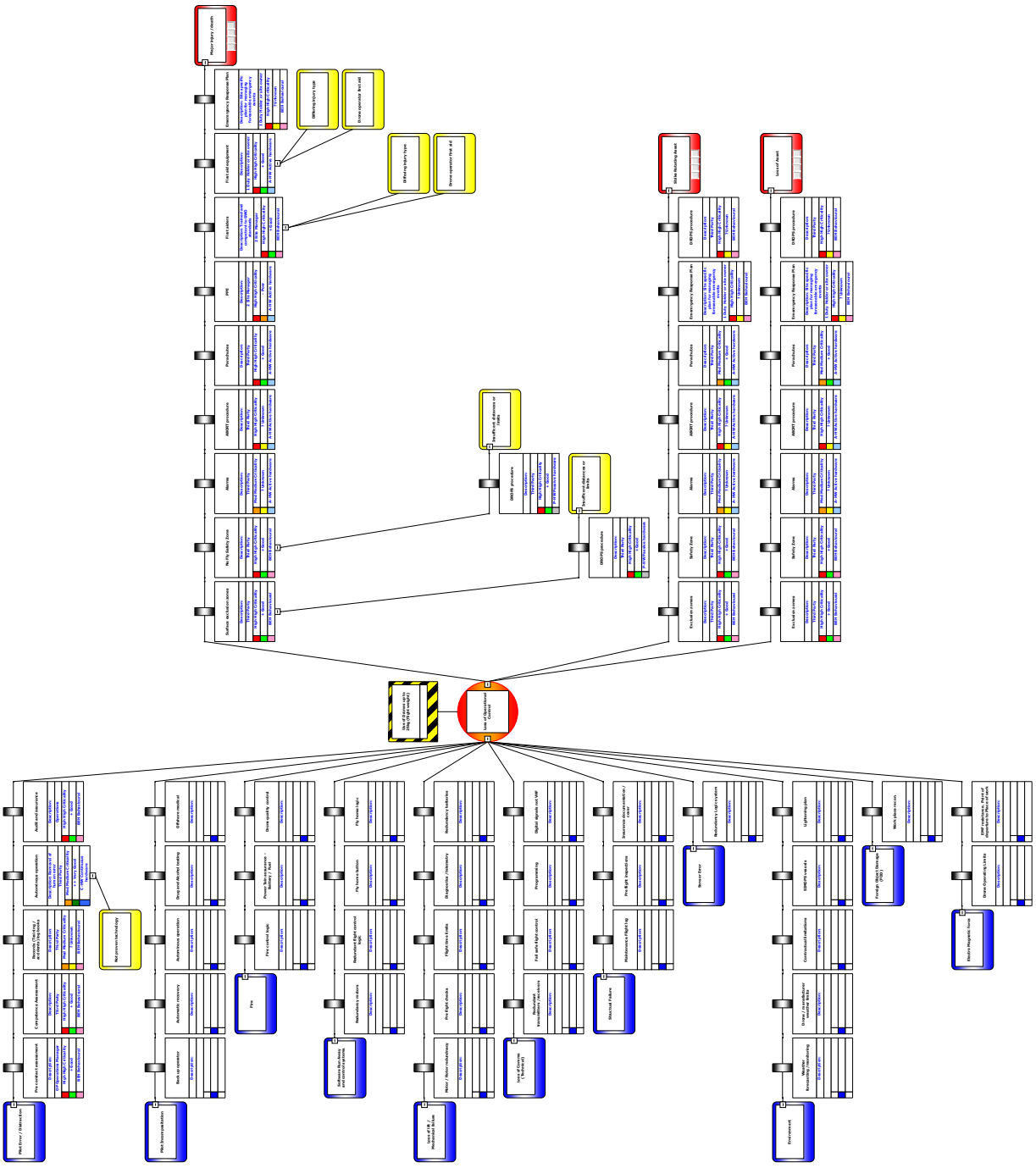
1. Scope of work required 2. Processes followed 3. Teams involved 4. Risk approach taken 5. Number of flights performed	6. Types of flights performed 7. Delivered to requirements? 8. Delivered on time? 9. Any issues or flight/operational incidents? 10. Would they use again/recommend?

Customer Testimonial Summary:

Annex E – Example Bowtie Analysis

In essence, the BowTie is a logic diagram that captures how events and circumstances may combine to lead to a hazardous situation (in this case, 'Loss of Operational Control'), and the barriers and recovery measures that can mitigate the consequences, as well as any escalation factors.

Figure 11 – Example BowTie Analysis Courtesy of SiemensGamesa



Annex F – Example of Emergency Procedures

This Annex provides an example of emergency procedures.

Site Incursion

Incursion of 50m (30m t/o or ldg) radius by person or vehicle not under the control of the PIC.

- REPOSITION AIRCRAFT
  Reposition aircraft to increase separation and hold until third party is clear.

If third party continues to encroach site or approaches pilot:
- LAND ASAP
  Land at first available safe location

Airspace Incursion

Aircraft noise heard in the vicinity of the site.

- ATTEMPT TO LOCATE AIRCRAFT

If unable to locate aircraft:
- REDUCE ALTITUDE
  Bring aircraft to low level hover

If aircraft located:
- ASSESS THREAT

If no threat:
- CONTINUE FLIGHT AND MONITOR

If threat:
- REDUCE ALTITUDE OR LAND

GPS Flyaway

Operating in GPS mode control of aircraft is lost or becomes erratic.

- SELECT 'ATTI' MODE (or equivalent where fitted)
  This disables the GPS
- LAND ASAP
  Once control has been recovered, discontinue flight

If unsuccessful:
- LAND ASAP
  Reduce throttle to increase rate of descent. Attempt to land in safe location
- RAISE DEFECT and MOR
  A defect should be raised for troubleshooting - consider filing a MOR

Loss of Engine Power

Partial or complete loss of power of one or more engine.

- LAND ASAP
  Land aircraft at the nearest available safe location

Transmitter Battery Failure

Failure of the transmitter battery

- AIRCRAFT ENTERS FAILSAFE MODE

Loss of Control Link

Failure of the signal between the transmitter and aircraft

- AIRCRAFT ENTERS FAILSAFE MODE

Aircraft Battery Failure

Failure of a battery on an aircraft.

- ESTABLISH FLIGHT TIME
  Determine remaining flight time and monitor endurance
- RETURN AIRCRAFT HOME
  Return the aircraft to the landing zone if it has enough charge.

If remaining endurance is insufficient to return home:
- LAND ASAP
  Land aircraft in nearest available safe location

Pilot Incapacitation

Pilot becomes unwell to the extent that the safety of the flight is/will be compromised.

- ADVISE GROUND CREW MEMBER
- LAND AIRCRAFT
  Return the aircraft to the landing zone or land in nearest safe location

If unable to maintain control of aircraft:
- SWITCH OFF TRANSMITTER
  This will active failsafe mode

If unable to switch off transmitter:
- GROUND CREW ALERT
  Ground crew should switch off transmitter

Fire or Smoke

Smoke and/or fire coming from aircraft.

- LAND AIRCRAFT ASAP
  Land at nearest available safe location
- ENGINES OFF
  Shut engine(s) down and make safe
- CLEAR AREA
  Clear people and hazards from around the aircraft
- REQUEST ASSISTANCE
  Raise the alarm and request assistance (emergency services if required)
- GATHER SAFETY EQUIPMENT

If safe to approach and to do so:
- EXTINGUISH FIRE
  Use CO2 or a powder extinguisher
- DISCONNECT BATTERY
- LEAVE TO COOL

Annex G – Example of a Pre-Site Survey & Operational Risk Assessment

This Annex provides an example of a pre-site survey and operational risk assessment.

G1. Pre-Site Survey			
Section 1: Job Details			
Date of Flight:		Job Number:	
Pilot in Command:		Mission Summary:	
Support Pilot:			
Observer:			
Site Details:			
Landowner/Client:		Site Address	
Tel:			
Email:			
Permission Received:	Y ☐ N ☐		
Site Coordinates:			
Vehicle Access:	Y ☐ N ☐		
Site Altitude (ft. amsl):			
Local Hospital:			
Contact Number:			
Local Police:			
Contact Number:			
Section 3: Airspace			
3A: Airspace (within 10NM)			
Controlled/Uncontrolled:	C ☐ U ☐	Airspace Classification:	
ATC Permission Required:	Y ☐ N ☐		
3B: Airports/Heliports (within 10NM)			
Airport Name	Operation in (M)ATZ	Permission Required	Contact Name/Number
1:	Y ☐ N ☐	Y ☐ N ☐	
2:	Y ☐ N ☐	Y ☐ N ☐	
3:	Y ☐ N ☐	Y ☐ N ☐	
3C: Airspace Hazards (within 10NM)			
Item	Airspace Ref Number(s)	SUA Prohibited	Comments/Restrictions
Danger Areas:		Y ☐ N ☐	
Restricted Areas:		Y ☐ N ☐	
Prohibited Areas:		Y ☐ N ☐	
Conservation Areas:		Y ☐ N ☐	

Other Airspace:		Y ☐ N ☐	
NOTAM Restrictions:		Y ☐ N ☐	

Section 4: Ground Assessment	
Item	Comments/Restrictions/Mitigations
Congested Areas:	
Isolated Structures:	
Third Party Infringement	
Risk and Site Control:	
Roads and Rights of Way:	
Fauna:	
Recreational Spaces:	
Other Restrictions:	

Section 5: Weather Forecast	
Item	Comments
Wind Strength:	
Temperature (max/min):	
Humidity (approx.):	
Sunrise/Sunset (If limiting):	
K Index (space weather):	
General Forecast:	

Section 6: Notes and Comments

Section 7: Approval to Operate		
On the basis of the flight planning assessment I believe the flight can be conducted safely, in accordance with the Air Navigation Order, company PFAW and Operations Manual. Y ☐ N ☐		
Prepared by:	Signed	Date:

G2. Operational Risk Assesment Risk Assessment Form			
Site Location:		Job Number:	
Flight Operation:		Job Date:	
Flight Team:	Remote Pilot:	Observer:	
		Aircraft:	

1 - HAZARD (Something with the potential to cause harm, how will it be realised and what is the potential injury?)"	2 - AT RISK	3 - EXISTING CONTROL MEASURES	RISK			7 - FURTHER CONTROL MEASURES	RISK		
			4 SEVERITY	5 PROBABILITY	6 RISK		4 SEVERITY	5 PROBABILITY	6 RISK
Mech Failure	EC	Pre-Flight Checks/After T/O Check/App Monitor	4	1	4				
Fly Away	A	In-Flight Checks/Test Flt after updates	4	1	4				
Battery Fail	EC	Pre Flight Check/App Monitor/Start 100%	4	1	4				
Mid Air Collision	A	Multiple Observers	4	3	12	File NOTAM	4	1	4
FURTHER ACTIONS (Further control measures which could be implemented at the planning stage to improve safety)									
ADDITIONAL COMMENTS (Actions identified by personnel on site, to make the operation safer)									

AUTHORISED BY THE ACCOUNTABLE MANAGER	NAME (Print):		Signed:

AT RISK (Column 2)	SEVERITY (Columns 4 and 8)		PROBABILITY (Columns 5 and 9)		RISK RATING (Columns 6 and 10)	
E - EMPLOYEE	1	NO INJURY, PROPERTY DAMAGE	1	EXTREMELY UNLIKELY	Severity x Probability = 1 to 5	MIN Y - Acceptable Risk
C - CLIENT	2	MINOR INJURY	2	REMOTE POSSIBILITY	Severity x Probability = 5 to 10	LOW Y - Acceptable Risk
V - VISITORS	3	REPORTABLE INJURY	3	WILL POSSIBLY OCCUR	Severity x Probability =12 to 15	MED ? - Needs further consideration
P - PUBLIC	4	MAJOR INJURY OR FATALITIES	4	WILL PROBABLY OCCUR	Severity x Probability =15 to 20	HIGH N - Unacceptable Risk
A - ALL			5	ALMOST CERTAIN		

Annex H – Stakeholder Contact Details

- CAA
- Crown Estates (Crown Estate Scotland and The Crown Estate)
- DfT
- EUROCONTROL
- ICAO
- JARUS
- EA/ SEPA
- EASA
- HSE
- Local authorities (functions other than planning)
- MCA
- MoD
- NATS
- Planning authorities

Annex I – References and Literature Review

Reference Sources:

Oil and Gas UK (O&GUK)

- Unmanned Aircraft Systems (UAS) Operations Management Standards and Guidelines – Issue 1 2017: https://oilandgasuk.co.uk/product/unmanned-aircraft-systems-uas-operations-management-standards-and-guidelines-issue-1-2017-hse05/

RenewableUK

- Wave & Tidal Health & Safety Guidelines – Issue 1 2014: https://cdn.ymaws.com/www.renewableuk.com/resource/collection/AE19ECA8-5B2B-4AB5-96C7-ECF3F0462F75/WaveTidal_HealthSafety_Guidelines.pdf
- Offshore Wind & Marine Energy Health & Safety Guidelines – Issue 2 2014: https://cdn.ymaws.com/www.renewableuk.com/resource/collection/AE19ECA8-5B2B-4AB5-96C7-ECF3F0462F75/Offshore_Marine_HealthSafety_Guidelines.pdf
- Onshore Wind Health & Safety Guidelines – Issue 1 2015: https://cdn.ymaws.com/www.renewableuk.com/resource/collection/AE19ECA8-5B2B-4AB5-96C7-ECF3F0462F75/OnshoreWind_HealthSafety_Guidelines.pdf
- Offshore Renewables Aviation Guidance (ORAG) Issue 2 2019: https://cdn.ymaws.com/www.renewableuk.com/resource/collection/0B792CF1-8B8A-474B-95B6-17886BF724A7/ORAG_Aviation_Guidance_26-04-19_INTERACTIVE.pdf
- Integrated Emergency Response – Renewables (IER-R)/ IOER-R

The Civil Aviation Authority (CAA)

- CAP382 Occurrence Reporting Scheme: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=214
- CAP393 The Air Navigation Order 2016 and Regulations: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=7523
- CAP722 Unmanned Aircraft System Operations in UK Airspace – Guidance: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=415
  - CAP 722A Unmanned Aircraft System Operations in UK Airspace – Operating Safety Cases
  - CAP 722B Unmanned Aircraft System Operations in UK Airspace – The UK Recognised Assessment Entity
- CA1094 Airprox Report Form: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8997
- CAP1496 ECCAIRS Reporting Portal UK User Guidance: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7672
- CAP1687 Air Navigation (Amendment) Order 2018 – Guidance for Small Unmanned Aircraft Users: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8570

Global Wind Organisation (GWO)

- *GWO accredited minimum safety training*

Health and Safety Executive (HSE)

- HSE R2P2 Reducing Risks, Protecting People 2001: http://www.hse.gov.uk/risk/theory/r2p2.pdf
- INDG417 Leading Health & Safety at Work (Rev 1) 2017: http://www.hse.gov.uk/pubns/indg417.pdf

NATS

- UK AIP ENR 1.14 ATS Airspace Classification: http://www.ead.eurocontrol.int/eadbasic/pamslight-7E538D39EB66596463448965000CE185/7FE5QZZF3FXUS/EN/AIP/ENR/EG_ENR_1_4_en_2019-02-28.pdf
- UK AIP (MIL) ENR 1.14

Joint Authorities for Rulemaking on Unmanned Systems (JARUS)

- JARUS guidelines on Specific Operations Risk Assessment (SORA) Edition 1 2017: http://jarus-rpas.org/sites/jarus-rpas.org/files/jar_doc_06_jarus_sora_v1.0.pdf

Department for Transport (DfT)

- Taking Flight - The Future of Drones in the UK 2019:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/771673/future-of-drones-in-uk-consultation-response-web.pdf

Literature Review Sources:

- Unmanned Aircraft Systems Industry Guidelines Issue 2, Oil & Gas UK
- Basic Aviation Risk Standard – Remotely Piloted Aircraft Systems, Flight Safety Foundations, Version 1 July 2016
- JARUS Guidelines – Specific Operations Risk Assessment (SORA) Edition 1.2 May 2018
- Guidance Notes on using Unmanned Aerial Vehicles, American Bureau of Shipping, March 2018
- Remotely Piloted Aircraft Systems (RPAS) Operations, Shell Aircraft, January 2017
- Chevron Aviation Standards, Revision 5 May 201, Section 10.5 UAS Guidelines
- International Association of Oil & Gas Producers (IOGP), Aircraft Management Guidelines, Section 6 Unmanned Aerial Systems, May 2017

Annex J – Abbreviations

AAIB	Air Accidents Investigation Branch
ACOP	Approved Code of Practice
ALARP	As Low As Reasonably Practicable
ANO	Air Navigation Order
ANSP	Air Navigation Service Provider
AOC	Air Operator Certificate
ARPAS UK	Association of Remotely Piloted Aircraft Systems UK
ASBU	Aviation System Block Upgrade
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
BLOS	Beyond Line of Sight
BSI	British Standards Institute
BVLOS	Beyond Visual Line of Sight
CAA (UK)	Civil Aviation Authority
CAP	Civil Aviation Publication
CDM	Construction (Design & Management) Regulations 2015
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CES	Crown Estate Scotland
CNS	Communications, Navigation & Surveillance
CONOPS	Concept of Operations
CS-LURS	Rotary Wing, Light Unmanned Rotorcraft System
CS-LUAS	Fixed Wing, Light Unmanned Aero Plane System
DAA	Detect and Avoid
DfT	Department for Transport
DPR	Daily Progress Report
EA	Environment Agency
EASA	European Aviation Safety Agency
ELOS	Extended Line of Sight
ERCOP	Emergency Response Co-operation Plan
ERP	Emergency Response Plan
FDM	Flight Data Monitoring
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GWO	Global Wind Organisation
HAZID	Hazard Identification
HAZOP	Hazard & Operability Study
H&S	Health & Safety
HSE	Health & Safety Executive
ICAO	International Civil Aviation Organisation
IEC	International Electrotechnical Commission
IFR	Instrument Flying Rules
IMO	International Maritime Organisation
IMU	Inertial Measurement Unit
ISO	International Organisation for Standards
ITT	Invitation to Tender
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
KPI	Key Performance Indicators
LOS	Line of Sight
MCA	Maritime & Coastguard Agency
MGN	Marine Guidance Notice
MHSWR	Management of Health & Safety at Work Regulations 1999
MoD	Ministry of Defence
MOR	Mandatory Occurrence Report
MOU	Memorandum of Understanding
NAA	National Aviation Authority
NATS	National Air Traffic Services
NOTAM	Notice to Airmen
NSO	Non-Standard Operations
NQE	National Qualified Entity
OEM	Original Equipment Manufacturer
O&GUK	Oil & Gas UK
O&M	Operations & Maintenance
ORAG	Offshore Renewables Aviation Guidance
ORE	Offshore Renewable Energy
ORED	Offshore Renewable Energy Development
OSC	Operational Safety Case
PfCO	Permission for Commercial Operations
PINS	Pipeline Inspection Notification System

PPE	Personal Protective Equipment
PQQ	Pre-Qualification Questionnaire
PUWER	Provision & Use of Work Equipment Regulations 1998
QA	Quality Assurance
RAMS	Risk Assessment & Method Statement
RIDDOR	Reporting of Injuries, Diseases & Dangerous Occurrences Regulations 2013
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RUK	RenewableUK
SAR	Search & Rescue
SARPS	Standards & Recommended Practices
SEPA	Scottish Environmental Protection Agency
SIMOPS	Simultaneous Operations
SMS	Safety Management System
SOP	Standard Operating Procedure
SOV	Service Operations Vessel
SQEP	Suitable Qualified & Experienced Personnel
SUA	Small Unmanned Aircraft
SUSA	Small Unmanned Surveillance Aircraft
TCE	The Crown Estate
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
VFR	Visual Flying Rules
VL UAS	Very Light Unmanned Aerial Vehicle
VLOS	Visual Line of Sight
VMC	Visual Meteorological Conditions
VOR	Voluntary Occurrence Report

Annex K – Acknowledgements

RenewableUK would like to thank the following companies and institutions for their contributions to the compiling of Issue 1 of this guide:

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MTCS UK
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Offshore Wind Consultants
Texo UAV Services

And peer review from stakeholders: TBC

Civil Aviation Authority
G+ Offshore Wind Health & Safety Association
Health & Safety Executive
Maritime & Coastguard Agency
NATS
Oil & Gas UK
SafetyOn

Notes

Notes

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RenewableUK members are building our future energy system, powered by clean electricity.

We bring them together to deliver that future faster; a future which is better for industry, billpayers, and the environment. We support over 400 member companies to ensure increasing amounts of renewable electricity are deployed across the UK and access markets to export all over the world. Our members are business leaders, technology innovators, and expert thinkers from right across industry.

RenewableUK is committed to the environment.
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