Australian Aerospace
Industry Forum

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AAIF REVIEW OF DRAFT CASA ADVISORY MATERIALS

AAIF CERTIFICATION AND REGULATION WORKING GROUP
UNMANNED AIRCRAFT SYSTEMS SUB-COMMITTEE

FOREWORD

There is a lot of activity directed towards the progression of aviation safety regulations for civil Unmanned Aircraft System (UAS) operations in Australia. The current regulations contained in Civil Aviation Safety Regulations (CASR 1998), Volume 3, Part 101, are widely considered to be a very proactive regulation, which has enabled the Australian UAS industry to grow to what it is today.

As with any innovative and active industry, the needs of the Australian civil UAS industry have grown and changed over the decade since the regulations were first written. The Civil Aviation Safety Authority's (CASA) awareness and knowledge of these needs has also grown. Changes to the current regulations and guidance material are required to meet these needs. The first phase of these regulatory changes are to be undertaken as part of CASA Project OS 11/20, titled *"Review of Regulations and Guidance Material Relating to Unmanned Aircraft Systems (UAS)"*.

It is universally recognised that the progression of regulation requires a strong collaboration between industry, Government, academia and the regulator. This report is the product of such a collaboration, representing the collective input of the Australian Aerospace Industry Forum (AAIF) Sub-Committee on UAS Certification and Regulation to the initial phases of CASA Project OS 11/20.

I would like to personally commend CASA on their continuing recognition of UAS as a valid and important airspace user, and on their proactive approach to integrating UAS requirements into the Australian regulatory system based on solid collaboration with the UAS industry.

I would also like to thank the AAIF UAS Sub-Committee along with individual representatives from the UAS industry, AUVS-A, and other airspace user groups for participating in the CASA SCC Working Group, which made this report possible.

The Sub-Committee is delighted to continue to be involved in the process of establishing regulation, guidance and standards for Australian civil UAS.

Ian Honnery
Chair
Australian Aerospace Industry Forum

EXECUTIVE SUMMARY

This document is a review of the Civil Aviation Safety Authority (CASA) draft Advisory Circulars (ACs) addressing Unmanned Aircraft conducted by the Australian Aerospace Industry Forum (AAIF) Sub-Committee on UAS Certification and Regulation. The AAIF Sub-Committee on UAS convened a workshop in Adelaide on the 22nd and 23rd February 2012. The discussion and outcomes of that workshop were compiled into this report.

The review workshop and this report followed an agreed set of guiding principles. The first of which was that comments and recommendations should reflect views of the individual independent of the concerns of any particular organisation. It was recognised that individuals and their organisations maintained the right to submit their own review to CASA during the public input phase of the CASA project. It was also agreed that the review and report would present, where possible, the consensus of the AAIF Sub-Committee, and if consensus could not be reached, then the majority and all alternate positions would be documented. Finally, it was further agreed that for each critique or issue identified, the AAIF Sub-Committee should attempt to provide guidance as to how it could be addressed.

The AAIF Certification and Regulation Working Group Sub-Committee on UAS wishes to acknowledge and commend CASA on their proactive approach towards the integration of UAS into the Australian regulatory system. Given the long turn around time on regulations, the Sub-Committee supports CASA's approach to update the guidance material first. The Sub-Committee appreciates the opportunity to support the development of this guidance material and ultimately, a framework of regulations that will ensure the safe operation of UAS and a prosperous industry.

The Sub-Committee presents the following key review comments with respect to drafts of AC 101-1(1), AC 101-4(1), AC 101-5(1), AC 101-6(0), and AC 101-7(0).

- The Sub-Committee supports the clear distinction being made between model aircraft and UAS (*i.e.*, on the basis of operations being not for sport or recreational purposes).
- The Sub-Committee does not support the proposition that all UAS are performing air work, and should therefore require an Unmanned Operators Certificate (UOC). This is inconsistent with the interpretation of air work within the manned aviation regulations. The ACs redefine the existing concept of air work to encompass previously excluded aerial operations such as research, development, private operations, *etc*. It is a blanket requirement, which can impose substantial costs to the industry and community irrespective of the risks posed. The Sub-Committee recommends as a minimum, that the requirement include the possibility of exemption with guidance provided as to the necessary conditions for exemption.
- The Sub-Committee does not support the exclusion of Optionally Piloted Aircraft (OPA) and "fully autonomous" UAS from the guidance material. This may not be intentional but the offered terminology implies a scope restriction on CASR101. Much of the draft guidance material would be applicable to both OPA and fully autonomous UAS. The Sub-Committee recommends that the guidance, by default, be applicable to all UAS unless specific guidance is required for a specific "sub-group" of UAS, in which case the wording of the guidance would be explicit in the change of scope of the subsequent guidance. The guidance material should direct applicants with OPA and fully autonomous UAS to contact CASA to discuss any additional requirements not covered in the guidance material.
- The Sub-Committee finds that the term "autonomous" UAS is not well defined in CASA documents, ICAO documents, or academic literature. The Sub-Committee recommends that further work be undertaken to identify a suitable definition or alternate terminology that provides greater clarity. The Sub-Committee acknowledges and supports CASA's phased approach in addressing Remotely Piloted Aircraft (RPA) in the first instance; however clarity is required to adequately define what levels of autonomy are consistent with RPA and recognise that increased levels of autonomy are in work.

- The Sub-Committee finds that definitions and terminology are inconsistently used across the ACs and that this detracts from the usability of the guidance material. The Sub-Committee further finds that the definitions and terminology are inconsistent with those presented in ICAO CIR328. The Sub-Committee recommends that ICAO CIR328 definitions and terminology be the primary reference source and where CIR328 is deficient, definitions that have been previously used in CASA regulations and international guidance material (*e.g.*, CAP722) should be used. If neither source provides the necessary definitions and terminology then it would be appropriate to raise new definitions and terminology within the UAS ACs, and if used across multiple UAS ACs, these terms should be found in AC 101-1. It would be considered appropriate to re-state definitions and terminology from CIR328 and other CASA regulations and material in the ACs, with a reference to their source.
- The Sub-Committee finds that the ACs attempt to provide general guidance over the entire range of UAS and their potential operations. The Sub-Committee recommends that more tailored guidance should be provided. To allow more specific guidance across this spectrum of UAS systems and operations the Sub-Committee recommends that the ACs divide this spectrum into a discrete number of broad classes and develop "rule of thumb" material for each class. These classes should be consistently referenced throughout all of the ACs. It is advocated that a classification of UAS permits a more appropriate tailoring of requirements and guidance material to the unique needs of different types and operations. Further, a classification permits a phased development of regulatory materials, simplifies the communication of material and helps to put regulatory material into context. It is recommended that these classes be developed based on risk/existing regulatory divides (*e.g.*, populous/non-populous, ← 400ft *etc*.). Examples of such a classification are provided in this document. The Sub-Committee acknowledges that further work is planned on a risk-based classification and offers this recommendation as a path way to the final solution.
- The Sub-Committee finds that the presentation style and layout of the individual ACs significantly hampered their value and usefulness. In particular: key points are lost, they are confusing and disjointed, and difficult to interpret. The ACs also assume the reader has background knowledge in aviation and the principles of aviation safety regulations. Although it is acknowledged that the ACs are not meant to be educational, in the short term, they will inescapably serve as interim educational materials. Additional material will need to be provided to bring the new entrants into the aerospace community up to speed with aviation regulation. Foundational principles and catchall statements are missing (*e.g.*, equivalent level of safety, seamless operations, how they trace to guidance materials). The Sub-Committee recommends that the ACs be rewritten assuming the reader to be a "new entrant" to the aviation community, and that a professional writer should be engaged to help communicate the complex array of material to a "lay audience". Better use of tables, process diagrams, and illustrations should be included to summarise key points.

The Sub-Committee has identified numerous areas where the guidance provided could be improved and these are presented in detail in the body of this report. The Sub-Committee has also identified a number of key issues that require further discussion between CASA and industry stakeholders. Based on the breadth of the issues and recommendations identified, it is felt that the draft ACs will require a number of significant iterations and revisions before they will be in a state suitable for release for broader public comment. This brings into question the viability of the proposed release date of May/June 2012. Due to the significance of some of the issues identified, further iterations of the guidance materials should continue to be made in direct consultation with industry stakeholders.

The AAIF Sub-Committee on UAS Certification and Regulation looks forward to working alongside CASA in the development of these ACs and UAS Regulations.

DISTRIBUTION

Version	Description	Distribution	Date
Draft	Initial draft for review	Electronic distribution to AAIF Members	8-March-12
1.0	First release to CASA SCC	Electronic and hardcopies presented to CASA Standards Consultative Committee Meeting	9-March-12
1.1	Final version	Electronic and hardcopies presented to CASA, Department of Industry, Innovation, Science, Research and Tertiary Education, and AAIF.	27-April-12

CONTRIBUTORS

The following members of the AAIF Sub-Committee on Unmanned Aircraft Systems Certification and Regulation have contributed towards the compilation of this document. The comments and recommendations made in this document reflect the consolidated position of the individuals listed and do not reflect those of any individual organisation. There was only one discussion point where a degree of difference from the reported consolidated position exists and this has been noted in the report, Section 2.1.

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REFERENCE DOCUMENTS

Designator	Title	Date / Version
AC 101-1(1)	CASA Advisory Circular Unmanned Aircraft Systems – General (DRAFT)	January 2012
AC 101-4(1)	CASA Advisory Circular Unmanned Aircraft Systems – Training and Licensing (DRAFT)	January 2012
AC 101-5(1)	CASA Advisory Circular Unmanned Aircraft Systems – Operations (DRAFT)	January 2012
AC 101-6(0)	CASA Advisory Circular Unmanned Aircraft Systems – Maintenance and Continuing Airworthiness (DRAFT)	December 2011
AC 101-7(0)	CASA Advisory Circular Unmanned Aircraft Systems – Manufacturing and Initial Airworthiness (DRAFT)	November 2011
ICAO CIR328	Unmanned Aircraft Systems (UAS), ICAO Cir 328 AN/190	2011

GLOSSARY

This report adopts the definitions and terminology as defined in ICAO CIR328.

Acronym	
AA	Area Approval
AAIF	Australian Aerospace Industry Forum
AC	Advisory Circular
ADF	Australian Defence Force
AGL	Above Ground Level
ATC	Air Traffic Control/Controller
ATS	Air Traffic Services
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
CoA	Certificate of Airworthiness
CRM	Crew Resource Management
FM	Flight Manual
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules

Acronym	
IMC	Instrument Meteorological Conditions
MM	Maintenance Manual
OC	Operator's Certificate
OPA	Optionally Piloted Aircraft
Operations Manual	Operations Manual
RPA	Remotely Piloted Aircraft
RPS	Remote Pilot Station
SCC	Standard Consultative Committee
SMS	Safety Management System
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UOC	UAS Operators' Certificate
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

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1. INTRODUCTION

1.1 BACKGROUND

In 2002 the Civil Aviation Safety Authority (CASA) became the first in the world to implement regulations on the operation of civil Unmanned Aircraft Systems (UAS). The forward-thinking regulations [contained in Civil Aviation Safety Regulation 1998 Part 101] allowed the fledgling Australian civil UAS industry to mature whilst at the same time ensuring the safety of other airspace users and the people overflown.

The industry has grown in size, capability and experience in the decade since the introduction of CASR 101. Beneficial commercial and civil opportunities have emerged, however many of which are not viable due to the long lead-time on approvals to operate. Further, the increasing number and diversity of applications for UAS operations has placed a high demand on CASA resources. Consistent assessment and timely processing of these applications is becoming a major concern. It is becoming increasingly apparent that the industry has matured to a point where the regulations no longer meet their needs.

New guidance material is needed to: address the emerging needs of the industry; to keep pace with international regulatory initiatives (*e.g.*, ICAO); advancements in technology; and changes in the operational (*i.e.*, airspace), political and social environments.

The AAIF Certification and Regulation Working Group UAS Sub-Committee was formed in March 2009 in recognition of this need. Since then, the AAIF UAS Sub-Committee has aimed to

1. Provided a forum for industry to raise and discuss UAS regulation issues constraining the development of the aerospace industry.
2. Engaged with the Civil Aviation Safety Authority (CASA), the Australian Defence Force (ADF) and other organisations such as AUVS-Australia, on key regulatory issues of concern to the industry.
3. Provided a cooperative approach to further develop the regulatory system.
4. Developed draft policy positions on UAS issues for adoption by the Aerospace Forum.

The AAIF UAS Sub-Committee comprises representatives from the UAS industry, Australian Department of Defence, and academia with observers from CASA.

The Aviation White Paper (released December 2009 and available on The Department of Infrastructure and Transport Website) recognised the growing need for regulatory reform for the Australian civil UAS sector[1]. Specifically, the Aviation White Paper stated that:

> *The Government will ensure CASA: enhances oversight of the operation of unmanned aerial vehicles (UAVs);*
>
> And
>
> *In accordance with this growth* [in the UAS sector]*, CASA will be enhancing its capacity to regulate this sector, including through the establishment of a 'future technologies' area to examine safety trends relevant to new technology.*

On the 25th of July 2011 CASA announced the creation of Project OS 11/20 titled "*Review of Regulations and Guidance Material relating to Unmanned Aircraft Systems (UAS)*". Project OS 11/20 consists of a number of phases, the first of which relates to the review of current advisory materials.

A UAS Joint CASA/Industry Working Group was established under the CASA Standards Consultative Committee (SCC) in December of 2012 to lead Project OS 11/20. The AAIF Working Group UAS Sub-Committee along with individual representatives from the UAS industry, the UAS industry association AUVS-Australia, and other airspace user groups are participating on the CASA SCC Working Group. Draft copies of the proposed advisory materials were provided to the CASA SCC Working Group members for review by the 13th of March 2012.

1 Recognition of this need was largely due to the detailed submissions made by individual members of the UAS industry and UAS Australia (predecessor of the AAIF) to the Aviation Green Paper.

The AAIF UAS Sub-Committee held a workshop on the 22nd and 23rd of February 2012 in Adelaide Australia to review the draft guidance materials. The outcomes from this workshop provide the basis for the feedback contained in this report. Additional input, received via email, has also been incorporated into this report. The report has been circulated within the AAIF UAS Sub-Committee for consensus review and approval by the members detailed in the table of *Contributors*, p.3. It is important to note that the comments and recommendations made in this report represent the consolidated position of the group and not any single individual or organisation.

1.2 SCOPE

This document summarises the AAIF UAS Sub-Committee's initial review of the draft Advisory Circulars (ACs). This review is to be tabled at the CASA SCC UAS Joint CASA/Industry Working Group meeting to be held on the 13th March 2012.

The primary objective of this document is to provide the CASA SCC UAS Joint CASA/Industry Working Group with an objective and consolidated review of the draft ACs (detailed in the *Table of References* on p.3 of this document). Where possible the AAIF UAS Sub-Committee has endeavoured to make recommendations as to how the issues identified can be addressed.

The review did not include a review of the current *regulations* except in those cases where a potential discrepancy between the guidance provided in the draft ACs and the regulations was identified.

1.3 GUIDING PRINCIPLES FOR REVIEW

The following general principles were agreed to and adopted prior to the review of the advisory materials:

- Individuals contributing towards the review come as individuals and not representatives of their organisations. Comments and recommendations should reflect their individual position (in concern for the entire industry);
- The review is to present the consensus of the group as opposed to the individual. Should consensus not be reached, then the majority position and the alternate positions should be documented;
- For every critique or problem identified, the group should provide a recommendation or some guidance on how it can be addressed.

As described in the ACs, the objective of the UAS advisory material is to provide:

- *"... better guidance to operators, RPA crew, manufacturers and maintainers of UAS in the operation and construction of remotely piloted aircraft (RPA), and the means whereby they may safely and legally operate them. This and the related ACs also provides guidance to CASA staff on the processing of approvals for RPA operations. While these documents prescribe a means of compliance with legislation, alternate procedures demonstrating an equivalent or greater level of safety may be considered on a case-by-case basis."* AC 101-1(0), p.2.

Each of the draft ACs are reviewed in relation to how well they meet the objective defined above. To achieve this objective, the draft ACs, when considered individually and as a collection, should be:

- Correct – the information provided is without error
- Consistent – adheres to the same set of principles
- Complete – all necessary elements are included/covered
- Compatible – exists without conflict
- Unambiguous – not open to more than one interpretation
- Clear – clarity of presentation and the ease of interpretation
- Relevant – the information is pertinent to the purpose, mandate or discussion
- Informative – the amount of information provided is sufficient to meet the objective

Although only guidance material, any requirement made within the ACs should be:

- Practicable / achievable – the requirement can be attained within normal means
- Verifiable – the requirement is provable / demonstrable

The AAIF working group recognises that safety should always be the primary concern. However, it should also be acknowledged that unnecessary or inappropriate regulation can lead to unjustifiable costs to the industry. Thus, the review also considered any guidance and recommendation made in the ACs in relation to their implications for the UAS industry.

All of the issues identified have been assigned a priority to aid the SCC in its revision of the ACs. The priority scheme used in this document is detailed in Table 1.

TABLE 1 - PRIORITISATION SCHEME

Priority	Description
High (H)	Showstoppers – These must be addressed within the ACs
Medium (M)	Significant Issues – The ACs should not go out without correction
Low (L)	Misinterpretations & Clarifications – Possible improvements to the ACs
Edit (E)	Editorials (e.g., spelling, typographical errors, order), queries or comments

1.4 STRUCTURE OF REVIEW DOCUMENT

The review of the ACs considered them as a collection and as individual documents. This is reflected in the structuring of the body of the document:

- Section 2 – High Level Review
- Section 3 – Review of AC 101-1(1) – General
- Section 4 – Review of AC 101-4(1) – Training and Licensing
- Section 5 – Review of AC 101-5(1) – Operations
- Section 6 – Review of AC 101-6(0) – Maintenance and Continuing Airworthiness
- Section 7 – Review of AC 101-7(0) – Manufacturing and Initial Airworthiness
- Section 8 – Concluding Statements

2. HIGH LEVEL COMMENTS

The draft ACs represent a substantial step towards the development of a comprehensive suite of guidance material for the civil UAS industry. The AAIF commends CASA on making this proactive step.

At a very high level, the AAIF felt that the ACs provided guidance on (or have nominated placeholders for) all of the required areas. The AAIF also support CASA's approach in separating the original AC into six separate ACs. Not only does this help to emphasise the key elements of safe UAS operations (*e.g.*, initial and continuing airworthiness, training and licencing, operations, and safety management) but it facilitates an iterative approach to the ongoing revision and improvement to these elements of the regulation of UAS.

The AAIF have identified a number of areas where the guidance provided could be potentially improved. The AAIF have also identified a number of key issues that require further discussion between CASA and industry stakeholders.

Based on the breadth of the issues and recommendations identified, it is felt that the draft ACs will require a number of significant iterations and revisions before they will be in a state suitable for release for broader public comment. Consequently, the industry participants believe that the proposed release date of May/June 2012 is overly optimistic, and it would be sensible to delay this for some months. Due to the significance of some of the issues identified, further iterations of the guidance materials should continue to be made in direct consultation with industry stakeholders.

2.1 DEFINITIONS AND FOUNDATIONAL TERMS

A second area of significant concern is the incomplete and inconsistent usage of key terms. As a consequence, the ACs are difficult to interpret, ambiguous, and in some places conflicting. Addressing these issues should be considered a *high* priority. It is recommended that:

1. definitions common to all of the ACs be defined **once only** and these definitions should be included in *AC 101-1 General*. Definitions specific to a particular AC should be defined in that AC;
2. the definitions should be stated **exactly** as defined in ICAO CIR328;
3. in those cases where ICAO CIR328 does not provide a suitable definition, the ACs should avoid defining entirely new concepts. The ACs should, as much as practicably possible, make use of existing aviation definitions (*e.g.*, definition of airfield, pilot in command, *etc.*) or those provided in existing UAS regulations (e.g., UK CAA CAP722 *etc.*). A reference should be provided where an existing aviation definition is used;
4. the set of all definitions should be collectively reviewed to ensure they are not in conflict and that a complete coverage of concepts has been provided;
5. the relationship between newly defined concepts (*e.g.*, Remotely Piloted Aircraft, Remote Pilot) and those used in CASR 101 (*i.e.*, Unmanned Aerial Vehicle) must be clearly stated;
6. where newly defined concepts have been equated to those used in CASR Part 101 (*e.g.*, the term RPA has been equated to/replaced the existing concept of UAV) - these should be checked for consistency/conflict in relation to the original intent/scope of the regulation;
7. a simple diagram illustrating the relationship between the defined concepts be provided (see Figure 1).
8. the ACs be reviewed to ensure that all concepts used have been explicitly defined.

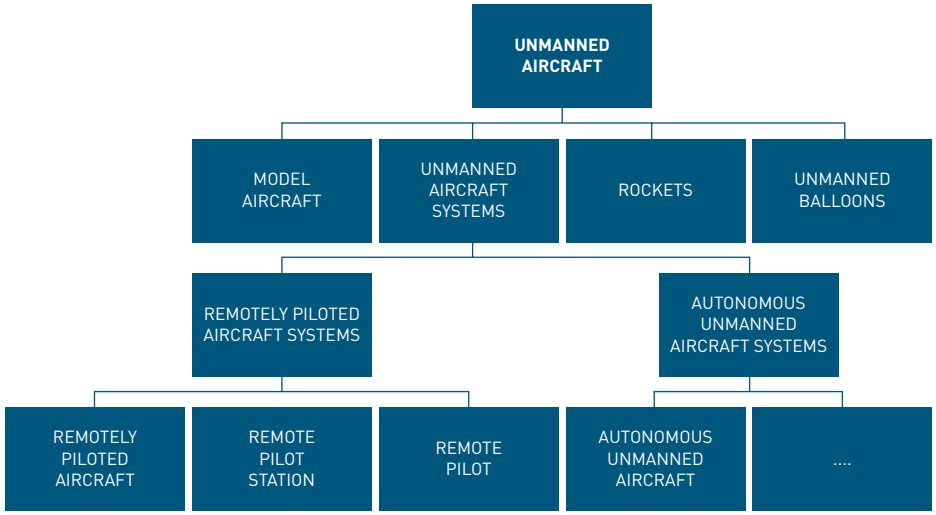

Figure 1 - Example Hierarchy of Terminology

Clarification of the following terms should be considered a *high* priority issue as they are foundational to the classification of UAS and in turn the requirements on their design, manufacture, maintenance and operation.

9. *Autonomy* – The concept of *autonomy* is paramount for distinguishing between a *remotely piloted aircraft* and the CASA notion of a *fully autonomous UAS*. Whilst a definition of an *autonomous operation* has been provided (see *AC 101-1 General*), it has not been related to the definitions of a *remotely piloted aircraft* or a *fully autonomous UAS*. It is also noted that ICAO defines an *autonomous aircraft*. It is recommended that the notion of a "fully autonomous" UAS be changed to an autonomous UAS or autonomous unmanned aircraft, as defined by ICAO and CAP722. The meaning of autonomy, as used in the CASA ACs needs further clarification. In particular, what level of autonomy distinguishes a *remotely piloted aircraft* from an *autonomous UAS*? In what system functions is this level of autonomy relevant? In addition, a *remotely piloted aircraft* could be considered an *autonomous UAS* (*i.e.*, is conducting an autonomous operation) under certain failure conditions or phases of flight (*e.g.*, communications loss), discussion should be provided as to whether the classification of the *remotely piloted aircraft* changes under such circumstances.

   It is strongly recommended that the concept of *Autonomy* be clarified. It is a key discriminator in the regulation, as significant as the distinction being made between model aircraft and UAS. Further work into the meaning of autonomy is needed.

   Some guidance may be found in the coming update to UK CAA CAP 722. Further, there is existing research into the meaning of autonomy (ARCAA, BR&TA, and AOS), which should be explored.

10. *Aerial Work* – CAR 1998 Part 1 (2)(7B) sates that all unmanned aircraft operating in accordance with CASR Part 101 are considered to be performing Aerial Work. Further, in Section 8 of *AC 101-1 General* it is stated that: *"RPA are flown for air work that includes commercial activities (for hire and reward), training, research and development, company internal operations, air tests, exhibitions and demonstrations. This is the interpretation of sub regulation 101.235 (1) of CASR 1998 and has been applied."* The AAIF believe this to be a poor interpretation of CASR 101.235(1). This interpretation is not consistent with the concept of aerial work used in the regulation of conventionally piloted aviation, which distinguishes aerial work from private, training, research and development, company internal operations, air tests, exhibitions and demonstrations. It is on this basis that the draft ACs make the statement that all UAS operations will require an UOC. This is in conflict with CASR 101.270 which states that the requirement for a UOC is if the UAS operation is conducted for *hire or reward*. The requirement put forward in the AC is also in stark contrast to how the requirement for an Operators Certificate is mandated for conventionally piloted aviation. It is an example of a one-size-fits-all approach to the regulation of the UAS industry. It is the position of the AAIF that:

    Not all UAS operations should require the operator to hold a UOC (*e.g.*: high school students entering the UAV Challenge Competition)

The AAIF requests that CASA justify its position as to why all UAS operators should be required to have an UOC when this is over and above what is expected of conventionally piloted operations?

It is recommended that the:

a. blanket requirement for all UAS operators to obtain an UOC be relaxed; or
b. ability for applicants to seek an exemption/waiver from this requirement be included and guidance as to the type of operations which would be eligible for an exemption be included in the ACs.

NOTE: While this recommendation reflects the consolidated position of members it was the subject of robust discussion and it is not the view held by all members of the sub-committee.

11. *Line of Sight* and *Beyond Line of Sight* – further clarification of the meaning of these terms is required. It is noted that no reference to LOS or BVLOS is made in the current regulations. However, the draft guidance materials propose LOS / BVLOS as a key factor for determining the requirements applicable to a particular UAS operation. A clear definition of these terms is considered a *high* priority.
12. *UAV Control Station* – the definition provided unnecessarily restricts the concept of the ground element of a UAS. Specifically, the definition excludes ground-based **monitoring** and **control** elements of an unmanned aircraft system (*e.g.*, handheld radio control gear). Such elements must be considered part of the remote pilot station (See ICAO discussion on the criticality such elements have to the overall safety performance of the UAS). It is recommended that the less restrictive definition of a remote pilot station, as provided by ICAO, be adopted:

    remote pilot station – The station at which the remote pilot manages the flight of an unmanned aircraft.

The distinction between *Model Aircraft* and UAS has been made in terms of whether the aircraft is being operated for "sport and recreational purposes". The distinction is clear and unambiguous and should be used *consistently* throughout the advisory materials. However, as discussed above, this should not be the only basis used for determining requirements for UAS (*e.g.*, the requirement for a UOC). It should be ensured that this definition provides complete coverage of potential model aircraft and UAS operations (*i.e.*, there are no unmanned aircraft operations which fall within a gap in the regulation due to the definition used). Model aircraft regulations / MAAA apply only to aircraft with a maximum take-off weight ← 150 Kg. It is not explicit as to what happens to a model aircraft operator (*i.e.*, someone operating an unmanned aircraft for sport and recreational purposes) above this weight. By definition they are not considered an Unmanned Aircraft System as they are being operated for sport and recreation [see 101.030(2)].

It is also noted that, in accordance with CASR 101.400, a model aircraft can be operated above 400ft and outside of an approved area if it is kept in visual range and away from populous areas. Large model aircraft (*e.g.*, 25kg – 150kg MTOW) must be operated in accordance with additional requirements stipulated by the MAAA. These additional requirements include restrictions on where large model aircraft can be operated. However, small model aircraft not subject to the MAAA rules (*e.g.*, less than 25kg MTOW) can still be operated in accordance with CASR 101.400. Conversely, the operation of similarly sized UAS (*i.e.*, ← 25kg MTOW) are not allowed to fly above 400ft outside of an approved area. If the risks to people on the ground and on board other aircraft are largely the same, then why is there a difference in the requirements mandated on UAS over that of model aircraft?

It is recommended that the operational requirements for UAS be reviewed against those of the Model Aircraft industry. A consistent regulatory standard should be applied across both sectors and this should be based on the risks presented.

Where the operational risks are comparable, risk-informed regulation would suggest that both industries should be comparably regulated. However, it is acknowledged that commercial UAS operations are likely to attract additional regulatory requirements due to a difference in public acceptance of the risks.

2.2 SCOPE OF ADVISORY CIRCULARS

An issue considered of *high* priority are the changes to the scope of CASR101 implied through changes in the scope of terminology being adopted. In Section 2 of *AC 101-1 General*, it is stated that:

> *"The term Unmanned Aerial Vehicle will be replaced with the more correct terms of Unmanned Aircraft System (UAS) and Remotely Piloted Aircraft (RPA)."*

The scope of CASR101 would be substantially changed should the term Unmanned Aerial Vehicle be equated to a Remotely Piloted Aircraft (RPA) or Remotely Piloted Aircraft System (RPAS). Specifically, all UAS considered by CASA to be "fully autonomous" (*i.e.*, autonomous aircraft/UAS) would be excluded from the scope of the regulation and associated guidance material.

> **It is recommended that the existing concept of an "Unmanned Aerial Vehicle" be replaced/equated to the ICAO definition of an Unmanned Aircraft System (UAS) and not a Remotely Piloted Aircraft System (RPAS).**

In the same introductory section of *AC 101-1 General* it is stated that the scope of the ACs are specific to RPA. It is recommended that the scope of the ACs include *Autonomous UAS* (ICAO definition of *Autonomous Aircraft*). Many *Remotely Piloted Aircraft* could be considered *Autonomous* during particular phases of flight (*e.g.*, autonomous launch and recovery) or under abnormal circumstances (*e.g.*, automated recovery and emergency forced landing systems). It is acknowledged that there are additional considerations in the development and operation of *Autonomous UAS* over and above those for *Remotely Piloted Aircraft*. The majority of the guidance material is still relevant to the design, manufacture, maintenance, training and operation of *Autonomous UAS*. Therefore, it is recommended that the scoping of *AC 101-1 General* be rewritten, along the lines of:

> *"The ACs provide recommendations and guidance for the safe operation of Remotely Piloted Aircraft Systems (RPAS). It should be noted that nothing in CASR 101 or these ACs precludes the operation of autonomous UAS* [ICAO Cir 328 Definition]. *Guidance relating to the safe design, manufacture, maintenance, personnel training and operation of an autonomous aircraft will include additional considerations over and above those described in the current suite of advisory materials. An applicant should contact CASA at the earliest time possible to discuss requirements relating to the operation of autonomous aircraft."*

So as not to limit the applicability of the ACs and to be consistent with ICAO hierarchy of terminology, it is recommended that:

> **The ACs be written in the context of the highest order terminology (*i.e.*, in terms of Unmanned Aircraft Systems) unless guidance material is specific to Remotely Piloted Aircraft Systems, Remotely Piloted Aircraft or Autonomous Unmanned Aircraft Systems (see Figure 1).**

This is considered an issue of high priority.

The AAIF acknowledges that in the interim some operators may make use of Optionally Piloted Aircraft (OPA). Guiding comments along the lines of how OPA are viewed in relation to the CASR 101 regulations and the guidance materials should be provided. Critical will be providing clear and unambiguous definitions of an OPA and the "mode/condition" for when it is considered a manned or unmanned aircraft. As a minimum, CASA should state that CASR 101 and the associated guidance materials are applicable to OPA, to seek additional guidance from CASA, and define a placeholder for more prescriptive guidance in the future.

Finally, and similar to the comments made in relation to autonomous UAS and OPA, the guidance material should not preclude consideration of multiple RPA to a single RPS. As a minimum CASA should state that CASR 101 and the associated guidance materials are applicable to multi-UAS operations, to seek additional guidance from CASA, and define a placeholder for more prescriptive guidance in the future.

2.3 STYLE, PRESENTATION AND LAYOUT

The AAIF acknowledges that the ACs reviewed are still only in draft form and that some references are made to manuals of standards and revised regulations which have yet to be released. Acknowledging the above, the AAIF felt that many of the valuable points and key messages made in the ACs were lost primarily due to the clarity of the layout and style of presentation. It is felt that significant improvements to the advisory materials would be achieved if CASA engaged a professional writer.

The ACs made use of flow diagrams, which helped immensely to simplify large sections of the guidance material. It is recommended that further revisions of the ACs, particularly those that address operations and training versus certification, use graphical material, such as tables, diagrams and flow charts, as their prime means of conveying information. This is particularly important in view of the substantial proportion of non-aviation people wishing to operate RPAs.

The ACs assume that the reader has some background aviation knowledge. The unmanned aircraft industry is attracting many new entrants to the aviation industry; people who have limited or no prior experience in aviation. It is acknowledged that the ACs are not meant to be educational, however, we are dealing with a new and quickly evolving regulatory space and therefore, the AAIF believes that the ACs will inherently serve an educational function. It is highly recommended that the ACs be rewritten assuming the reader has limited to no knowledge of aviation regulation.

2.4 FOUNDING PRINCIPLES AND CONTEXT FOR REQUIREMENTS

The ACs endeavour to provide guidance across a diverse range of UAS types, operations, and operational environments. As stated, the rationale behind this guidance is the management of the risks to airspace users and the people overflown. However, the overarching goals of the regulation (*e.g.*, management of the risks to an equivalent level of safety and the interoperability within the existing airspace system) are not clearly stated upfront. Further, the linkage between the guidance material to these overarching objectives needs to be clearly established.

The AAIF believe that a presentation of these objectives and the definition of the different "risk regimes" providing the context for the different guidance/requirements should be established upfront. Further, these "risk regimes" or broad "classes of UAS operations" should be referenced consistently throughout all of the ACs. Further discussion is provided in Section 3.

To accompany these foundational paragraphs, the AAIF strongly recommends the use of a risk matrix/matrices/simple tables to establish the context for the guidance material (*i.e.*, establish the broad classes of UAS operations). This matrix does not need to be quantified but should be expressed in relation to different operational regimes (*e.g.*, populated, unpopulated, controlled, uncontrolled airspace, ← 400ft, *etc.*) and the complexity of the systems (*e.g.*, small, large, RPA, autonomous aircraft, multiple UAS operations, *etc.*). Illustrative examples are provided below in Figure 2. Such matrices would greatly simplify the different guidance/requirements on the diverse range of UAS operational concepts (*i.e.*, serve as an index) and help to put requirements in context with each other (*e.g.*, why different operations attract different requirements). It must be recognised that they will be viewed as the "de facto" approval classes whilst more prescriptive maintenance, certification, training and licencing classes (*e.g.*, formal type certification categories) emerge. Therefore, it is recommended that the statement that these matrices and the different risk regimes depicted serve as ***guidance only*** and are provided only to aid applicants with establishing the minimum requirements applicable to their system and intended operation.

	SMALL	LARGE		Restricted Airspace	Uncontrolled	Near Aerodrome	Controlled
Populated	A	B	← 400	A	C	E	G
Unpopulated	C	D	→ 400	B	D	F	H

Figure 2 - Example Matrices for establishing the de facto "approval classes"

2.5 THE RELATIONSHIP TO SAFETY RISK MANAGEMENT

As stated by CASA, and a requirement of ICAO, the policy, rulemaking and oversight processes related to UAS operations should be determined by a safety risk management process. The AAIF appreciates that additional guidance material specific to Safety Management will be provided as part of the final suite of guidance materials for UAS and that this guidance will reflect the common safety risk management strategy adopted by CASA.

As a general comment across all ACs, the connection between the safety risk management process with the 1) proposed guidance materials and 2) proposed activities of the UAS operator (*e.g.*, the submission of an area approval or application for a UOC) is lost. Specifically, the ACs fail to clearly articulate:

1. How the safety risk management process has led to the guidance material for different types of operations (*e.g.*, higher risk operations); and
2. How the safety risk management process and over-arching SMS feed into an operator's application for an UOC or Area Approval (AA).

It is felt that the partitioning of the operational/application space into classes (refer to Section 2.4 and Figure 2) would greatly help to address problem 1) above. High-level statements as to how a UAS operator should undertake the application for an UOC or AA should specifically include the relationship between the initial undertaking of the safety risk management process AND the refinement of operational procedures and practices as an output of the ongoing safety risk management process (part of the organisation's SMS). This is further discussed in Section 5.

2.6 CONSISTENCY WITH REGULATIONS

The approach adopted by CASA where guidance materials are developed prior to regulations is viewed by the AAIF as a good strategy for affecting regulatory change in a timely manner. It also allows the industry and regulator to use experience to progressively refine the regulatory strategy for the UAS sector before it is enshrined in regulation.

> **The AAIF strongly supports the approach of developing guidance materials ahead of further changes to the regulations.**

It is acknowledged that this approach is not without its disadvantages and in particular, circumventing potential challenges arising due to disparities between the guidance material and current regulations. It is recommended that CASA provide some information as to the direction of the regulations/guidance material for UAS within *AC 101-1 General*. This information should establish where the current revision of the guidance materials sits in relation to the longer-term plan to revise the regulations. A statement along the lines of the following should also be included:

> *UAS operations are currently approved on a case-by-case basis. Timely approval of an application for UAS operation is more likely to be achieved if the application follows the guidance material provided in these ACs.*

The ACs made numerous references to CASRs and CARs. This was very beneficial for providing a linkage to the "head of power" for a number of the requirements made within the draft ACs. However, some cited regulations were either not relevant to the statements being made within the ACs or were referenced in the wrong context (*e.g.*, as a head of power when they weren't). It is acknowledged that the draft ACs are precursor to a revision of the regulations, however, the consistency of citing should be carefully reviewed, especially if they are being used in the context of justifying guidance or requirements made within the ACs.

As the ACs are likely to serve as a guide to future changes to the regulations, it is recommended that CASA reviews the usage of terminology such as *must*, *should*, *shall*, *could*, *may etc*. to ensure the appropriate intent of any implied requirements.

3. REVIEW OF AC 101-1(1) GENERAL

3.1 GENERAL COMMENTS

AC 101-1 General is a valuable addition to the suite of advisory materials. The intent of the circular is to provide:

- an introduction to UAS (*i.e.*, statement of scope, their definition and background);
- the founding principles and rationale supporting the regulation of UAS (*i.e.*, the overarching safety objectives, priorities, and underlying principles adopted, *etc*.);
- the current regulatory framework put in place to manage the risks (*e.g.*, the current scope, the "regulatory components", the individual ACs and how they relate to achievement of safe UAS operations);
- a statement of CASA's direction/plan for the regulation of UAS and how the current advisory materials fit into this plan;
- the regulatory process (*e.g.*, stages, administration, fees, and the need to engage with CASA early, *etc*.).

However, it is felt that not all of the above elements were comprehensively addressed in *AC 101-1 General*. Key "scene setting" information was also missed. The following sub-section describes some of the higher level issues. Detailed lower-level issues are summarised in Table 2.

3.2 LAYOUT AND PRESENTATION

The UAS industry is attracting people from a diverse range of backgrounds, many of whom have limited to no knowledge of UAS, aviation systems or the principles behind the regulation. *AC 101-1 General* would be greatly improved if the content, presentation style and structure of the document were reviewed on the assumption of an audience that includes individuals with no prior aviation knowledge. Much of the needed high level and introductory content can be found in the ACs, however, it should be consolidated into the *AC 101-1 General*. The AAIF recommends the following content and structure be used to guide the revision of *AC 101-1 General*:

A. Statement of definitions common to all ACs (refer to discussion provided in Section 2.1).
B. What are UAS, what differentiates them from model aircraft, the different classes and types of UAS (*e.g.*, RPA and autonomous aircraft).
C. The basis for their regulation – *i.e.*, ICAO requirement for CASA to appropriately manage the risks associated with UAS operations.
D. Provide high level statements of the guiding requirements on the regulation of UAS:
    a. State the expectation that UAS exhibit, as a minimum, an equivalent level of safety to that of conventionally piloted aviation with respect to the level of risk they pose to people on the ground and on-board other aircraft.
        i. This requirement should be substantiated (*e.g.*, guidance on the qualitative/quantitative expression of the equivalent level of safety objective).
        ii. Link to responsibility as per CASR 101.055
    b. State the expectation that UAS should operate seamlessly within the existing airspace system. Specifically, that from the perspective of Air Traffic Service provider and other airspace users, a UAS should behave and appear no differently to that of conventionally piloted aircraft.
        i. This requirement should be substantiated (*e.g.*, will need to meet the same communication, navigation and surveillance performance requirements as any other aircraft operating in a given class of airspace, *etc*.)
        ii. Include relevant content from the existing section titled "Air Traffic Control" in *AC 101-1 General*.

c. Unless there exists a justifiable safety argument, regulations should not impose constraints or restrictions on the UAS industry that are above and beyond that of comparable conventionally piloted aviation operations.

E. Current regulation of UAS operations

a. CASA must develop and promulgate regulations and provide industry oversight to meet the high level objectives. As mandated in ICAO SARPS, a safety risk management process must guide the policy, rulemaking and oversight activities that are undertaken by CASA.

b. Scope of regulations for UAS:

i. Remotely piloted aircraft, autonomous unmanned aircraft and optionally piloted aircraft (refer to discussion provided in Section 2.2)

ii. State Registered Aircraft/ VH Tails (move discussion from AC 101-5)

c. The development of more prescriptive regulations for UAS is an ongoing activity. In the absence of more prescriptive requirements, CASA has adopted a safety outcome-based approach towards the management of the risks associated with UAS operations. Foundational to this approach is a safety risk management process, which serves as the primary input to the establishment of a safety case for a proposed UAS operation. These safety cases are assessed by CASA on a case-by-case basis. The safety case should encompass all of the key elements necessary for the safe operation of a UAS, specifically requirements in relation to the:

i. Training and licencing of personnel (AC 101-4)

ii. Operation of the UAS (AC 101-5)

iii. Operator's system of maintenance and the ongoing airworthiness of the UAS (AC 101-6)

iv. Design and manufacture (initial airworthiness) of the UAS (AC 101-7)

v. Operator's Safety Management System (AC 101-8)

d. The AC's listed above provide guidance to a UAS operator on how to establish the safety case for UAS operations.

e. It is recognised that there are a diverse range of UAS and potential concepts for their operation. It is clear that a one-size-fits-all approach for such a diverse range of systems will not result in an effective management of the risks. Based on the operational safety risks, CASA has established some broad classes of UAS operations to aid both UAS operators in determining the minimum requirements on a UAS operation. This broad classification is intended to also aid CASA Field Officers in the consistent and systematic assessment of the diverse range of safety cases presented by UAS operators.

[BROAD CLASSIFICATION OF OPERATIONS]
(refer to discussion provided in Section 2.4)

f. The above classifications are intended to be used as a ***guide only*** and should not be considered as type certification categories. Key concepts in this classification include:

i. Populous areas

ii. Autonomy

iii. Line of sight and beyond line of sight

iv. Aerodromes

(refer to discussion provided in Section 2.4)

g. A statement along the lines of: Whilst safety technologies and more prescriptive standards on the airworthiness of UAS are being developed, the majority of the risks associated with UAS operations will need to be managed through restrictions on where and when different types of UAS can be operated. Initially, UAS operations will be limited to approved areas or conditions as stipulated in an UAS Operator's operations manual. The approval can be progressively widened as the design, procedures and supporting frameworks of an operator mature through operational experience. Ultimately, a mature UAS operator may be given approval to operate outside of any pre-defined operating area.

h. In conjunction with industry, CASA's long-term goal is to develop a regulatory framework that will ultimately allow UAS to routinely operate alongside other aircraft and over populated areas. CASA also recognises that not all UAS will require such freedom of operations and subsequently, the regulations will need to be tailored. This tailoring will be based on the level of risk associated with the different concepts of operation.

i. Include discussion/statements on how the current guidance materials relate to the regulations and the ongoing development of regulations (refer to discussion provided in Section 2.5).

F. Administration

a. Include information/discussion about the administrative process. Need to engage CASA early, *etc*.

b. Include statement here about following guidance material as the easiest path to approval (refer to discussion provided in Section 2.5).

c. A flowchart of the high level process for gaining approval.

d. Legal obligations.

G. Oversight

a. CASA considers UAS as it does any other sector of the aviation industry and therefore, it will be subject to oversight, surveillance, and enforcement. This can include…

b. Enforcement.

H. Scope of CASA Responsibilities

a. As per t*XXXCivil Aviation Act 1988*, CASA's jurisdiction extends only to the safety of aviation.

b. An applicant will need to engage with local, state and federal stakeholders to determine non-safety related requirements on the operation of UAS. This may include:

i. Frequency and Spectrum Management – Will need to consult with ACMA about the usage of different frequency bands. More information can be found here [insert link]. It is important to note that guidance provided by ACMA will only relate to compliance to radio frequency band allocation and licencing. The properties of the communication system (*e.g.*, coverage, availability, security, resilience to interference, bandwidth, redundancy, *etc*.) that can influence the safety of a UAS operation will need to be considered within an operator's safety case.

ii. State-based legislation relating to the fitment of spraying equipment [insert reference].

iii. Noise abatement – reference to policies in relation to privacy and noise?

iv. Local government requirements in relation to access to operating areas (*e.g.*, closure of roads, access to local government property, *etc*.)

c. Insurance

i. Include the statement in relation to the need for insurance

d. ATSB Accident and Incident Reporting

i. CASA requirements

ii. ATSB additional requirements under the Transportation Safety Act and reference/link to further information.

It is recommended that the below sections be moved to the relevant ACs:

1. Training and Licensing
2. Maintenance and Continuing Airworthiness
3. Manufacture and Initial Airworthiness
4. Roadmap to UAS Operations
5. Meteorological Conditions
6. Operations over populous areas
7. Documentation

Detailed comments made in relation to the draft AC 101-1(1) are included in Table 2 of Appendix A.

4. REVIEW OF AC 101-4(1) TRAINING AND LICENSING

4.1 GENERAL COMMENTS

The Training and Licensing section is a more mature document, reads well and is relatively easy to follow. In general, detailed information should be included in the Manual of Standards and not in the AC.

The AAIF believes that an overarching statement is required, which ties to the high level requirements presented in *AC 101-1 General* and discussed in Section 3.2 of this document. More specifically, training and licensing for UAS should closely follow existing aviation requirements with necessary adjustments for the unique aspects of UAS.

We note that CASA do not consider private and recreational UAS activity and hence the AC is necessarily focussed on commercial operation only. Whilst we are not objecting to this approach it does differ from the current situation with manned operations and removes the PPL element and private operations from UAS regulations leaving all operations under the Air Work category of operations. If this is the intent the AC should state this logic as this provides good guidance as to how UAS operations will be approached from prior experience.

It is recommended that:

> **The existing CASA-defined roles of launch, flight and supervising controller be removed. The AAIF believes that these are "roles" performed by a Pilot in Command and a Remote Pilot.**

How many people are required to perform the roles/functions of a Pilot-In-Command and Remote Pilot will depend on the size, complexity of system, its operation, and the underlying safety case. For many UAS operations the roles of Pilot-In-Command and Remote Pilot can potentially be performed by the same person (*e.g.*, small multi-rotorcraft, Heron and MQ-9 Reaper). Therefore, it is recommended that:

> **The guidance material make no restrictions on the minimum number of people required to perform the roles of Pilot-In-Command and Remote Pilot. Instead, the minimum number of people required to perform these roles should be determined by an operator's assessment of the safety and the complexity of their intended operations.**

Clarification is needed as to the scope of formal training and licensing and how these relate to the formally defined (ICAO) roles of *Remote Crew, Pilot-in-Command* and *Remote Pilot*. *i.e*. Who does CASA wish to regulate and what role guidance should be provided? AAIF proposes that CASA consider the formal training and licensing only in relation to the *Remote Crew Member* as defined by ICAO:

> *Remote Crew Member – A licensed crew member charged with duties essential to the operation of a remotely-piloted aircraft, during flight time.*

The Pilot-in-Command (PIC) is always responsible for the safe operation of the platform, including the actions of the remote pilot. Our recommendation is that only two roles require formal regulatory oversight (as a *remote crew member*):

1. the Pilot In Command; and
2. the Remote Pilot.

Those roles not subject to formal training and licensing should be explicitly defined in relation to the ICAO definition of a *Remote Crew Member* (*e.g.*, Non-Remote Crew Members). Such roles need to be acknowledged by CASA as contributing to the safe operation of a UAS however, the qualifications, training, and competencies and how these roles interact with the members of the remote crew (*e.g.*, the PIC and Remote Pilot) will be determined by the nature of the UAS operations. The AAIF believes that it is more appropriate for these roles to be stipulated in the Operator's Operations Manual (OM) and that any required competencies and training for these roles be determined by the safety case specific to the operator. The requirement for an operator to nominate qualifications, training, competencies and interactions with the PIC and Remote Pilot for these roles in their operations manual should be stipulated by CASA.

The position and role of the Chief Pilot (CP) is not covered in the series of AC's. The AAIF believes that a CP is required for some UAS operations and that the requirement for a CP should be included in one of the AC's with reference to UOC Nominated Key Personnel (*i.e.* major post holders as listed in AC 101-1(0) 10.3). The AAIF do not believe the requirement for a CP should be based on the number of aircraft types operated by the organisation. However, the AAIF was not able to reach agreement as to what the requirement to have a CP should be.

One position is to follow the same requirement for conventionally piloted aviation, whereby any organisation performing Air Work is required to have a CP. However, it was noted that under current regulations, which state that all UAS are considered to be performing Aerial Work, this position would mean that all organisations would be required to have a CP. Changes to the definition of Aerial Work would be needed.

The second position acknowledges that it would be unrealistic to expect small commercial operations (*e.g.*, such as small multi-rotor, below 400ft, within VLOS and away from populous areas) to have to employ a full time CP because they operate more than one type of multi-rotor UAS or they are deemed as performing Air Work. Instead the requirement for a CP needs to be tailored and this tailoring could potentially be based on:

- Particular UAS "operational classes" (*e.g.*, based on complexity of operation, airspace operated in, and risk); or
- A certain size of commercial UAS operation.

The minimum requirement for a CP requires further discussion with CASA and industry.

Based on the above discussion, it is recommended that the AC should be re-structured into two sections: 1) formally regulated roles (*i.e.*, Remote Crew Members: PIC, Remote Pilot and Chief Pilot) and 2) guidance only roles (*i.e.*, Non Remote Crew Members). Guidance as to the structure and content of these sections of the AC is provided in the following sub-sections.

4.1.1 GUIDANCE RELATING TO FORMALLY REGULATED ROLES (REMOTE CREW MEMBERS)

Making use of hierarchical headings, include all of the information relevant to the training and licensing of *Remote Crew Members* under a single heading. This section should:

A. Provide a clear description of the members of the *Remote Crew* subject to formal training and licensing:
    a. Pilot in Command, Remote Pilot and Chief Pilot
    b. It is noted that ICAO definitions consider the *RPA Observer* to be a member of the *Remote Crew* and therefore subject to the formal training and licensing requirements of CASA.
    c. The AAIF recommend that the training and licensing of the RPA Observer be considered as a *Non-Remote Crew Member*. As such, the competencies, training and currency requirements relating to an *RPA Observer* should be determined by the safety case of the operator. With that said, the importance of the role of the *RPA Observer* (and other non-formally regulated roles) should not be understated. The *RPA Observer* can be a critical part of an operator's safety case for managing mid-air collision risk. The importance of this role should be clearly stated in the AC.
    d. It is recommended that the RPA Observer be changed to the broader concept of a *UAS Observer* (role is currently restricted to RPA only).

B. Make use of diagrams to show the relationship between:
    a. The different roles described above, and
    b. The formal qualifications/levels and the electives.

C. Make a better distinction between electives and the formal levels of training and licensign.

D. How electives can be added to a level.

E. Remove **ALL** detail in relation to the training standards from the AC. These should be included in the Manual of Standards (MOS).

F. A level of Crew Resource Management (CRM) training should be required for any size of operation.

4.1.2 GUIDANCE RELATING TO NON-REMOTE CREW ROLES

Making use of hierarchical headings, a second section on the training and licensing of non-remote crew roles should be provided. The AC should provide some guidance on what the range of roles are (*i.e.*, roles the operator should consider in putting together their operation), and the competencies that should be considered. However, the specific training of the *Non-Remote Crew Member* roles should be defined by the UOC holder, and the individual approved/authorised by the UOC holder. Detailed information is not required and should not be included. But statements on the minimum information that needs to be provided in the Operators' OM should include the need to document the:

A. Minimum competencies for the performance of the individual role.
B. Medical requirements (if any).
C. The training provided and who provided it.
D. Details of "team-level" training (*e.g.*, CRM, communications, handling of abnormal operations, *etc*.).
E. Records of training and experience.
F. Training course details, including syllabus and admin requirements, should be included in the operations manual of the UOC for CASA review (similar to current CAR217 training organisation requirements).

It should be clearly stated that non-remote crew roles, although not formally regulated, can play an important role in the safe operation of a UAS. The onus is on the UAS operator to show (through their safety case) that the level of competency, training, and currency of personnel in non-regulated roles is acceptable. This must be clearly stated in the AC.

Detailed comments made in relation to the draft AC 101-4(1) are included in Table 3 of Appendix A.

5. REVIEW OF AC 101-5(1) OPERATIONS

5.1 GENERAL COMMENTS

A lot of information was presented in AC 101-5(1) however, the structure of the document and the style of presentation made a comprehensive assessment of its content almost impossible. The document lacked a logical structure (progression or flow). It was difficult to clearly ascertain what guidance material related to what operation. It is recommended that the document be restructured and a recommended structure and possible content is provided in Section 5.1.2 of this document.

The need for a restructure largely arises due to the diversity of UAS and potential operational concepts that need to be covered by the guidance material.

> **It is highly recommended that the ACs reduce/simplify this operational space by proposing classes (refer back to discussion presented in Section 2.4 of this document).**

A table or diagram, with references to section headings within the AC, should be presented. In so doing, an applicant can use their proposed operation as an index to the guidance material. It also puts the guidance material applicable to one category of operation in context with the guidance material for other categories of operation (*e.g.*, higher/lower risk operations). The tables included in Appendix B of this paper provide a good example of how tables can be effectively used to simplify requirements specific to different UAS operations.

The consistency of terminology and how it is related to the regulation remains a significant issue in this AC. Multiple terms are used to describe the same concept and many terms remain undefined. A clear hierarchy of terms is required and context for their usage needs to be consistent with the scope of the term. The AAIF also recommends a review of the use of terms: must/shall/should/may *etc*. against the intent of the guidance material as an implied requirement.

Clear guidance on the rules of the air applicable to UAS is not provided in the AC. For example, over-arching statements as to how a UAS should operate in different airspace environments (some guidance is provided for operations in controlled airspace but these are ambiguous). Should a UAS fly at VFR cruise levels? Should UAS break right in a potential collision situation? In summary, where is the linkage to requirements such as "see and avoid", right of way and the general rules of the air? It must also be noted that CASR 101.020 states that Parts 4, 4A, 4B, 4C, 5, 7, 9, 10, 11, 12, 13 and 14 of CAR 1988 do not apply to UAS. These Parts include requirements that a pilot "see and avoid" and "remain well clear" of other aircraft.

> **As a matter of high priority, the revision of the ACs should make explicit the general rules of the air that are applicable to UAS.**

On the issue of completeness, there is limited guidance relating to the operation of UAS outside of controlled airspace (particularly for UAS operating under VFR). The information that is provided is lost within a number of sub-sections of the AC. As recommended above, the structuring of the document around discrete "operational classes" would help to resolve this issue.

Initially many UAS operations will be permitted under an Area Approval (AA), for flights below 400ft and away from populated areas. Key to the safety case for such operations is ensuring containment to the intended operating area. The issue of assuring containment has not been adequately addressed in the current AC.

> **The AAIF recommends that a distinct section discussing the need to consider the ability to ensure containment of a UAS operation be included in the AC.**

This section should also provide guidance as to how assurance of containment can be demonstrated (*e.g.*, procedures, margins, technologies, *etc*.) as part of the safety case and should also include guidance as procedures for handling a loss of containment. Should an adequate safety case be established, operations above 400ft and/or over populous areas should be achievable under the regulations/ guidance material.

Related to the previous comment, more information is also required on Automatic Recovery Systems and Flight Termination Systems. The two are distinct systems and this distinction is not made in the AC.

CASR 101.270 says that a person can operate a UAS for hire or reward only if they hold a UOC. The definition used by CASA in the ACs appears to be related to non-sport and recreational operations (*e.g.*, all but model aircraft), and not hire and reward. Discussion on this matter has been presented in Section 2.1.

Other considerations, such as noise abatement and the broader right to privacy should be included in AC 101-5. Specific guidance may not be required but references to responsible authorities and possible practices should be provided.

5.1.1 AC 101-5 IS ABOUT ESTABLISHING A SAFETY CASE

As the title of this sub-section indicates, the main purpose of the AC is to provide guidance to a UAS operator on how they can establish the safety case for their intended operation.

The focus of the draft of AC 101-5 Operations is clearly on the technical measures that can be used for mitigating the risks of UAS operations. There is limited discussion of possible ***operational*** strategies that may be adopted by the operator to help manage the risks. Guidance is needed. For example, "… in selecting an area of operations, the UAS Operator should consider the: number, distribution and type of air traffic utilising the airspace; the CNS equipage of these users; and the pattern of airspace utilisation (time and space). For initial approvals, airspace should be of low number and density of operations." The level of guidance on how to establish a safety case for UAS operations is considered inadequate. This is largely due to the absence of such practical guiding statements (as above), for all of the different categories of UAS operations. As stated previously, the guidance that is provided does not cover all possible operational environments and UAS types. A "shopping list" of considerations, by category of operational area, would be a valuable annex to the AC.

It is acknowledged that the regulation of UAS should be outcome based, and therefore, any guidance provided should not prescribe how the safety case is achieved but rather what factors should be considered in the preparation of the safety case.

The relationship between the safety case and the documentation required for an application for an UOC or AA is not clearly established within the AC. It is recommended that a clear statement of how the safety case relates to the requirements on the UAS operator (*e.g.*, the preparation of an application for an UOC or AA) be provided in the introductory sections of *AC 101-5 Operations*. Further, this statement should be clearly linked to the overarching requirements for an equivalent level of safety and for seamless operations of UAS (*e.g.*, refer to Sections 2.4 and 3.2 of this document). This is taken into consideration in the proposed restructuring of the AC 101-5 operations as provided in the following sub-section.

5.1.2 RECOMMEND RESTRUCTURING OF AC 101-5(1) OPERATIONS

Many of the issues identified stem from the *readability* of the draft AC. These issues could be addressed through a simple restructuring of the document and a clear statement of the foundational principles upon which the regulation of the operation of UAS is to be based. The following is a suggested structure for a revised AC. It includes some guidance as to the content of different sections. To note is the use of hierarchical sections/headings.

A. Introduction – high level risks that need to be managed and the need for seamless integration – re-state the objectives (as done in *AC 101-1 General*, refer to Section 3.2 of this document) but provide further information on their substantiation, specifically:
    a. The expectation that UAS exhibit, as a minimum, an equivalent level of safety to that of conventionally piloted aviation with respect to the level of risk they pose to people on the ground and on-board other aircraft.
        i. This requirement should be substantiated (*e.g.*, guidance on the qualitative/quantitative expression of the equivalent level of safety objective)
        ii. Reference to CASR 101.055 – hazardous operations.
    b. The expectation that UAS should operate seamlessly within the existing airspace system. Specifically, that from the perspective of ATS providers or other airspace users, a UAS should behave and appear no differently to that of conventionally piloted aircraft.

i. This requirement should be substantiated (*e.g.*, will need to meet the same communication, navigation and surveillance performance requirements as any other aircraft operating in a given class of airspace, *etc*.)

ii. Include relevant content from the existing section titled "Air Traffic Control" in *AC 101-1 General*.

c. Unless there exists a justifiable safety argument, regulations should not impose constraints or restrictions on the UAS industry that are above and beyond that of comparable conventionally piloted aviation operations.

B. Regulation of UAS operations

a. Goal is to be able to permit routine operations alongside other aircraft and over populated areas. Those UAS operations over populous areas and alongside other aircraft in non-segregated or high-use airspace will logically attract more regulatory "rigour" than those that are not.

b. It is also recognised that not all UAS require seamless operation alongside other aircraft in all classes of airspace or over populous areas. Thus, some form of tailoring of operational requirements to the different types of UAS operations commiserate to the level of associated risks, is required.

c. Currently, the UAS operations are assessed on a case-by-case basis. This assessment is made on the basis of the safety case established by the UAS operator. Guidance as to what should be considered as part of this safety case is included in this AC.

d. The safety case is a necessary input to the application for a UOC or AA. It also drives the design objectives, procedures, and practices that are documented in an organisation's OM, MM, FM, *etc*.

e. The guidance as to the safety risk management process, which is the primary input to the establishment of the *initial* safety case for a UAS operation, is provided in AC 101-8 Safety Management System (SMS).

C. Introduce the components for obtaining an approval to operate

a. UAS Is not a model aircraft – professional industry

i. Some UAS excluded? E.g., micro/harmless etc.

b. Most UAS operations will require the UAS operator to hold an UOC

i. Conditions for when a UOC may not be required (refer to discussion in Section 2.1.)

c. Obtaining an UOC requires the operator to provide information relating to all aspects of the safe operation of their UAS:

i. Details of appropriate training/licencing (ref AC)

ii. An appropriately designed (ref AC) and maintained aircraft (ref AC)

iii. SMS practices in place (ref AC)

iv. Description of the general operations to be conducted, the identified risks and how they will be managed (Discussed in this AC)

v. ...

d. This information is documented in the Operations Manual, System of Maintenance, Flight Manual, Safety Management Manual, and ... *etc*.

e. The collection of documents is used to establish the safety case for a UAS.

f. An UOC will be issued to the UAS operator based on the acceptability of the safety case presented to CASA. The issuing of the UOC may include restrictions on the applicant's operations.

g. To operate outside these conditions will require the UAS operator to obtain an area approval.

i. Area approval is separate and additional to the conditions stipulated within the approved Operating Manual of a UAS operator.

ii. An AA an be short term, or long standing.

iii. An AA can be used as a step towards obtaining more relaxed general operating conditions defined within an UOC.

h. As well as under-pinning the safety case necessary to obtain an UOC or AA, a detailed safety risk management process is an ongoing part of the safety of the UAS organisation's operations. It runs in parallel for the

life of the organisation as part of the organisation's Safety Management System (SMS).

D. CASA may place a number of requirements on the operation of a UAS depending on the intended operations and the assessed risks. In general, these requirements relate to:
    a. The overarching goal for the seamless operation of UAS within the airspace system
        i. In general, UAS must meet the same CNS requirements as expected of a conventionally piloted aircraft operating in the same class of airspace and for the same conditions (*e.g.*, VFR/IFR).
    b. The general requirement to ensure an ELOS to conventionally piloted aviation;
        i. To simplify the guidance across the wide range of UAS operations for different UAS systems and potential operating environments, CASA has divided the UAS operations into ***X*** broad classes as described in *AC 101-1 General* (see Section 2.4 and Figure 2 of this document).
        ii. The following sections provide guidance with reference to the general classes as illustrated/defined above.

E. Operational requirements and factors that will need to be considered as part of the safety case (input to the application for an UOC or area approval)
    a. Operations over populous areas (i.e., Operational Classes X, Y and Z, FIGURE)
        i. Definition (scope)
        ii. Requirements for operation over populous areas
        iii. Technologies and equipment that needs to be considered in safety case (flight termination and automated recovery systems, *etc*.)
        iv. Reliability and relationship to design, *etc*.
    b. Operations above 400ft (i.e., Operational Classes X and Y, FIGURE)
        i. General considerations (technologies and operational procedures that should be considered in the safety case as part of the UOC or AA)
        ii. Possible equipage
        iii. Layered approach
        iv. Operational mitigations
    c. Operations near aerodromes (i.e., Operational Classes X and Z, FIGURE)
        i. ...
    d. Operations in CTA (i.e., Operational Classes Y and Z, FIGURE)
        i. Etc
    e. Operations in **....** (i.e., Operational Classes **....**)
        i. Etc.
    f. General Considerations
        i. Containment
            1. Describe why is it important? Essential to managing the risks to other airspace users and people on the ground. Containment is likely to be a key consideration in the assessment of a safety case for an AA or UOC
            2. Technologies/procedures for assuring containment
            3. Managing loss of containment
        ii. Considerations for Emergency procedures etc...

F. The Approval Process
    a. Introduction
        i. Provide a high level flow chart summarising the sequence and concurrent processes necessary to obtain approval and maintain safe UAS operations. Similar to that which is already provided but updated to show the feedback and approval processes, include the documentation inputs/outputs, the safety risk management process as an input to the development of the OM/MM/FM etc. and

their subsequent input to the issuing of a UOC. Concurrent and ongoing processes such as the SMS should also be illustrated.

b. The UOC
    i. What are they, when are they needed, what inputs are needed (e.g., documentation) to get one, considerations, administration, application, costs;
    ii. Make reference to the template UOC in Appendix of the AC;
c. Area Approvals
    i. What are they, when are they needed, what needs to go in them, considerations, administration, application, costs;
    ii. Make reference to the template UOC in Appendix of the AC;
d. Practical Considerations
    i. Time, engagement of CASA, templates *etc*.

G. Appendix
    a. Shopping list of items that should be considered in the safety risk assessment of UAS operations alongside airspace users and over populated regions.

H. Appendix
    a. Template UOC

I. Appendix
    a. Template Area Approval

Detailed comments made in relation to the draft AC 101-5(1) are included in Table 4 of Appendix A.

6. REVIEW OF AC 101-6(0) MAINTENANCE AND CONTINUING AIRWORTHINESS

6.1 GENERAL COMMENTS

The content of AC 101-6(0) Maintenance and Continuing Airworthiness is disappointing. The main body is short, general and prescriptive across the **entire spectrum** of UAS. The appendices appear to have been copied from manned operations and are extremely details, specific, and prescriptive. Appendix A of the draft AC is very much in checklist form that has been lightly tailored, if at all, to consider UAS requirements. Aspects unique to UAS are missed (*e.g.*, ground elements, communications, launch and recovery, *etc.*)

The AC only addresses maintenance activities and is silent on modifications and engineering oversight, a key component of continuing airworthiness. There is no linkage between the maintenance and continuing airworthiness requirements and the basis of the initial airworthiness determination and manufacturing requirements. The members of the review team propose that this AC be presented in a way that requires a strong linkage between initial airworthiness requirements, manufacturing requirements and standards, the overarching safety case and the system of maintenance and engineering change management that is required. Such a linkage, in particular the safety case, will allow the setting of an appropriate system of maintenance and engineering that addresses where the UAS sits in the broad spectrum of the UAS space. Figure 3 captures some of the identified factors that will influence the System of Maintenance and Engineering.

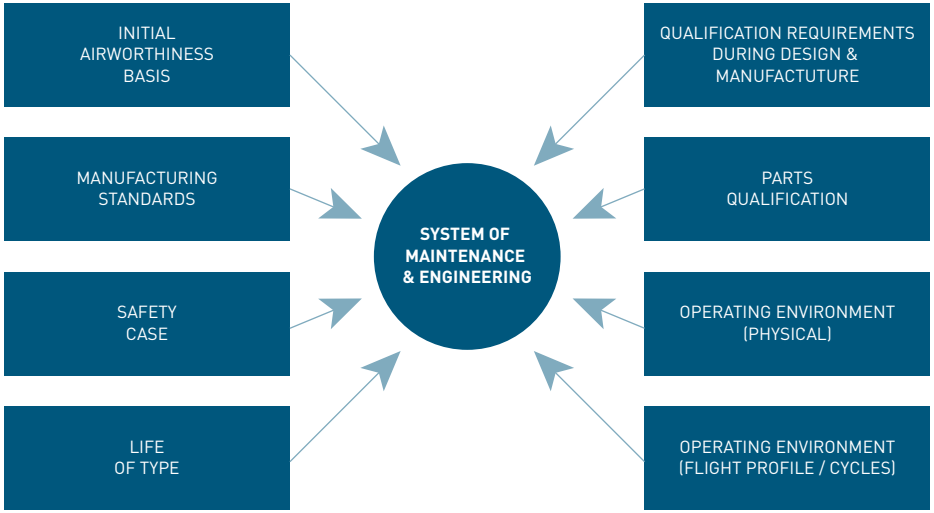

Figure 3 - Factors Influencing System of Maintenance and Engineering

The review team proposed that the guidance should reflect that where the UAS is operating in a high consequence regime the requirements for continuing airworthiness will be more prescriptive and approaching those of manned aircraft. Specifically, the requirements on the system of maintenance for UAS should be tailored in accordance with the risk and complexity of the operation. The "operational classes" as discussed in previous sections would provide a good starting point for this tailoring (refer to Section 2.4 of this document).

Logically, it would be expected that if a tailored version of FAR 23 or FAR 25 was used as the initial airworthiness basis then a tailoring of their equivalent continuing airworthiness requirements would be proposed. Equally, a smaller, less prescriptive continuing airworthiness program would be proposed for those

UAS operating in a low consequence regime. In all cases there should be a direct linkage between mitigations identified in the safety case that addresses high consequence or high risk elements and continuing airworthiness to ensure the integrity of the implemented mitigation.

Figure 4 seeks to show a cascading or flow down of requirements from the Safety Case to the Initial Airworthiness, to Continuing Airworthiness. In the conventionally-piloted aircraft case, a significant cascade or flow down has already occurred from Safety Case to Initial Airworthiness via regulations for specific classes of air vehicle.

Figure 4 - Requirement Flow Down

The AAIF Sub-Committee Review Team believes that given the broad spectrum of UAS solutions a sound understanding of this integral linkage of Safety Case, Initial Airworthiness and Continuing Airworthiness is essential and critical to ensuring appropriate and sound continuing airworthiness practices are put in place. Consideration of maintenance activities whose purpose is to support a desired life of type should also be identified. For those new to the aerospace industry, entering via the UAS segment, AC 101-6(0) should provide this requirement. While ACs are not typically education documents, given the nature of the UAS sector an exception is warranted. The AC should provide guidance on: the need for a system of maintenance; the components of a maintenance system; what skills, competencies, and licensing are required for these components; and how the maintenance system is developed.

The review team also noted that the information presented in AC 101-6(0) did not address unique UAS sub-systems, such as the data link infrastructure, remote pilot station, launch and recovery devices. It was also identified that it is possible to conduct maintenance on sub-systems while the air vehicle is in flight. Guidance should be provided as to whether this is acceptable and if it is then guidelines on how to assess potential consequences on the controllability of the air vehicle. The review team believe that this form of maintenance activity could be undertaken if the appropriate analysis was undertaken to ensure the overall safety of the air vehicle and the operation.

The AC should also present clear guidance on software configuration control specifically, and configuration management in general. Observation at the UAV Outback Challenge indicates that the UAS community are not coming from a manned aviation background and do not understand the implications of last minute configuration changes. In a world of regular software and firmware updates it is important that the auto-update mindset is not encouraged (e.g., Windows OS automatic updates).

There is a broad range of UAS parts available from those in the remote control hobby sector through to fully certified, traceable aeronautical parts from the manned sector. Market forces are unlikely to move parts manufacturers supplying at the lower end of the scale to higher and/or more formal standards. If it is the longer term desire of the Regulator to have such a move, then indications of that intent need to be included in this and other relevant ACs so that the industry can make appropriate plans and investment.

The issue of documentation and record keeping is a challenging one. There is significant evidence to suggest that continuing airworthiness assurance is best achieved by documenting all maintenance activities and recording sufficient data for reliability analysis. This could be a significant overhead on an operator of a UAS conducing operations in a low consequence regime, but a minimum standard / requirement should be considered. The guidance on data collection was

recognised, but more guidance on the type of data to collect would be warranted. The standard of publications, either self-generated or provided by OEMs, will also be challenging, with guidance being required to set a minimum standard for the UAS industry.

The review team also indicated that the AC should present guidance on the mindset and human factor differences between manned and unmanned aircraft in the context of continuing airworthiness. In particular, the experience within the review team suggested that the fact that no one is aboard the unmanned aircraft, consciously or not, changed the attitude towards maintenance activities on a UAS. This is a similar psychology to the disassociation effect of the remote pilot, compared to the response when the aircrew are physically on the air vehicle.

The review team also propose that the AC should set expectations on what documents should be included in a request for approval to operate and maybe more appropriately, what specific questions need to be addressed. It is proposed that the minimum standard would be a document that clearly linked the safety case mitigations to continuing airworthiness activities and requirements. There should also be wording that acknowledges the UAS pedigree and how that will be managed to ensure integrity of the safety case mitigations. The document should detail the proposed System of Maintenance and Engineering, and include the rationale. The rationale would be essential for the Regulator to gauge whether the UAS operator has the required understanding of continuing airworthiness.

The AC needs to address whether the system as a whole should be treated as an aeronautical product with a prescribed set of requirements, or whether the system can be broken down into sub-systems with levels of criticality each with their own requirements for documentation, skill/competency, licensing and testing. An example may be the air conditioner for the remote pilot station. Is this to be serviced by a regular air conditioning tradesman or a Licenced Aeronautical Maintenance Engineer? Primary to this determination is the impact of failure of that system and this type of thinking should be reflected in the submitted documentation.

7. REVIEW OF AC 101-7(0) MANUFACTURING AND INITIAL AIRWORTHINESS

7.1 GENERAL COMMENTS

This AC unfortunately falls well short of providing an applicant or CASA FOI staff with guidance on CASA's requirements for UAS initial airworthiness or manufacture.

From an '*initial airworthiness*' perspective, the AC does provide some general insight into criteria that might be germane to CASA's approval of a UAS design. However, there is insufficient information in the AC for either applicants or CASA FOI staff to apply the AC to evaluate a particular UAS design. In other words, an applicant could never present a design package to CASA that covered off on the issues identified in the AC, and be reasonably confident that CASA would find the package sufficient. Similarly, CASA staff could not use the AC as a means for pragmatically and consistently assessing a UAS design package. Instead, the AC merely lists some design issues that might or might not be relevant to a UAS design, and then states that the design element will be evaluated by CASA.

Guidance on design requirements should be tailored (*i.e.*, general guidance across the broad spectrum of UAS and their intended mission is unlikely to be useful). The classes proposed in earlier sections could be appropriate in this context.

From a '*manufacturing*' perspective, the AC provides no useful coverage. While one paragraph is dedicated to manufacturer/production approval in the AC, in fact the issues covered in the paragraph are not relevant to UAS manufacture/production at all. Rather, the information primarily consists of Instructions for Continued Airworthiness (ICA) requirements such as inspection, maintenance and checklist requirements. Each of these issues are related to the UAS design, not to manufacturer/production approval.

To overcome these shortfalls, a fundamental re-think of the AC is required. Importantly, the AC must define precisely how the design/manufacture of a UAS contributes to safety, since this will provide essential context to the remainder of the AC. It must clearly describe the design versus operational trade-offs that are possible with a UAS. For example, few design constraints are probably necessary for a UAS that will be operated solely in remote locations, whereas a UAS operating over densely populated areas will inevitably face more onerous design constraints. In other words, UAS that present a higher risk to the public will inevitably attract a higher level of prescriptive regulation. This would then lead into discussion on the role of a safety case (or, in extreme cases, perhaps a comprehensive Type Certification program) in supporting a CASA approval for a UAS design for a particular operating environment.

Once the above essential context has been presented at the start of the AC, the remainder of the AC can provide guidance to applicants and CASA FOI staff on how to evaluate the design of a particular UAS. It could retain the design elements included in the extant draft AC, but in each case it should provide guidance on how the design element should be tackled in the safety case. For example, it should guide the applicant on how the UAS operating environment and design features such as a flight termination system might affect the integrity required for a particular design element such as propulsion or electrical systems. Security requirements (*e.g.*, links, ground control station, data, *etc.*) should also be covered. The extant list of equipment requirements could still remain, albeit further guidance is required regarding what operating environments actually need the equipment, and what level of design integrity is required. Critically, the AC should differentiate between design requirements relating to airspace de-confliction/integration and those relating to the management of the risks to people overflown.

Then, since a safety case will inevitably be cornerstone to CASA's approval of the design of a UAS, the AC should define the scope and structure of a safety case, and provide pragmatic and comprehensive guidance on what CASA FOI staff will be looking for in the safety case. In other words, the AC should define CASA's 'pass mark' for a UAS safety case. This could be achieved through a quantitative

statement of the high-level safety goal as proposed for AC 101-1 and AC 101-5 of this document.

Finally, pragmatic guidance on UAS manufacture/production should be provided, covering the quality and conformance of the product to a design type. This guidance should be linked firmly to the above 'initial airworthiness' guidance, since the approval rigour for UAS manufacture/production should be commensurate with the integrity of the UAS design. That is, the manufacture/production approval requirements for a small low integrity UAS that will only be used in remote locations, will be substantially different to a UAS that will be routinely flown over major cities.

Detailed comments made in relation to the draft AC 101-7(0) are included in Table 5 of Appendix A.

8. CONCLUDING REMARKS

The AAIF has provided a detailed review of the draft Advisory Circulars. The ACs are a positive step forward in the direction of a comprehensive suite of advisory materials for the UAS sector. However, given the large number of issues identified in this review, the AAIF believes the ACs are some way off from being ready for release for broader consultation. This review has identified a number of critical issues. The guidance contained in the ACs reflects anticipated changes to be made to the regulations and as such, some of the "implied requirements" within the ACs need to be further discussed with industry.

The AAIF is committed to working with CASA and the Standards Consultative Committee to help address the issues identified.

9. APPENDIX A – DETAILED COMMENTS ON DRAFT ADVISORY CIRCULARS

9.1 DETAILED COMMENTS - AC 101-1(1)

TABLE 2 – DETAILED COMMENTS FOR AC 101-(1)

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
1	5, p.3	Definitions are inconsistent with ICAO definitions. E.g., autonomous operation definition in conflict with ICAO definition.	ALL definitions should be changed to ICAO definitions	✓			
2	5, p.3	Definitions not in alphabetical order	Put in alphabetical order				✓
3	5, p.3	Unused definitions (*e.g.*, Built in test, pre-flight inspection, flight/launch/ supervising controller)	Remove all unused definitions.				✓
4	5, p.3	Definition of "Evolution" includes undefined concepts of manual and autonomous control	These concepts are critical and should be defined.		✓		
5	6.2, p.3	The purpose of this paragraph is not clear. It also views UAS in a negative light "problem" and the final sentence does not make sense. The paragraph is restricted to only those operations in controlled airspace and over populous areas. What about other UAS operations in Class G and non-populous areas?	Remove this paragraph.			✓	
6	7.1, p.4	Good to include ICAO requirement.					
7	7.2, p.4	The concepts of manual and autonomous control are not defined. Scope is unnecessarily restricted to RPA.	See previous comments and recommendations.	✓			
8	8, p.4	The system of maintenance is not part of the UAS.	Remove statement		✓		
9	8.2, p.4	By definition of aerial/air work, not all RPA operations should be considered as being flown for air work. This is in contrast to existing definitions and precedence as used for conventionally piloted aviation. This is a poor interpretation of CASR 101.235(1).	Refer to previous discussion in relation to air work and UAS. Distinction between model aircraft and UAS should be made only on the basis of sport and recreation.	✓			
10	10, p.5	Consistent usage of terminology (*e.g.*, Operators' Certificate versus UOC)	Review AC for consistency with defined terms.			✓	

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
11	22.2, p.8	Key factors in determining "populous area" and the potential for harm to people on the ground is the performance of the unmanned aircraft under failure and the navigation information provided.	Include the performance of the unmanned aircraft under failure and navigation performance as factors to be considered.		✓		
12	22.1 & 22.2, p.8	The use of terminology such as "crash" and death portrays UAS in a negative light. For conventional aviation terminology such as incident and risk to people is used.	Update terminology to be consistent with terminology used for conventionally piloted aviation. Consideration for how the terminology used portrays the industry.			✓	

9.2 DETAILED COMMENTS - AC 101-4(1)

TABLE 3 – DETAILED COMMENTS FOR AC 101-4(1)

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
1	2.2, p.2	This paragraph is a copy and paste from previous ACs. States that the scope of the AC includes guidance on UAS operations *etc*. Scope of this AC is Training and Licensing.	Update introductory sections.			✓	
2	3.1, p,2	**The reference to** ACs 6 and 7 is around the wrong way					✓
3	4, p.2	Definitions are not listed in alphabetical order and include definitions not used in the AC.	All generic definitions should be placed in AC 101-1 General. Only those definitions specific to the AC should be included in that AC. List in alphabetical order.			✓	
4	5.1, p.3	"Cutting Edge Technology" statement does not really reflect UAS developments	Suggest it would be better to state "These systems are based on the rapid advancements in autonomous technologies flowing from Military developments being applied to civil aerospace. These developments will offer new and improved civil / commercial applications as well as potential improvements to the safety and efficiency of all civil aviation"			✓	

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
5	6, p.4 & 5	How do the remote crew defined by ICAO (*e.g.*, the remote navigator, remote pilot, remote engineer, described at the top of page 5) relate to the positions defined by CASA (*e.g.*, the supervising controller, launch controller and flight controller, *etc*).	A clear hierarchy of roles consistent with ICAO terminology should be provided. These should be presented in a hierarchy/tree diagram. Clear traceability of terms needs to be shown for: remote crew, non-remote crew, pilot-in-command, remote pilot, observer, *etc*. As discussed in previous sections, the CASA defined roles of supervising controller, launch controller and flight controller should be scrapped.		✓		
6	7.3, p.5	The diagram provided is not helpful. The relationship is not hierarchical (as depicted in the figure). The relationship is phased/sequential. *E.g.*, a level and then an elective. Roles that are not to be regulated by CASA should not be shown. Better explanation of the elective/core units and who they relate to is needed. This figure serves to confuse rather than simplify the guidance.	The relationship between the core units and elective units should be depicted as a sequential series and not a hierarchy. Sensor operators and ground crew should not be included if they are not part of the formally regulated *Remote Crew*. A separate diagram for *Non-Remote Crew* should be provided.		✓		
7	7.4 – 7.11, p.6	The levels are not explicitly defined before they are used. The requirements for a particular level are not clearly stated (e.g., do you need level one to be able to attain level two, *etc*.)	It is recommended that the "levels", the requirements for entry, and the operations they permit be summarised in a Table at the start of the section.			✓	
8	7.8, p.7	Nominating 75% is not based on any criteria or simulator fidelity. Manned aircraft pilots can conduct 100% of their training on a high fidelity simulator and be issued with an endorsement	This requirement needs to be further justified.		✓		
9	7.10, p.7	A Registered Training Organisation (RTO) accreditation is an external training certification for both the organisation and each individual course. It requires significant investment to both obtain and maintain. Whilst appropriate for flying training organisations with high student throughput, it would be beyond most operators to achieve or financially justify. Few, if any aviation companies or airlines maintain an RTO accreditation for their own training. Nor should it be imposed on UAS operators at this point of time.			✓		

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
10	7.11, p.7	Whilst the three levels of Remote Pilot qualifications seem appropriate there is not a natural alignment and read across to current manned aircraft pilot qualifications, as there should be. Level 1 should read across to PPL standard equivalent, Level 2 to Commercial Pilot Standard and Level 3 to ATPL. The Level 3 description in particular misses the mark and references an "international pilot qualification" that does not exist. If three levels are used, there should be recognised and easily regulated sub divisions defined with respect to the each of the levels. For example, for Level 2, some operators may want to operate close to airfields and/or above 400ft but not necessarily beyond visual line of sight. Therefore, they may not require the extra burden of IREX licensing .	Review against piloted aviation "levels".		✓		
11	7.11.4, p7	Competency, not hours should be the criteria for Licensing. A schedule of experience would be an appropriate alternative to nominating flight hour experience.	Change the requirement for minimum number of flight hours to competency-based requirements.			✓	
12	7 & 8, p7-9	A table of qualifications and requirements would be more helpful than the current block text format			✓		
13	9.1, p.9	Class 2 medical is considered acceptable however an exemption should be possible as the full range of physical requirements needed to safely pilot a manned aircraft are not necessarily required for UAS operations. For example, physical requirements (movement of limbs), physiological issues due to barometric requirements.	Include the provision for exemptions where equivalent safety can be demonstrated.		✓		
14	10.3, p.9	Guidance does not include the provision for military qualifications where the majority of UAS experience will come from for the foreseeable future.	The guidance should include provision to recognise Military UAS qualifications. Guidance should include nominating transitional arrangements.			✓	
15	11.1, p10	Refer RTO concerns at Item 9 7.10 comments Note Referenced Appendix 3 not supplied/reviewed			✓		
16	11.3, p10	The 5000' AMSL ceiling seems arbitrary without reason, OCTA should be sufficient	Justification for providing operational restriction should be provided – or related back to the risk regimes/approval categories described in *AC 101-1 General*. Refer to discussion in section 2.4.		✓		

ID	Ref	Comment	Recommendation / Solution	H	M	L	E
17	12, p.10	Appropriate however refer comments on use of simulators at Item 8 7.8. UAS simulators often exactly replicate real flight operations for a Remote Pilot hence appropriate to use as a currency in lieu of live operations. This is not dis-similar to manned aircraft simulator session is used to for meeting currency requirements.					
18	13, P10	Guidance does not include the provision to recognise Military UAS maintenance qualifications. This is where the majority of UAS experience will come from for the foreseeable future.	The guidance should include provision for recognition of Military UAS maintenance qualifications. Guidance should include nominating transitional arrangements.			✓	
19	14, p.11	CASA does not currently recognise, designate training or requirements for other crew of manned aircraft. Hence consistency should prevail and CASA should recognise these roles exist and support the safe operation of UAS. But should not specify training or requirements beyond requiring operators to do so in their ops manual.	Refer to general comments made in relation to clearly defining which roles should be formally regulated or not (Section 4.1)		✓		
20	15, p.12	Clarify scope - Requirement for qualified instructor for what roles? PIC/ Remote Pilot or other roles?	Include a statement as to the scope of the requirement for an instructor, *e.g.*, "The following requirements on the qualifications of an instructor would be favourably considered for all roles..., however, considered minimums for PIC/ Remote Pilots..."		✓		
21	15.2, p.12	Qualification criteria for RPA Instructors are defined not in terms of competencies.	Remove hours / years of experience criteria. Focus should be on competency, knowledge and ability to teach. Conditions should include: competency as a remote pilot, current and extensive knowledge on type, cert IV, test based on instruction ---- detail to be included in MOS. Note should also recognise existing manned aircraft instructors to satisfy this requirement.			✓	
22	16, p.12	Ref Item 18 13 comments. Recognition of Military qualifications could be covered off at the Clause.				✓	

9.3 DETAILED COMMENTS - AC 101-5(1)

Some of the below low level comments made in relation to AC 101-5(1) may not be relevant should general recommendations (as made above) are addressed.

TABLE 4 – DETAILED COMMENTS FOR AC 101-5(1)

ID	Ref	Comments	Recommendation	H	M	L	E
1	2.1, p.2	Reference to ACs is incorrect.	AC 101-6 is Maintenance and Ongoing Airworthiness and AC 101-7 is Manufacturing and Initial Airworthiness.	X			
2	3, p.3, par.1	Definition of an *Autonomous Operation* limited to pre-programmed segments of flight. Many UAS fly under autonomous flight plans when in emergency or degraded situations (Comms outage). Not necessarily pre-programmed. "Does not allow" human input. Is a highly autonomous system, this conflicts with usage of *autonomous operation* in the definition of UAV, which is used interchangeably with RPA.	Remove the inclusion of "pre-programmed" and "does not allow".		X		
3	3, p.3, par.4	Definition of C2 Link – does not encompass the coordination functions whereby the link acts as the VHF comms relay, inter-aircraft communications, or hand over between RPS.	Recommend including "communication and coordination" within the C2 link definition. I.e., C4 link.		X		
4	3, p.3, par.6	Unclear how manual control and autonomous control relates to the inputs/ commands from the remote pilot.	Definition and relationship between manual and the different levels of autonomous control needs to be specified.	X			
5	3, p.3, par.8	Line of sight is not defined. How does FPV fit? Who provides LOS?	Definition of LOS is required. This should be associated with the roles of personnel at different phases of mission.	X			
6	3, p.3, par.9	Pre-flight inspection is unnecessarily limited to manufacturer requirements. Pre flight inspection appears twice in list.	Recommend moving manufacturer specifications as sole source of pre-flight inspection.		X		
7	3, p.3, 11 and 12	Inconsistent distinction between categories of UAS. Large RPA/UAV are specified as launch mass, whereas micro UAS are specified in gross weight (actually gross mass). Is this the maximum take-off weight? Possible to have it fly with low payload and be at a different class.	Recommendation to adopt a common specification of delineation between categories. Specify in relation to a fixed (non changing) property of the UA. Define in relation to UA not UAS/RPA as it does not have anything to do with the capability/autonomy of the system.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
8	3, p.3, par.11	CASR does not make explicit that powered parachutes and lifting bodies are considered an UA/UAV. Could be implied that part encompasses these sub-types through CASR 101.030 (2).	Recommendation that power parachutes and lifting bodies be included as a type of UAS.			X	
9	3, p.3, par.14	Definition of populous area provides limited practical guidance as to what is "populous or not".	Provide some examples. Different definitions may need to be provided depending on the scope/envelope of the operation. E.g., a small quad-rotorcraft LOS operation vs fixed wing operation.	X			
10	3, p.3, par.15	*UAS Controller* is undefined. How does the *UAS Controller* relate to the launch, flight or supervising controller or the definitions of Remote Pilot, Remote Crew provided by ICAO?	Recommend removing existing terminology. Recommend putting in a clear statement of the relationship between the RPA Pilot and the different roles, at different phases of the operation (e.g., launch, recovery, evolution, autonomous operation, handover, *etc*.)		X		
11	3, p.3, par.15	How is *direct control* related to autonomous/manual control?	Clarification of control terms		X		
12	3, p.3, par.16	Can an RPA be operated autonomously (*i.e*., autonomous operation), if RPA is interchangeable with UAV then it can be as by definition an UAV can be "operated autonomously"	Clarification of the relationship between aircraft and operational modes (manually operated, autonomously operated, veto). For all modes of operation or just under normal modes of operation.		X		
13	3, p.4, par.2	RPA Control Station is limited in function to the control of the RPA	Recommend removing restriction on functionality. RPA Control Station can also be used for communications, command, control, coordination etc. all functions related to the safe operation of the UA.			X	
15	3, p.4, par.2	How does the RPA Control Station relate to the "Pilot Station" defined within the definition of *Unmanned Aircraft System*?	Use ICAO terminology and clarify relationship.		X		
16	3, p.4, par.7	The definition of UAV is circular, it refers to UAV.	Recommend changing to: A powered UA other than a model….	X			
17	3, p.4, par.7	Definition of UAV unnecessarily restricts types of UAS. It is possible to have UAV gliders.	Recommend removing "powered" to factor in UA gliders.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
18	4.3, p.4	CASR 101.020 states that CAR Parts 4, 4A, 4B, 4C, 5, 7, 9, 10, 11, 12, 13 and 14 are not applicable to unmanned aircraft. This conflicts with paragraph 4.3.	Check conflict between operational regulations.	X			
19	4.4, p.4	Potential conflict with this paragraph and the regulations. In accordance with CASR, some small UAS operations currently do not require approvals. Small UAS do not require area approval as per conditions of 101.250. Small UAS not for hire and reward, below 400ft, away for aerodromes and not over populous areas do not require an UOC (101.270 – "hire and reward").	Hire and reward is being used to delineate between UAS operational requirements – this is different to aerial work. Aerial work may include non-hire and reward activities. Recommend consolidating to one term. See previous comments in Section 2.4.	X			
20	5, p.5	Flow chart is a good inclusion however elements are missing. Where is the flight manual and the system of maintenance and why they are not shown as components that need to be developed in parallel and prior to the application for an UAS Operator Certificate?	Should include all missing elements necessary for a UOC application. Recommend feedback lines between boxes to show iterations and relationship between decision blocks (*e.g.*, CASA approval may require several iterations on the OM, FM, MM, *etc*.). The entire process may be iterative and is ongoing.		X		
21	5, p.5	Where does the area approval fit in relation to the flow chart already provided?	Should include the area approval process as the "next" box for operations outside of the conditions of the operations approved as part of the UOC. Possibly reference a more detailed flow chart which depicts the processes that go into an area approval. How these AA get amended to the Operations Manual.		X		
22	6.1, p.6	Air work is assumed equivalent to hire and reward. CASR 101.270 is defined in relation to hire and reward not air work.	Legal clarification on the two definitions should be sort. To see if they are equivalent.	X			
23	6.4, p.6	References section 7.4 but this section has nothing to do with the preparation of an operations manual.				X	
24	6.4, p.6	A description of what is in an operations manual, flight manual, etc etc should be provided before they are used.			X		

ID	Ref	Comments	Recommendation	H	M	L	E
25	6.4, p.6	A bullet point list is used to convey that the process is serial. It is not. It is iterative with some components completed in parallel with others. E.g., Safety Risk Management Process helps to define your operations manual, it is not an afterthought of the Operations Manual. As such the outcomes of the safety risk assessment may be fed back into the Operations Manual. Several iterations may be required. Similarly, several iterations of the OM may be required with CASA before they are approved.	Recommend conveying 6.4 list as a detailed flow chart, showing the different activities which are in parallel, and showing the iterations/feedback lines between activities and between activities and decision points. Refer to above comment.		X		
26	6.5-6,8, p.6/7	Ordering of sections is all over the place.	Shift 6.5, 6.6, 6.7, 6.8 prior to section 6.4.			X	
27	7.2 p.7	Consistency with Regulations – incorrect citing of regulation. CASR 101.030 does not state that Area Approval is required for operations, it states what goes into an AA.	Check consistency against regulations.	X			
28	7.2 p.7	Consistency of terminology. Some regulations are defined in relation to an airfield whilst others are defined in relation to an aerodrome. AIP/MOS 139 provides a definition of aerodrome and aircraft landing area. Authorised Landing Area is no longer used. CAR 89 was removed in 1992.	Why create a new definition? Clarification against existing is required. Do not use Authorised Landing Area.		X		
29	7.3 p.7	Definition of BVLOS is essential but not provided. Also the use of "may" implies it's at the discretion of the regulator. Open to subjectivity.	Suggest including a definition of VLOS and BVLOS. Need a head of power to enforce requirements in relation to BVLOS operations.		X		
30	7.3 p.7	*UAV Controller* is not defined in relation to the *Remote Pilot*, or the existing roles of *launch*, *flight* or *supervising controllers*.	See previous comments on definition of roles and consolidation to ICAO terms.		X		
31	7.3 p.7	Nowhere in CASR 101 does it say that BVLOS operations are associated with the training/licensing of UAV Controllers, Area approvals or UOC.	The regulations make no reference to VLOS operations as a basis for issuing area approvals, UAV Controller licencing, or UOC. CASR 101.235(2) makes reference to "in sight" operations but it is coupled with a logical "AND". The intention of CASR 101.235 is to distinguish UAS from model aircraft.	X			

ID	Ref	Comments	Recommendation	H	M	L	E
32	7.3 p.7	CASR 101.295(2)C refers to what qualifies a UAV Controller ***not*** who needs to have the required UAV Controller rating.	VLOS operations are not part of the conditions for training and licensing of UAV Controllers. Recommend changing the sentence in the guidance material to relate only to large UAS (consistent with 101.265). Or creating a head of power to require UAV Controllers to be certified.		X		
33	7.4 p.8	Requirement for permission to operate at an aerodrome or within the vicinity of the aerodrome is not in accordance with 101.030.	Change to: Operations at aerodromes are in accordance with 101.075, which calls up 101.080. CASA approval requires 101.085 for an area approval, which is detailed in 101.030	X			
34	7.4 p.8	"Near" is not explicitly defined in the AC	Make explicit what is meant by the term "near". This is within 3NM and above 400ft, or in the areas of an aerodrome as defined in 101.075(1) and (2). Permission needs to be obtained in accordance with 101.080.			X	
35	7.4.1 p.8	AIP/MOS 139 provide a definition of aerodrome and aircraft landing area. Authorised Landing Area is no longer used. CAR 89 was removed in 1992. Aerodrome - A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. (MOS 139).	Recommend that airfield be defined in relation to certified/registered aerodromes and that other factors be taken into consideration such as the number of aerodrome users, location of entry/exit and approach/departure lanes, circuit areas, the types of airspace users, and whether it is CTAF-R/ CTAF or other services. Recommend removing Authorised Landing Area and replace with Aircraft Landing Area. Recommend defining regulation in relation to AD (~300 Cert or Reg in ERSA) or ALA (~300 in ERSA – which can be UNCERT or UNREG). RPT or AC with MTOW → 5,700kg recommended to land at AD only. Note – that a UAS Launch and Recovery would be considered as an ALA (by definition).		X		

ID	Ref	Comments	Recommendation	H	M	L	E
36	7.5.2 p.8	No guidance provided as to how to perform the risk assessment or what is meant by as low as reasonably practicable. Describe key risks (primary hazards and domains of concern). Need to follow an accepted risk management/assessment process.	Link paragraph to AC on SMS / Risk Assessment guidance material OR provide references to ISO310000:2009. Include a "shopping list" of items that should be considered in the risk assessment as an appendix to the AC. Do not go into detail.		X		
37	7.5.3 p.8	Order of sections is not consistent with the content and does not present a logical flow for the reader.	Shift 7.5.3 prior to 7.5.1. Shift final sentence of 7.5.3 to start. Shift payment of costs etc. to end.		X		
38	7.7 p.9	The last dot point requires that the RPA alone must be able to 'detect and avoid' other aircraft.	Allow provision for other elements of the system to provide 'detect and avoid' capability. I.e., ground based radar or observers. Retain avenue for alternative safety based solution as suggested in the first sentence. Detect and Avoid may be achieved through a layered approach of numerous technologies and operational procedures. Do not restrict to a single concept. See FAA Document on SAA performance.			X	
39	7.10.1 p.9	CASR 101 does not prescribe any requirements in relation to VLOS/ BVLOS operations of small UAS. Current regulations permit operations independent of whether the UAS is flown within LOS or BVLOS. Subject to legal challenge.	See previous comments in relation to BVLOS/LOS.		X		
40	7.11 p.9	**Insufficient Information -** No guidance provided as to what factors need to be considered by CASA.	As a minimum – the AC should reference other sections of the AC to where guidance can be found.		X		
41	9 p.10	**Ambiguity –** remote pilot in command and mission commander are not defined. How is the remote pilot in command related to the remote pilot in direct control or the supervising commander?			X		
42	9 p.10	Information in Section 9 is not related in any way to the application of the AOC/AA. Where/how should the requirements/considerations detailed in this section be related to the preparation of an AOC or AA?	A paragraph should be included about where the "RPA OPERATIONS – GENERAL" section is relevant in terms of the preparation of an UOC or Area Approval.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
43	9.1 p.10	No mention of a run through of emergency procedures, or of any unserviceables that have been accepted as part of the maintenance hand over, or the hand over of control between phases, ATC procedures (e.g., phone etc.) that are unique to the particular operation.	Recommend including a run through of all aspects unique to the particular operation on the day: emergency procedures, any U/S that have been accepted as part of the maintenance release, special procedures for ATC, etc. as items to be included on the list.		X		
44	9.2 p.10	Is the use of aeronautical frequency band radio only recommended?	Change this from recommended to required.		X		
45	9.2 p.10	There is no mention of what the communication requirements are for UAS operating BVLOS. Only VLOS are defined.	Are additional requirements needed or can "visual line of sight" be removed from 9.2?		X		
46	9.3 p.10	As currently written, this section reads as though all UAS are required to have a transponder etc. No context for the applicability of the requirements is provided. Consideration of factors related to the use of one or more of these technologies.	The requirements contained in section 9.3 should have a context of applicability. They should be stated as: "The following mitigating technologies, in isolation or combination, should be considered as part of the risk assessment of UAS operations. This should be detailed in the UOC or AA where required...."				
47	9.3 p.10	There is no reason to say that given the advent of Detect and Avoid equipment that these technologies won't still be required.	Instead say, that detect and avoid technologies may be required for some operations. Other technologies that should be considered as part of the applicant's safety case, include: ..." Recommend removal of "pending the introduction of".		X		
48	9.3 p.10	"if applicable"... if applicable to what? Does this relate to formal conditions for installation on a particular UAS? or does this relate to whether they are simply installed or not?	Reword and clarify meaning of the paragraph.		X		
49	9.3.5 p.10	No mention of communications for coordination with other air traffic on a local frequency and the important role alerted see and avoid can play. Due to the operation of the UAS, the airband radio transceiver may be located on the UAS via a comms relay to the RPA Station.	Inclusion of communications with other aircraft for coordination and situational awareness.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
50	9.3.5 –	Communications assumes in Controlled Airspace, what about when you aren't?	Statement should be changed, to something more general e.g.,: At all times you should be able to communicate with other airspace users and air traffic control, as required by the class of airspace and whether VFR/IFR...			X	
51	9.3 p.10	No consideration is given to other operational or technical mitigation strategies that can be adopted.	Guidance should be included on a range of risk mitigating strategies that can be employed. As a minimum, CASA should include a statement that "other technologies/operational measures – such as ground based radar, chase planes, operations at night, etc. can be considered as part of the safety case for UAS operations. The applicant should detail how these additional measures are to be incorporated in their operations, what are the proposed benefits in terms of risk reduction, limitation, added risks... etc. Risk assessment should include the consideration of the combination of technologies/measures and not just assessments in their isolation. What are the common modes of failure?		X		
52	10.1 p.11	Where does air work imply qualified crews? Via UOC? There is no head of power that mandates qualified crews for all types of UAS. No legal basis for enforcing this requirement.	Add additional information to address.		x		
53	10.2 p.11	Cites CASR 101.030. CASR 101.030 does not have anything to do with the requirement to have an Area Approval, just describes what needs to ***go in*** an area approval.		X			
54	10.2 p.11	Reference to paragraph 9.3 which has nothing to do with area approvals				X	
55	10.2 p.11	Currently mandates that all research and development flights are to be conducted within VLOS of the RPA Controller. Irrespective of the conditions of the operating approval?	Such requirements should only be mandated as an outcome of the risk assessment.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
56	10.2 p.11	"and subject to ATC Clearance" may not be required, but as stated here, appears as a mandatory.	Include: "... and, *if required*, a clearance from ATC."			X	
57		No guidance is provided in the AC on what should be taken into consideration in relation to spectrum and communications and the approval to operate UAS. Nor is there guidance as to where these considerations should be documented.	Statements should include: that the operator is responsible for determining whether the links used are legal (ACMA) and this should be included as part of their AOC. The integrity, availability, coverage, redundancy and reliability of links – part of the safety case and OM Operator needs to take into consideration operational factors that can influence the performance of the links (e.g., shadowing/LOS due to mountains regions of expected higher noise floor, high/low altitude). Links need to be considered across all elements of the system (Should also consider ground-to-ground communications links, ATC, UA-GCS) Roles and responsibilities in relation to the monitoring of links? – who's job is it? Recommendations in relation to testing of the EM environment in a particular operational area? What about the Security of the communications links?		X		
58	12 p.11	The section is not presented in a logical order.	Shift Section 12 to immediately after Section 9.		X		
59	12.1 p.11	Paragraph implies that all of the requirements in the previous sections are additional to the ones contained in section 12.				X	

ID	Ref	Comments	Recommendation	H	M	L	E
60	12.1 p.11		Recommend including statement that UAS should operate seamlessly alongside other airspace users, such that from the perspective of ATC, they appear no different to that of a manned aircraft.			X	
61	12.3 p.11	Flight rules are defined in Part 91 not by the ATS provider? Or is the paragraph referring to the procedures within a CTR or CTA? E.g., in accordance with STARS/SIDS/Missed Approaches *etc*.	Clarify what is meant by rules governing flights.		X		
62	12.7 p.11	What is the difference between Section 12.7 and 12.10? "Communication requirements for RPA radio line of sight operations are as required...". Communications who with? ATC?	Clarification required.			X	
63	12.7 p.11	No mention of how communications should be managed with ATC. Guidance on what factors to consider should be included.	Communications management plan - should include the establishment of procedures with the appropriate ATC centre, including radio frequency change over, handover of responsibility of communications with ATC and other pilots in a given region. These should be detailed in the operations manual.		X		
64	12.12 p.13	The repartition of the equipment levels (other than paint) as captured in section 9.3.2-5 adds confusion	In document restructure consider clear singular equipment definition			X	
65	12.12 p.13	No mention of communications for coordination with other air traffic on a local frequency and the important role alerted see and avoid can play. Due to the operation of the UAS, the Airband radio transceiver may be located on the UAS via a comms relay to the RPA Station.	Inclusion of communications with other aircraft for coordination and situational awareness.		X		
66	12.13 p.13	Flight termination systems are not mentioned under general UAS operations.	Recommend including FTS/ARS as considerations for general UAS operations as well as those in controlled airspace.	X			
67	12.14 p.13	What procedures? The ones contained in which section?	Clarify statements made in paragraph.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
68	12.14 p.13	The definition of *direct control* over the UAS needs to be defined. This is associated with the definition of an RPA. Would the ability to command the RPA to follow a new waypoint be sufficient, or is Remote Pilot input in relation to the attitude and speed of the RPA required? Safety case for one over the other?	No definition provided. Clarification required.		X		
69	12.15.3 p.13	This paragraph not appear as relevant within section 12 which relates to UAS operations in controlled airspace. This requirement relates to operations in Class G.	Shift paragraph.			X	
70	12.17.2 p.14	Prescribes all UAS operations to be at VFR cruising levels irrespective of VFR/IFR operations.	Distinction needs to be made between UAS operating under IFR (CAR 180 cruising levels) and for VFR under CAR 173.				
71	12.17.2 p.14	Similar requirements on cruising levels do not exist in the section describing UAS operations outside of CTA.	Include requirements.			X	
72	12.18.2 p.14	Section 12.12 states that UAS "should" have SSR. In this paragraph, the requirement is at the discretion of CASA.	Clarify conflicting statements. Should/discretion.		X		
73	12.17.2 p.14	Prescribes operation at VFR cruising levels irrespective of VFR/IFR operations.			X		
74	12.19 p.14	Similar comments on noise abatement should appear in the section describing UAS operations outside of CTA. Important consideration, i.e., persistent operations over an area, which previously had no air traffic. Concentrated activity will attract negative reaction from public.	Considerations for noise abatement, whether formal or informal, should be mentioned. Especially, if the UAS is to operate at a location for an extended period of time, or a new long term area approval is being established next to communities which previously had limited aircraft activity. Spreading operations, altitudes, other means to fly neighbourly! Considerations should not be limited to operations in controlled airspace.		X		
75	12.17.2 p.14	Conflict with Regulations – The requirement to comply with Reg 173 CAR 1988 conflicts with CASR 101.020 which exempts UAS from this Part.	Resolve conflict with regulation.	X			

ID	Ref	Comments	Recommendation	H	M	L	E
76	13.1 p15	Clarification of the procedures and flight plans in the event of an emergency.	Lost link procedures should be defined in the operations manual or pilot's operating handbook. 13.2 outlines well what information should be briefed to ATC as required – some of which could be mandatory on a flight plan submission where required.		X		
77	13.3 p15	It may not be possible for the RPA crew to interact with the RPA during a data link failure.	Remove "and manually by the RPA controller"		X		
78	13.4 p15	Suggestion – use the 7600 SSR code for both VHF airband radio or datalink failures. The initial action is similar for ATC (re-establish communications with PIC / GCS using radio or cell phone). It is recognised that a different squawk code may be required for different types of communications failure (e.g., for the case where you still have downlink telemetry but the command control uplink is not available). For this example case, 7600 may not be appropriate.	SSR 7600 should be squawked, avoiding the use of 7700 and the implications this has for a manned aircraft.				
79	15 and 16 p.16	Reorder sections to create better flow.	Shift Sections 15 and Section 16 to immediately follow section 12 on flight in controlled airspace.				
81	16.7, p17	"the principles of noise abatement procedures.." – define what these are or where they can be sourced	Provide additional information or a link to where the information can be found.		X		
82	16.8.1, p17	The listed events should not be prescribed for all systems, but arrived at from a Failure Modes Analysis for the specific system.	Define objective for establishing primary failures and then prescribe that all primary failures must be detailed; preferably in the Operations Manual or Pilot's Operating Handbook.		X		
83	16.8.2, p18	This sentence and the following bullets are only loosely associated, but there is not clarity w.r.t. the inclusion of the "NOTAM".	Restructure this paragraph to clearly annunciate meaning.		X		
84	16.8.2, p18	**Suggestion:** to include the ground station or contact phone number within the NOTAM for coordination prior and during operations with 3rd parties.				X	
86	21.2, p21	**Suggestion:** is there any guidance for incident grading and hence response levels that could be added here to shape the communities alignment	Addition of guidance text or reference off to where to find such info.			X	
87	22, p21	**Addition –** there is no discussion of operator fatigue or rest/recovery between operations or broader human factors.	By adding some guidance then there is an expectation within the community that this is to be considered for safe operations		X		

9.4 DETAILED COMMENTS - AC 101-7(0)

Section 7.1 stated that this AC falls well short of providing an applicant or CASA FOI staff with sufficient guidance on CASA's requirements for UAS initial airworthiness or manufacture. Given the extent of the shortfalls, it is debatable whether 'specific comments' should be provided against this AC, since it may infer that these present the full extent of the problems. Upon reflection, the group elected to provide 'specific comments' to provide CASA with some limited insight into areas that require rectification. It is by no means, however, a comprehensive list.

TABLE 5 – DETAILED COMMENTS FOR AC 101-7(0)

ID	Ref	Comments	Recommendation	H	M	L	E
1	2.2	The para states that this AC provides guidance on the "operation and construction of RPA". There are two problems with this statement: it incorrectly refers to 'operation' and also it limits applicability to RPA.	The word 'operation' should be replaced with 'initial airworthiness' since the former is covered in another AC. Also, where possible the wider term 'UAS' should be used instead of 'RPA' unless there is a particular need to refer to the subset of UAS that are RPA. In the case of this AC, broadly the same design considerations are equally relevant to even fully autonomous UAS, so there is no need to limit the applicability to RPA.		X		
2	2.2	The para incorrectly states that the AC provides guidance to CASA staff on the processing of approvals for RPA operations.	Once again the AC incorrectly refers to 'operation' instead of approval of the design. Further, the AC does not actually provide any such guidance, which would have been a valuable addition to the AC.		X		
3	5	Definitions are provided for some elements that are not relevant to this AC. Also, some definitions are not consistent with ICAO definitions.	Only include definitions that are specific to the AC. Also ensure consistency with ICAO Circular 328 definitions.			X	
4	6.2	UAS are defined as a 'problem'. This infers a CASA bias against UAS, and is therefore not a suitable statement to make in an AC.	Reword para. It could state that UAS regulation is an evolving field for NAAs worldwide, so the expectation is that this AC will require regular updating as CASA's UAS regulatory experience grows.			X	
5	6.2	By stating that UAS pose a problem for CASA in controlled airspace, there is an inference that UAS do not pose a problem in uncontrolled airspace	Remove the inference that UAS do not pose a problem in uncontrolled airspace			x	
6	6.4	This para limits applicability of the AC to RPA, and precludes 'Fully Autonomous UAS'.	There is no need to limit the applicability of this AC. After all, design and manufacture are as important to fully autonomous UAS as they are for RPA.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
7	7.1	This section states that the abbreviations and glossary of terms is at Appendix 1. This is at odds with sections 4 and 5 of the AC, which present the abbreviations and glossary.	Either delete para 7.1 or re-locate the extant sections 4 and 5 to Appendix 1				X
8	8	This section, which is supposed to provide a roadmap for this AC, is empty.	This is an essential element of the AC, and needs to be completed prior to AC release	X			
9	8	The AC does not define how the design/manufacture of a UAS contributes to safety.	The section should define precisely how the design/manufacture of a UAS contributes to safety, since this will provide essential context to the remainder of the AC.	X			
10	8	The section does not describe the design versus operational trade-offs that are possible with a UAS.	The section should describe the design versus operational trade-offs that are possible with a UAS, since this will provide essential context to the remainder of the AC.	X			
11	8	The section does not provide any insight into the role of a safety case in supporting a CASA approval for a UAS design for a particular operating environment.	The section should examine the role of a safety case in supporting a CASA approval for a UAS design for a particular operating environment. Since a safety case will inevitably be cornerstone to CASA's approval of the design of a UAS, the AC (either in this section or elsewhere in the AC) should define the scope and structure of a safety case, and provide pragmatic and comprehensive guidance on what CASA FOI staff will be looking for in the safety case. In other words, the AC should define CASA's 'pass mark' for a safety case. Finally, the section could confirm whether CASA will require a comprehensive Type Certification program for UAS that are to be operated in particularly challenging environments (eg over cities).	X			
12	9.2	This section purports to define 'Design Criteria', but provides only scant coverage (focusing only on HMI and fail-safe design of the FTS). It does not provide guidance to applicants and CASA FOI staff on the essential design criteria for a UAS.	This section should guide the applicant on how the UAS operating environment and design features might affect the integrity required for a particular design element. Critically, the AC should differentiate between design requirements relating to airspace de-confliction/integration and those relating to the management of the risks to people overflown.	X			

ID	Ref	Comments	Recommendation	H	M	L	E
13	9.3.1	This para provides CASA's overall safety objective for a UAS (ie risk to personnel/property no greater than a manned aircraft of similar class/category). However, no guidance is provided on precisely what 'number' this safety objective is, or how to apply it. This will inevitably result in inconsistent application by both applicants and CASA FOI staff.	A well-defined safety objective is absolutely fundamental to creating a safety case for a UAS. Such an important (and inevitably contentious) issue warrants substantially better guidance, to ensure the safety target is applied in a defined and consistent manner by both applicants and CASA FOI staff. At a minimum, for each aircraft class/category, the AC should specifically define numerical safety targets for the following: Tolerable collision risk Tolerable risk to people on the ground Tolerable risk to facilities on the ground Guidance should then be provided on how to apply these safety targets in a way that would be acceptable to CASA	X			
14	9.5.1 to 9.5.11	Broad and often nebulous design requirements are included in these paras. Most provide little insight into CASA's 'benchmark' against which these design requirements will be evaluated. Further, there is an inference that these 11 items are the only design issues that CASA is interested in, which is probably not the case for some UAS operating environments. The lack of clarity in this section will inevitably result in inconsistent application by both applicants and CASA FOI staff.	This section must clearly define CASA's 'benchmark' for UAS design. At a minimum, each element needs to include explicit links back to the safety objective for the UAS (see previous item).	X			
15	9.5.1	The para states that fail safe principles will govern the design of UAS. While this is certainly true for some UAS operations (for example large UAS over populated areas), it is largely irrelevant to UAS operated in remote areas where a crash poses little risk to people.	This criticism will inherently be rectified once the issues highlighted above (eg lack of clarity in UAS design criteria, safety targets, safe case, etc) are addressed.		X		

ID	Ref	Comments	Recommendation	H	M	L	E
16	9.5.3	This para states that all UAS software must meet DO-178B or equivalent. This presents the inference that all software on a UAS has a potential safety effect (regardless of what it controls and where the UAS is operated) and therefore requires the application of a software assurance standard. Also, 'software assurance' is just one element of assuring safe software, and must be coupled with an effective software safety and software development program to assure safety.	This para should provide value-adding guidance on the software assurance requirements for a UAS. It should explain how the system safety assessment will define the software assurance requirements for each UAS software system. It also needs to provide guidance on how to evaluate the 'consequence' of a software failure for a UAS, since this will ultimately drive the required software level. This is always a particularly contentious issue for UAS (since UAS crashes don't necessarily result in fatalities), so CASA's position on the issue needs to be promulgated in the AC. Without substantially more clarity and guidance on this issue, software assurance requirements will be applied inconsistently by both applicants and CASA FOI staff.	X			
17	9.5.4	The current para is akin to requirements for "catastrophic failure conditions" in Part 1309. Meeting this requirement is not necessary for UAS operations over uninhabited areas.	The scope of this requirement needs to be redefined.		X		
18	9.5.6	This para (and others) omit any discussion of UAS security.	Security requirements (eg links, ground control station, data, etc) should be covered in the AC.		X		
19	9.5.7	This para covers only one aspect of navigation, namely that it must provide positional information appropriate to the airspace. It omits the importance of accurate positional information in ensuring the UAS only flies over personnel/facilities that is authorised. For example, a large positional error may be acceptable in some airspace, but that same positional error may result in a low integrity UAS straying into areas of high population density.	Navigation requirements need to cover both airspace requirements and also population avoidance requirements.	X			
20	9.5.9	This para is potentially a gross over-simplification, particularly for UAS that are to operate in challenging operating environments. For example, no consideration is given to the design for Human Factors (e.g., ergonomics, conditioning, lighting, feedback, brightness of display), there is no mention of reliability/redundancy, and so on.	The RPS is often a critical contributor to the safety of a RPA. Comprehensive and value-adding guidance is needed to define CASA's 'benchmark' for a sound RPS implementation. A link to the safety objective, and guidance on how to apply it, is also needed.	X			

ID	Ref	Comments	Recommendation	H	M	L	E
21	9.5.10	This para is potentially misleading. As with most other UAS design elements, the required structural integrity for a UAS is dependent on the proposed operating environment. Interestingly, this para also infers that RPA structure is significantly more important than all other design elements, since it is the only one where CASA will advise design requirements by letter per CAR 1988 Pt 21.	This section must clearly define CASA's 'benchmark' for UAS design. At a minimum, each element needs to include explicit links back to the safety objective for the UAS.		X		
22	9.5.11	This para provides only vague guidance on when/where FTS/ARS systems might be required.	The AC should define CASA's minimum requirements for FTS/ARS systems, in terms of need, functionality and integrity.	X			
23	9.5.11	Several of the equipment requirements are specific and measurable. However, others use vague phrases such as 'as required' and 'may be needed'.	The AC should define CASA's minimum requirements for each equipment systems, in terms of need, functionality and integrity.	X			
24	9.5.11	The 'radios' element of this para is vague regarding the required communications capabilities, and seems to be ATC-centric. Also, the requirement to communicate with other aircraft, particularly outside controlled airspace, is omitted. The lack of clarity in this section may result in inconsistent application by both applicants and CASA FOI staff	The AC should comprehensively define CASA's minimum requirements for radio communication.	X			

ID	Ref	Comments	Recommendation	H	M	L	E
25	10.1	It is unclear how the certification process relates to all the design considerations mentioned previously. There is no clarity on how it should be documented, the role of the safety case, and so on.	The AC should define CASA's certification requirements, documentation and processes. A suggestion: it would be extremely useful if the AC defined the "left of arc" and the "right of arc" extremes for CASA approvals of UAS designs. For example, at one extreme is the regular use of a large UAS over major cities, in which case the AC could outline the comprehensive certification process that would need to underpin CASA's approval of the design. At the other extreme, a small UAS being used in the desert presents a very low risk to personnel, so the AC could define CASA's minimum requirements for this operating environment (eg safety case confirming safety targets are met, essential equipment, integrity of positional data, FTS requirements, etc). Since every other UAS would be somewhere between these two extremes, it would at least provide applicants and CASA FOI staff with valuable context. (Note: Even better would be to include a 'middle case', which examines the case where a UAS poses a moderate risk to personnel on the ground. Including this middle case would have several benefits: it would provide additional context to applicants and CASA FOI staff, and more importantly, it would require the CASA author of this AC to apply the content of the draft AC prior to issuing the NPRM, to ensure that it is pragmatic and usable.)	X			

ID	Ref	Comments	Recommendation	H	M	L	E
26	11	This section has missed the objective of the manufacturing process, which is to produce systems that meet the approved type design. Rather, the information primarily consists of Instructions for Continued Airworthiness (ICA) requirements such as inspection, maintenance and checklist requirements. Each of these are related to the UAS design, not to manufacturer/production approval.	Pragmatic guidance on UAS manufacture/production should be provided, covering the quality and conformance of the product to a design type. This guidance should be linked firmly to the 'initial airworthiness' guidance provided in the AC, since the approval rigour for UAS manufacture/production should be commensurate with the integrity of the UAS design. That is, the manufacture/production approval requirements for a small low integrity UAS that will only be used in remote locations, will be substantially different to a UAS that will be routinely flown over major cities.		X		
27	11	Markings and identification requirements are not provided.	Markings and identification requirements should be provided in this section		X		

10. APPENDIX B – TABLES SUMMARISING CURRENT REGULATIONS

TABLE 6 – SUMMARY OF CASR PART 101 FOR THE OPERATION OF MICRO UAS

		Non-Controlled		Controlled		Aerodrome (within 3 NM – 101.075)		In or Over a Prohibited or Restricted Areas
		← 400	→ 400	← 400	→ 400	← 400	→ 400	
Micro UAV	Populated		101.085 Area Approval		101.070 Area Approval and ATC Clearance	101.075 Permission is obtained (101.080) or other part.	101.075 Permission is obtained (101.080) or other part. 101.085 Area Approval	Permission from authority controlling area 101.065
	Unpopulated		101.085 Area Approval		101.070 Area Approval and ATC Clearance	101.075 Permission is obtained (101.080) or other part.	101.075 Permission is obtained (101.080) or other part. 101.085 Area Approval	Permission from authority controlling area 101.065

TABLE 7 – SUMMARY OF CASR PART 101 FOR THE OPERATION OF SMALL UAS

		Non-Controlled		Controlled		Aerodrome (within 3 NM – 101.075)		In or Over a Prohibited or Restricted Areas
		← 400	→ 400	← 400	→ 400	← 400	→ 400	
Small UAV	Populated	101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.085 Area Approval Reqd 101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(1) Radiotelephone etc	101.070 Area Approval and ATC Clearance 101.085 Area Approval 101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(1) Radiotelephone etc	101.075 Permission is obtained (101.080) or other part. 101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.075 Permission is obtained (101.080) or other part. 101.085 Area Approval 101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	Permission from authority controlling area 101.065 101.250 Area Approval Reqd 101.270 Req UOC if hire and reward 101.280 must be certificated UAS to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA
	Unpopulated	101.270 Req UOC if hire and reward 101.285(3) Radiotelephone etc discretion of CASA	101.085 Area Approval 101.270 Req UOC if hire and reward 101.285(3) Radiotelephone etc discretion of CASA	101.270 Req UOC if hire and reward 101.285(1) Radiotelephone etc	101.070 Area Approval and ATC Clearance 101.270 Req UOC if hire and reward 101.285(1) Radiotelephone etc	101.075 Permission is obtained (101.080) or other part. 101.270 Req UOC if hire and reward 101.285(3) Radiotelephone etc discretion of CASA	101.075 Permission is obtained (101.080) or other part. 101.085 Area Approval 101.270 Req UOC if hire and reward 101.285(3) Radiotelephone etc discretion of CASA	Permission from authority controlling area 101.065 101.270 Req UOC if hire and reward 101.285(3) Radiotelephone etc discretion of CASA

TABLE 8 – SUMMARY OF CASR PART 101 FOR THE OPERATION OF LARGE UAS

		Non-Controlled		Controlled		Aerodrome (within 3 NM – 101.075)		In or Over a Prohibited or Restricted Areas
		← 400	→ 400	← 400	→ 400	← 400	→ 400	
Large UAV	Populated	101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.085 Area Approval 101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(1) Radiotelephone etc	101.070 Area Approval and ATC Clearance 101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(1) Radiotelephone etc	101.075 Permission is obtained (101.080) or other part. 101.255 Cert required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA	101.075 Permission is obtained (101.080) or other part. 101.085 Req area approval 101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height	Permission from authority controlling area 101.065 101.255 Cert UAS required 101.275 Req CASA approval and UOC 101.280(3) must get approval to fly ← glide height 101.285(3) Radiotelephone etc discretion of CASA
	Unpopulated	101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(3) Radiotelephone etc discretion of CASA	101.085 – Area Approval 101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(3) Radiotelephone etc discretion of CASA	101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(1) Radiotelephone etc	101.070 – Area Approval and ATC Clearance 101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(1) Radiotelephone etc	101.075 Permission is obtained (101.080) or other part. 101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(3) Radiotelephone etc discretion of CASA	101.075 Permission is obtained (101.080) or other part. 101.085 – Area Approval 101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(3) Radiotelephone etc discretion of CASA	Permission from authority controlling area 101.065 101.255 Cert required 101.265 UAV Controller Cert Req 101.275 Req CASA approval and UOC 101.285(3) Radiotelephone etc discretion of CASA