Transport Canada Transports Canada

UAV SYSTEMS

PROGRAM DESIGN WORKING GROUP

PHASE 1 FINAL REPORT

MARCH 2012

RDIMS # 7366871

TABLE OF CONTENTS

ABBREVATIONS/ACRONYMS

- ASTM American Society for Testing and Materials
- C2 Command and control
- CAA Civil Aviation Authority
- CARAC Canadian Aviation Regulation Advisory Council
- CARC Civil Aviation Regulatory Committee
- CARs Canadian Aviation Regulations
- CASA Civil Aviation Safety Authority
- C of A Certificate of Airworthiness
- DND Department of National Defence
- EASA European Aviation Safety Agency
- EUROCAE European Organisation for Civil Aviation Equipment
- FAA Federal Aviation Administration
- ICAO International Civil Aviation Organization
- IFR Instrument Flight Rules
- JARUS Joint Authorities for Rulemaking on Unmanned Systems
- MTOW Maximum Take-off Weight
- NATO North Atlantic Treaty Organization
- NPAs Notices of Proposed Amendments
- OEM Original Equipment Manufacturer
- RPA Remotely-piloted aircraft
- RPAS Remotely-piloted aircraft system
- RTCA Radio Technical Commission for Aeronautics
- SC Special Committee
- SFOC Special Flight Operations Certificate
- SMS Safety Management Systems
- STANAG Standardization Agreement (NATO)
- UA Unmanned Aircraft
- UAV Unmanned Air Vehicle
- UAS Unmanned Aircraft System
- VFR Visual Flight Rules
- VLOS Visual Line-of-Sight
- VMC Visual Meteorological Conditions

EXECUTIVE SUMMARY

This document represents the Phase 1 Report of the Canadian Aviation Regulation Advisory Council (CARAC) Unmanned Air Vehicle (UAV) Systems Program Design Working Group, established in June 2010, to make recommendations for amendments to existing regulations and standards and to introduce new regulations and standards for the safe integration of routine UAV operations in Canadian airspace.

BACKGROUND

In December 2006, the General Aviation branch convened a joint government and industry Unmanned Air Vehicle (UAV) Working Group to review existing legislation and make recommendations for a regulatory framework for UAV operations. The UAV Working Group Final Report, dated September 2007, made recommendations regarding new terms and definitions, aircraft registration and marking, flight crew and maintainer licensing, maintenance, airworthiness and continuing airworthiness, operational flight rules and operational approval. Amendments to the *Canadian Aviation Regulations* (CARs) were proposed, in addition to recommendations for new regulations and standards. In December 2007, the Final Report was presented to the Civil Aviation Regulatory Committee (CARC) and the Work Plan was approved in principle.

At the June 2010 CARAC Technical Committee meeting, the Terms of Reference were approved and the members were defined for a UAV Systems Program Design Working Group consisting of a main Working Group and three Subgroups. The UAV Working Group 2007 Final Report served as a starting point for the new Working Group to develop recommendations. The first main Working Group meeting was held in October 2010.

TERMS OF REFERENCE

SCOPE

With the following exceptions, the UAV Systems Program Design Working Group examined all issues required for safe integration. The following list of items were not included in the scope of Phase 1.

- SFOC Staff Instruction amendments;
- UAVs operating inside buildings or underground;
- UAVs with passengers on board;
- Disposable UAVs;
- Spectrum management regulations (i.e. responsibility of Industry Canada);
- Reporting UAV occurrences (i.e. responsibility of the Transportation Safety Board); and
- Search and rescue for downed UAVs (i.e. responsibility of 1 Cdn Air Div).

Consideration was given to a single UAV being controlled from one control station, multiple aircraft controlled from one control station as well as multiple stations sharing control of a single aircraft (i.e. UAV handed off to the next station).

ASSUMPTIONS

The assumptions made in the UAV Working Group 2007 Final Report guided the work of the UAV Systems Program Design Working Group:

a. UAVs will integrate into the existing airspace structure in a safe manner;
b. UAVs will not create any greater hazards than manned aircraft;
c. UAVS will have access to all classes of airspace, providing the appropriate equipment requirements and other qualifying requirements have been met;
d. The air vehicle, payloads, communications architecture and command and control (control station) are all part of the total UAS;
e. All UAVs will have a pilot-in-command who always has responsibility for the aircraft;
f. UAVs will comply with ATC instructions, clearances and procedures;
g. Each manufacturer will produce Instructions for Continued Airworthiness (ICAs) in accordance with a Transport Canada approved/accepted standard; and
h. UAV operations will be conducted without amendments to the "airspace use" regulations and practices, including air traffic management. Changes may, however, be necessary in future.

MAIN WORKING GROUP AND THREE SUBGROUPS

The UAV Systems Program Design Working Group was divided into a main Working Group and three subgroups. Three subgroups were created according to the following subject areas: People, Product and Operations and Access to Airspace.

- Subgroup 1 – People (i.e. CARs Part IV)
- Subgroup 2 – Product (i.e. CARs Part II, V)
- Subgroup 3 – Operations and Access to Airspace (i.e. CARs Part I, III, VI, VII, VIII)

FOUR PHASES

The UAV Systems Program Design Working Group is divided into Four Phases. The subject of this report is Phase 1, namely addressing the requirements associated with the operation of all categories of UAV systems where the UAV MTOW does not exceed 25 kg and the UAV is operated within visual line-of-sight and under VFR, day or night.

HARMONIZATION

In developing recommendations, the Working Group endeavoured to take into account current policies and requirements of foreign regulatory bodies (e.g. FAA, ICAO and EASA) and other agencies, to ensure harmonization was achieved to the extent practical.

A documentation review was conducted at the outset of the UAV Systems Program Design Working Group activities, and after that at appropriate intervals, as new information became available. This review included: UAV-related outputs from Canadian and foreign Working and Standards groups (e.g. RTCA SC-203, ASTM International Committee F-38, EUROCAE WG-73, JARUS International Coordination Group), regulatory and advisory material from other civil aviation authorities, Canadian and foreign military documents (e.g. DND Technical Airworthiness Manual) as well as available documents from other bodies developing UAV standards, such as NATO, EUROCONTROL and ICAO.

WORKING GROUP MEMBERSHIP

The Working Group membership roster is included in the Appendix. Since membership has changed since the Working Group was established, this version of the roster represents those members who contributed to the majority of Phase 1 work.

Membership in the UAV Systems Program Design Working Group was selected by the Technical Committee in accordance with the *CARAC Charter* at the June 2010 meeting. Membership consists of representatives from the government and the aviation community, including but not limited to professional associations, UAV system developers, UAV operators, UAV sector associations and academia. Membership was limited to individuals having specialized technical knowledge and who expressed intent to participate actively in Working Group discussions.

MEETINGS AND REPORTING

The initial main Working Group meeting was held in October 2010. The subgroups met on a regular basis and made reports to the main Working Group during three meetings that were held in April 2011, October 2011 and November 2011. The meetings were of 3 days duration except for the final meeting which was of 2 days duration. During this period of time the CARAC Technical Committee was apprised of the progress of the Working Group at scheduled Technical Committee meetings.

PHASE 1 DELIVERABLES

During Phase I, all subgroups addressed the requirements associated with the operation of all categories of UAV systems where the UAV MTOW does not exceed 25 kg and the UAV is operated within visual line-of-sight and under VFR, day or night. Each subgroup reviewed the subject areas assigned to it and developed recommendations as appropriate. Subgroup 2 considered aircraft marking and registration requirements for all sizes and categories of UAVs, thereby eliminating the need for the topic to be addressed in subsequent Phases.

All subgroups considered micro size UAVs up to and including 25 kg. It was identified in the Terms of Reference that there may be a need to make a recommendation to establish a minimum weight or size limit for applying regulations.

DELIVERABLES – MAIN WORKING GROUP

- Make recommendations to the Technical Committee regarding UAV-specific insurance requirements (included in this report).
- Identify immediate needs for staff instructions, guidance material, policy documents, advisory circulars or exemptions and make recommendations to the Director, Standards (included in this report).

DISSENTS

This Phase 1 Report is submitted without dissents.

DELIVERABLES

The following serves as the deliverables for Phase 1 work. As approved by the Civil Aviation Regulatory Committee (CARC) and briefed at the September 2011 CARAC Technical Committee meeting, Notices of Proposed Amendments (NPAs) resulting from the Working Group's regulatory recommendations will not be drafted at this time. Instead, the recommendations will be included, to the extent practical, in the current guidance material for the issuance of a Special Flight Operations Certificate (SFOC). The Working Group will proceed with Phase 2 work, once Phase 1 work has been approved by the Technical Committee and CARC. Phase 1 work forms the basis of Phase 2 work, therefore, it is vital that there is agreement on the key principles and recommendations contained in this Phase 1 report before the Working Group can proceed with Phase 2. At some point in future, the whole package of regulatory changes will be put into the draft stage once the priority list of regulatory projects for civil aviation permits.

This report, therefore, outlines the key principles and recommendations for consideration and approval by the CARAC Technical Committee. The intent is not to focus on the details of the suggested wording changes to existing regulations or to agonize over the wording of new regulations, but rather the intent is for the Technical Committee to review and ultimately approve the underlying concepts that will guide the regulatory recommendations. Therefore, the Phase 1 regulatory recommendations have been placed in a separate document, and it is that document, combined with this report, that will be necessary for NPA development.

Foreword

Unmanned aircraft meet the *Aeronautics Act*'s definition of "aircraft", and therefore, are subject to the requirements of the *Aeronautics Act* and associated regulations. However, it would be inaccurate to say that current aviation legislation was written for, and entirely applicable to, unmanned aircraft systems. In some cases the existing regulations and standards that were written for manned aviation simply cannot or ought not to apply to the operation of unmanned aircraft. In other cases, such as in the area of command and control links, there is a complete lack of regulations and standards. In still other cases, there are standards that exist outside the *Canadian Aviation Regulation*s that were not written to be aviation specific, but may be applicable to unmanned aircraft, such as standards dealing with solar cells, fuel cells, batteries etc.

Components of unmanned aircraft system operations that are not specifically addressed in regulations include: safe flight-termination systems, sense and avoid systems, command, control and communication systems and control stations. In addition, the need for support equipment standards, such as launch and recovery systems (e.g., catapults, pneumatic/hydraulic launch systems), power supplies and starters have not been assessed.

The Working Group conducted a review of the current regulations and standards with unmanned aircraft in mind. The use of the term "aircraft" in existing provisions was taken to mean both those with a pilot on-board and those without a pilot on-board. Therefore, recommendations for regulatory amendments make this assumption, unless specifically stated otherwise.

The majority of the Working Group recommendations are focused on the domestic use of unmanned aircraft in consideration of the fact that Phase 1 work is within visual line-of-sight (VLOS) and cross-border operations will be the exception. However in accordance with the Terms of Reference, current policies and requirements of foreign regulatory bodies and other agencies, particularly the FAA and ICAO, were taken into account. The Working Group strived to avoid the creation of dedicated unmanned aircraft regulations as much as possible, since the goal is for UAVs to be integrated with, not segregated from, other airspace users. It should be noted that the Working Group did not limit the recommendations to known technologies and applications. Recommendations have considered safety as the highest priority.

Classification

The Working Group was tasked with providing rationale for weight classes of UAVs as a deliverable i.e. whether 25 kg was an appropriate second threshold for classifying UAVs. It is recognized that this threshold is being adopted elsewhere (e.g. by the FAA), but the Working Group tried to identify a risk basis for the choice. A review of documentation revealed a US FAA document, FAA AC 23.1309-1D, which defines "Hazardous Failure Conditions" and "Catastrophic Failure Conditions". A "Hazardous Failure Condition" is defined as an outcome which can cause a single fatality, while a "Catastrophic Failure Condition" could cause multiple fatalities. The *Canadian Aviation Regulations* have been developed with the intention of preventing catastrophic failure conditions and minimizing the possibility of hazardous failure conditions. Within the regulations, the acceptable probabilities of these failure conditions are "extremely improbable" and "extremely remote" respectively, according to the same FAA documentation.

It was concluded that a 25 kg aircraft, in the worst possible case, possesses a realistic probability of causing a single fatality upon impact (an uncontrolled crash into a crowd of people scenario). The same collision, however, would be less likely to cause multiple fatalities due to the typical physical size and geometry of such an aircraft. The reasoning then becomes that a "small UAV" (MTOW of 25 kg or less, excluding low energy UAVs – to be defined later in this report) may have a variety of ways to suffer hazardous failure conditions leading to a single fatality, but relatively few, if any catastrophic failure conditions. The primary regulatory requirement for small UAVs then becomes the means to keep the probability of hazardous failures to the extremely remote or less level. While the boundary value of 25 kg could be moved up or down a little, the rationale of a boundary "on the order of 25 kg" which represents aircraft with relatively low, if any, potential for catastrophic failure conditions, becomes a reasonable argument for this regulatory boundary based on this UAV weight. Therefore, Phase 1 work is based upon this maximum take-off weight (MTOW) classification and the Working Group has defined this class of unmanned aircraft as a small UAV.

Note: *The Working Group acknowledges that the most obvious source of a small RPAS catastrophic failure is one that leads to a mid-air collision with a passenger carrying aircraft, thus specific attention needs to be paid to loss of trajectory control and sense and avoid issues.*

Terminology

The Terms of Reference for this Working Group were written using the terminology UAV and UAV systems. However, since that time there has been a change and the international community is no longer using the term UAV (unmanned air vehicle). The new terms that have been introduced by ICAO and adopted elsewhere are: UA (unmanned aircraft), UAS (unmanned aircraft system), RPA (remotely-piloted aircraft) and RPAS (remotely-piloted aircraft system). These terms are more appropriate since they designate these "vehicles" as aircraft and recognize that the UAS/RPAS includes not only the airframe but also the associated elements required for flight. Therefore, for the balance of this report, the terms UA/UAS and RPA/RPAS will be used instead of UAV and UAV system. All regulatory recommendations include this new terminology.

CANADIAN AVIATION REGULATIONS (CARs)

Note: *The paragraph numbers contained in this document are not associated with any other numbering system, rather the numbers serve only to distinguish the key principles and to facilitate ease of discussion during the Technical Committee meeting.*

Part I – General Provisions

Interpretation

1.0 New terms and definitions have been harmonized, to the extent possible, with ICAO's proposed amendment to International Standards – Rules of the Air – Annex 2, FAA terms and definitions proposed by the Small UAS (sUAS) Aviation Rulemaking Committee report (April 1, 2009) and other relevant documents produced by international UAS Standards Groups and Working Groups. Additional terms and definitions may have to be added when work commences under Phases 2-4.

1.1 Definitions contained in subsection 101.01(1) of the CARs are being amended to include RPAS. Specifically, the definitions of "crew member "and "operator" are being amended to capture the fact that the pilot-in-command is not on-board the aircraft and that an RPAS is a system and the physical aircraft is only a part of that system. Additionally, the definition of small aircraft is being amended to remove small RPAS and the definition of UAV has been changed to RPAS.

1.2 New terms and definitions, essential to understanding RPAS operations are recommended and are being offered in this report in order to facilitate understanding. The intent is not to "wordsmith" either the term or the definition.

> **Command and control link (C2) -** means the data link between the RPA and the control station for the purposes of managing the flight.
>
> **Control station -** means the facilities and/or equipment remote from the RPA from which the RPA is controlled and/or monitored.
>
> **Handover** - means the act of passing pilot-in-command responsibilities from one control station or pilot to another.
>
> **Low energy RPA -** means an RPA that has been analyzed and/or demonstrated, for the case of an uncontrolled impact, to not impart a peak energy of more than 12J/cm^2 on a stationary person or object in the most unfavourable of circumstances.
>
> **Lost link** - means the loss of command and control link contact with the RPA such that the pilot-in-command can no longer manage the aircraft's flight.
>
> **Payload -** in the case of an RPA, means a system, an object or collection of objects on-board or otherwise connected to the RPA that performs, or is related to, a mission function but is not required for flight.

Radio line-of-sight - means the limit of direct reliable radio communication given the equipment being used and the prevailing conditions.

Remotely-piloted aircraft (RPA) - means a UA which is controlled by a pilot not on-board the aircraft.

Remotely-piloted aircraft system (RPAS) - means a set of configurable elements consisting of a remotely-piloted aircraft, its associated control station(s), the required command and control links and any other system elements as may be required, at any point during flight operation.

Safe flight-termination system - means a system that, upon initiation, terminates the flight of an RPA in a manner so as not to cause significant damage to property or severe injury to persons on the ground.

Sense and avoid - means the capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.

Small RPA - means an RPA with a maximum permissible take-off weight of 25 kg (55 pounds) or less, not including low energy RPA.

Small RPAS - means a set of configurable elements consisting of a small RPA, its associated control station(s), the required command and control links and any other system elements as may be required, at any point during flight operation.

Unmanned Aircraft (UA) - means a navigable aircraft which is intended to operate with no pilot on-board.

Unmanned Aircraft System (UAS) - means a UA and its associated elements.

Visual line-of-sight (VLOS) - means unaided (corrective lenses and/or sunglasses exempted) visual contact with aircraft sufficient to be able to maintain operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to decisively see and avoid other air traffic or objects.

Visual observer - means a crew member who is trained to assist the pilot-in-command in the safe conduct of the flight under visual line-of-sight.

1.3 RPA and RPAS are subsets of UA and UAS. In future, it is anticipated that there will be fully autonomous UAS i.e. not RPAS. For these aircraft systems, the ability to alter the mission and decisions on the conduct of the mission are made by the aircraft system without involvement of the pilot-in-command. This distinction is important since the Working Group specifically did not consider autonomous UAS in their deliberations.

1.4 Unmanned aircraft are defined as navigable aircraft, therefore fireworks, rockets, unmanned free balloons and unmanned tethered aircraft are not captured in the definition.

1.5 There is no intent for model aircraft to be captured in the definition of RPA or UA. At present, section 102.01 of the CARs states that the regulations do not apply in respect of model aircraft unless otherwise indicated in the regulations. On this basis, it is understood that the term RPA and UA do not mean model aircraft. A definition of "model aircraft" appears in section 101.01 of the CARs.

Application

1.6 The Subgroups were tasked with considering the need to make a recommendation to establish a minimum weight or size limit for applying regulations. In other words, they were tasked with identifying whether there was some sort of lower threshold, under which the RPA did not need to be regulated, or could be regulated to a very low extent. As a result, the Working Group is recommending that there is a class of RPAS that, due to their nature, do not present a significant risk of harm to persons on the ground.

1.7 This class of RPA is defined by the maximum kinetic energy they possess and the maximum energy per unit area that they can impose on a human being. These RPA were defined as "Low Energy RPA". This conclusion was based on a variety of information sources such as range safety guides and design guidelines for non-lethal weapons. It is also noted that such aircraft, by their very design, have relatively short range and endurance. This, coupled with their low mass, makes them extremely unlikely to pose a threat to manned aviation. Therefore, the Working Group is recommending that section 101.01 of the CARs be amended such that low energy RPAS are added to the list of aircraft to which the Regulations do not apply unless otherwise indicated (i.e. model aircraft, rockets, hovercraft or wing-in-ground-effect machines).

1.8 A low energy RPA is an RPA that has been analyzed and/or demonstrated, for the case of an uncontrolled impact, to not impart a peak energy of more than $12J/cm^2$ on a stationary person or object in the most unfavourable of circumstances. Such analysis/demonstration is the sole element of airworthiness documentation required to comply with CARS 5xx.01.

Note: *$12J/cm^2$ is still subject to final validation.*

1.9 It is a low energy RPA that, by virtue of a number of characteristics, such as:
(a) low mass;
(b) low maximum speed;
(c) frangible or energy-absorbing deformable structure;
(d) small footprint;
(e) "soft" flight termination recovery;
(f) no hard massive components;
(g) protection against fire; and
- the use of fire-resistant materials, or
- any combination of the above,
is unlikely to result in severe injury to persons or significant damage to property.

Note: *A repeatable method to evaluate these aircraft to ensure they meet these criteria will be required to be adopted (see below).*

As an example of what $12J/cm^2$ means, see the following:

1 Joule = 1kg m^2/s^2
1 knot = 0.514 m/s
Therefore:
$12J/cm^2$ = 0.5 kg travelling at less than 10 knots with 1 cm^2 frontal area, capable of imparting all of its kinetic energy instantaneously to a person.

For reference, here are some example values of kinetic energy/unit area:

Item	Typical Maximum Energy (J)	Typical Max. Energy/Unit Area (J/cm2)	Lethal?
Football	80	-	NO
Soccer ball	270	0.7	NO
Tennis ball	110	3.1	NO
Baseball	140	3.9	NO
Golf Ball	120	8.4	NO – but getting close!
RPA examples			
Maverick	440	440/4 **= 110J/cm**2**	YES
CyberQuad MAXI	133	133/42 **=3.17J/cm**2**	NO
Aeryon Scout	208 (total) 150 after "arms" break off	150/103 **=1.45J/cm**2**	NO

The level of energy that can cause harm when imparted on a human is cited in a variety of references, both regarding RPAS and non-lethal weapons. The values in RPAS specific documents range from 33.9J to 53[1]J. Equally, the harmful level of energy per unit area is cited anywhere from 6 J/cm^2, which can cause an eye injury in the most critical geometry collision, to $12.8J/cm^2$.

1.10 A new regulation is being introduced in Part VI, Subpart 2 that states that a low energy RPA shall not be flown into cloud, in a manner that is likely to be hazardous to aviation safety and in a manner to endanger or be likely to endanger the life or property of any person. This proposed regulation is consistent with section 602.45 of the *CARs* – Model Aircraft, Kites and Model Rockets.

Safety Management Systems

1.11 The Working Group was tasked with making recommendations regarding Safety Management System requirements in Phase 2. However, Subgroup 3 decided to take a preliminary look at SMS requirements during Phase 1 work and concluded that it is premature to apply the tenets of Safety Management Systems to Phase 1 operations. This topic will be reviewed during future phases of work.

[1] RCC. *Standard 321-02, Common risk criteria for national test ranges: Inert debris*. Range Safety Group Risk Committee, Range Commanders Council, US Army White Sands Missile Range, NM, USA, June, 2002 - which defines 42J = < 5% risk of fatal injury

Part II - Aircraft Identification and Registration and Operation of a Leased Aircraft by a Non-registered Owner

2. 1 For the purposes of Part II, it is recommended that RPA should be treated as closely as possible to manned aircraft. Therefore, the majority of Part II regulations will apply to small RPAS. This underlying concept reinforces the idea that RPA are aircraft.

Identification of Aircraft and Other Aeronautical Products

2.2 The Working Group recommends that small RPA have an identification plate. The intent of an aircraft identification plate shall be met, however, use of other physical forms, including micro-chips, should be allowable given the unique size and configuration characteristics of many small RPA. Many RPA of this class are too small to carry the conventional aircraft identification plate, yet should have some means of permanent marking for identification in the event of an accident.

2.3 Small RPAS have numerous components that are not large enough to comply with engine, propeller or life-limited component identification regulations. They are not maintained or controlled like aerospace products. Equally, since the parts have uses outside aviation, the application of these regulations will incur significant costs. These regulations will be reviewed during future phases of work to establish applicability to those phases.

Aircraft Marking and Registration

2.4 The Working Group recommends that small RPA be marked. This reinforces the concept that RPA are aircraft.

2.5 Given the diversity of size and configuration of unmanned aircraft, flexibility in marking specifications (e.g. size of lettering) will be required. Many RPA of this class are too small to carry the conventional size aircraft markings, therefore, the size of the marks will be as large as practical consistent with the size and configuration of the RPA.

2.6 The Working Group recommends that small RPA be registered. This reinforces the concept that RPA are aircraft.

2.7 Given the nature of small RPA operations, the Certificate of Registration, and other such regulated documentation, shall be accessible by the pilot-in-command during flight operations. This ensures that documentation is available to be presented by the pilot-in-command to any delegate of the Minister prior to, during or following any small RPA operation. Carriage of these documents on-board the unmanned aircraft is not required and not recommended.

Note: *For any operation where pilot-in-command responsibility is transferred, each pilot-in-command must be able to access the documents.*

2.8 A unique series of 4 letter registration marks, starting with a specific letter, for example, is recommended to address a variety of unique reporting requirements. This provides an easy manner to differentiate between manned and unmanned aircraft and will support Search and Rescue and Air Traffic Control concerns and practices.

Part III - Aerodromes, Airports and Heliports

3.1 No amendments to existing regulations in Part III are recommended at this time. In future, if there are going to be dedicated RPAS aerodromes then the Working Group recommends that existing Part III would apply.

3.2 The Working Group believes that the definition of aerodrome in the *Aeronautics Act* was not intended to capture RPAS operations being used at ad hoc locations for the launch and recovery of small RPA. Like hot-air balloons, the site used for take-off and recovery of a small RPA should not be interpreted to mean an aerodrome under the *Aeronautics Act* definition. Ideally, the definition of "aerodrome" in the *Aeronautics Act* should be amended.

Part IV - Personnel Licensing and Training

Flight Crew Permits, Licences and Ratings

4.0 RPAS pilots must be properly trained and regulated to assure safe integration within national airspace. All pilots should be licensed by Transport Canada.

4.1 Since it is envisioned that the vast majority, if not all, of small RPAS operations within VLOS will be conducted wholly within Canadian airspace, a pilot permit is being recommended rather than a licence, specifically a Pilot Permit - Small RPAS Restricted to VLOS. The age requirement is consistent with manned commercial operations and the knowledge, experience and skill requirements are consistent with other manned, "made in Canada" pilot permits. Specifically,

- Minimum age requirements will be imposed for RPAS pilots i.e. age 18.
- RPAS pilots will be required to complete a course of pilot ground school instruction in specific knowledge areas and pass a Transport Canada written examination that will be developed specifically for small RPAS - restricted to VLOS.
- RPAS pilots will need to acquire practical training on small RPAS and system-specific training. This training may be provided to the pilot by the manufacturer, operator or by a third party, providing the person holds a small RPAS pilot permit.
- RPAS pilots should have to demonstrate competency in the ability to perform normal and emergency procedures appropriate to the particular type of RPA. Skill tests/proficiency checks should be conducted by qualified RPAS operators, manufacturers or third parties.

4.2 Currency and proficiency for RPAS pilots should be maintained in accordance with section 401.05 of the CARs.

4.3 It is recommended that credits are provided for DND applicants and holders of Private Pilot Licences or higher.

4.4 It is recommended that operators of launch systems and arresting hooks, observers, payload operators and mission planners will not require licensing certification.

Aircraft Maintenance Engineers Licensing and Ratings

4.5 It is recommended that AME licensing would not be required for small RPAS operating within VLOS. The skill set that an Aircraft Maintenance Engineer possesses is not suited for aircraft of this size.

4.6 RPAS maintenance, including fitness of flight of the RPA, would be the responsibility of the RPAS owner/operator.

Medical Requirements

4.7 For issuance of a Pilot Permit – Small RPAS – Restricted to VLOS, a Medical Certificate will be a prerequisite (i.e. Category 4 Self-declaration valid for 60 months). This is consistent with other manned, "made in Canada" pilot permits.

Part V – Airworthiness

Annual Airworthiness Information Report

5.1 The Working Group is recommending that small RPAS owners should conform to existing aircraft reporting regulations. This will reinforce the concept that RPA are aircraft.

Flight Authority and Certificate of Noise Compliance

5.2 The Working Group is recommending that small RPAS should possess a flight authority that signifies that the type design of the RPA and its associated elements (RPAS) complies with the applicable airworthiness standard and that the specific RPA and its associated elements (RPAS) are in conformity with its type design. While the Working Group understands that in other jurisdictions there is a move to avoid the use of the term "airworthy", the membership saw no rationale for doing so. Other definitions of importance in this area are as follows:

> **Type Design -** the collection of drawings and other documents that fully describe the aircraft and/or its associated systems.
>
> **Type Certificate -** the document attesting that a type design has been found to be compliant to the Airworthiness Manual by the Minister or his representative.
>
> **Certificate of Airworthiness** - the document (or set of documents) attesting that the specific aircraft (and /or aircraft system) is in conformance with its type certificate.

5.3 It is recommended that the original equipment manufacturer or kit manufacturer is required to declare that the type design of the small RPA and /or small RPAS in question complies with the applicable airworthiness manual sections. This document is entitled the "Manufacturers Statement of Compliance". This level of oversight is consistent with the level of risk of these aircraft. Original Equipment Manufacturer (OEM) declaration still demands engineering analysis and record keeping, but at a level less than required for type certification. Details of the record keeping requirements are part of the proposed Airworthiness Manual section.

5.4 The flight authority for a small RPAS will be a "Special Certificate of Airworthiness - RPAS", issued by the Minister in response to an application by the RPAS owner/operator. While only an OEM declaration is required to signify that the type design conforms to the airworthiness standards, this recommendation allows Transport Canada some oversight into this sector, and provides a document (flight authority) that can be rescinded or otherwise controlled.

Approval of the Type Design or a Change to the Type Design of an Aeronautical Product

5.5 The subpart of the CARs dealing with approval and changes to the type design would not apply to small RPAS as they would not have "approved" or "certified" type designs. This subpart will be considered again in later phases of work.

Aircraft Maintenance Requirements

5.6 The Working Group is recommending that small RPAS be maintained by the owner/operator of the RPAS. General Maintenance of small RPAS shall be performed by a person possessing the relevant experience and training on the maintenance of the specific RPAS system and authorized by the owner/operator of the RPAS. This is consistent with the risk associated with this class of aircraft.

5.7 Maintenance of all "non-field replaceable" components and connections of avionics systems of small RPAS would be the only type of maintenance task deemed to be "specialized maintenance" and shall be performed by an Approved Maintenance Organization. This is consistent with the risk associated with this class of aircraft - these systems are critical to managing the risk of loss of trajectory control and thus require a higher level of oversight and specialization.

5.8 Use of certified parts would not be a requirement for small RPAS. This is consistent with the fact that the type design itself is not "certified" - parts installed in a small RPAS must still keep the RPAS conformal to its type design for the respective "Special C of A - RPAS" to be in force.

5.9 The maintenance release for a small RPAS would be signed by a person that has relevant experience, has received training on the maintenance of the RPAS system and is authorized by the owner/operator of the system.

Part V - New Subpart 5xx - Remotely-Piloted Aircraft Systems

5.10 The Working Group is recommending the creation of a new Subpart to CARs Part V which would provide a single location for defining all airworthiness requirements for RPA and RPAS. Provisionally, this subpart is referred to as Chapter 5xx. Provisionally it has three Subchapters:

- A - Small RPAS (with an RPA of a MTOW of 25 kg or less)
- B - Medium RPAS (with an RPA of a MTOW of greater than 25 kg up to and including 150 kg)
- C - Large RPAS (with an RPA of a MTOW of greater than 150 kg)

Pulling all RPAS related airworthiness standards into a single Part V subpart will greatly simplify the task of finding compliance and will eliminate many sources of duplication and/or conflict with other subparts

5.11 The content of this new subpart represents a balance between prescriptive requirements and statements of best design practice. Throughout the process, the existing regulations and standards for manned aircraft were heavily relied upon. Additionally, various emerging standards for RPAS were also considered during the Working Group deliberations. Throughout the subpart the concept that the probability of a hazardous failure condition (i.e. one that may result in no more than a single fatality) must not be greater than extremely remote, was the guiding principle.

5.12 The following is the content outline of the new Chapter 5xx – Subchapter A – Small RPAS

- General
- Flight Performance
- Structure
- Design and Construction
- Propulsion System
- Systems and Equipment
    - General Function and Installation
    - Flight and Navigation Information
    - High Intensity Radiated Fields (HIRF) Protection
    - Equipment, Systems and Installations
- Navigation Systems
- Sense and Avoid Systems
- RPAS Control
- Launch and Recovery Systems
- Payloads
- Manuals and Documentation
    - Small RPAS Operating Manual

Part VI – General Operating and Flight Rules

Airspace Structure, Classification and Use

6.0 Small RPA operating within VLOS and in visual meteorological conditions (VMC) should be provided the opportunity to operate in Class C airspace without radiocommunication equipment providing they receive authorization from the Air Traffic Control (ATC) unit prior to entering the airspace. This opportunity should also be extended to night operations. As with manned aircraft, if ATC is unable to accommodate the aircraft, then it shall not enter the airspace.

Operating and Flight Rules

6.1 A pilot-in-command shall be designated for every RPA flight and crew members must comply with pilot-in-command instructions or any person whom the pilot-in-command has authorized to act on behalf of the pilot-in-command.

6.2 Existing regulations that assume that the pilot-in-command and crew members are on-board the aircraft have been amended to accommodate RPAS where the crew are at the control station e.g. permission of the RPAS operator to use portable electronic devices in the control station.

6.3 Existing regulations that assume that take-offs are conducted from inside the aircraft (i.e. the phrase “take-off in an aircraft”) have been amended to “take-off of an aircraft” where it is applicable to RPAS operations e.g. no person shall conduct a take-off of an aircraft that has frost, ice or snow adhering to any of its critical surfaces.

6.4 It is recommended that RPAS may be authorized to take-off, approach and land within a built-up area of a city or town as authorized under a Small RPAS Operator Certificate or under a Special Flight Operations Certificate (SFOC).

6.5 It is recommended that small RPAS operations be permitted to operate at low altitudes due to the nature of the operations in which these aircraft are engaged. It is also recommended that RPAS operating under an SFOC be permitted to operate at low altitudes. Permissible low altitude flight regulations will be revisited during future Phases of work that deal with large aircraft and those operating beyond VLOS.

6.6 Regardless of whether the RPA resembles a glider, an aeroplane or a helicopter etc. it should follow the same right-of-way of rules as a manned glider, aeroplane or helicopter etc. Pilot on-board or off-board distinctions should be transparent to both Air Traffic Control and other airspace users. Since small RPA operating within VLOS will be in VMC they shall give way to manned aircraft at all times. This category of RPA may be undetectable to pilots of manned aircraft due to their size and shape, and in some cases, their mission requirements. The right-of-way regulations will be reviewed again during future Phases of work.

6.7 RPAS have been excluded from regulations that were written with persons on-board in mind e.g. the transoceanic flight regulation was written for manned aircraft with persons on-board. Once RPA begin carrying persons then this regulation will need to be revisited.

6.8 It is recommended that aerodrome lighting is not essential for small RPAS VLOS operations at night. In addition, it is recommended that an RPA exceeding 25 kg operating within VLOS may be authorized to operate from an aerodrome that is not lighted in accordance with an SFOC. This will be reviewed again during future phases of work.

6.9 In accordance with the Terms of Reference, the scope of the Working Group does not include RPA with passengers on-board. While carriage of persons on-board a small RPA is not a concern, the Working Group is recommending the introduction of an operating rule that prohibits RPA from operating with persons on-board unless authorized by the Minister.

6.10 The Working Group is recommending an operating rule that addresses communication requirements and standard operating procedures when visual observers are utilized for sense and avoid functions in RPAS operations.

6.11 The Working Group is recommending that an operating rule be created that requires the pilot-in-command to be able to assess the risk involved with lost link circumstances and to establish when auto-recovery manoeuvres or safe flight-termination shall be initiated.

Operational and Emergency Equipment Requirements

6.12 It is recommended that RPA be excluded from existing operational and emergency equipment requirements for power-driven aircraft. A new regulation addressing operational and emergency equipment is being introduced. This regulation allows for the equipment to be available to the crew, versus on-board the aircraft.

6.13 Small RPAS are being excluded from survival equipment regulations.

6.14 The pilot-in-command will need to instruct crew members of an RPAS with respect to their duties and with respect to the emergency equipment that is associated with the RPAS operation.

Pre-Flight and Fuel Requirements

6.15 It is the recommendation of the Working Group that reserve fuel requirements need not apply to small RPAS operating within VLOS or RPAS operations conducted under Subpart 3 of Part VI (SFOC). This regulation will be reviewed during future phases of work.

Operations at or in the Vicinity of an Aerodrome

6.16 The Working Group is recommending a new regulation that requires small RPA operating within VLOS to stay out of the way of, and not mix with, manned aircraft operating in the pattern of traffic at aerodromes.

6.17 It is envisioned that small RPA may be operating at aerodromes for the purpose of wildlife control, therefore, these operations should be permitted to operate at an altitude of less than 2,000 feet over an aerodrome. Additionally, it is recommended that RPA may be authorized under an SFOC to operate at an altitude less than 2,000 feet over an aerodrome since the associated risks of those operations are assessed on a case-by-case basis.

Visual Flight Rules

6.18 The requirement for the pilot to maintain visual reference to the surface was intended to help the pilot navigate and to keep VFR aircraft visible to other VFR aircraft. Unlike manned aircraft**,** RPA do not need visual reference to the surface to navigate. For RPA operated within VLOS, the assumption is made that if the pilot can see the aircraft, then the aircraft can see the surface. Therefore, no changes are recommended to the VFR rules. This will be considered again during future phases of work.

Special Flight Operations

6.19 The Working Group is recommending that the existing requirement for a Special Flight Operations Certificate for RPAS be retained. The current regulations and standards are being amended, however, to introduce the notion that the SFOC will only be available to RPAS operators for temporary short-term purposes such as testing and development flights. All other RPAS operators will be required to conduct operations under a new RPAS Part which is introduced later in this report.

Aircraft Requirements

General

6.20 There are several existing aircraft requirement regulations that apply to RPAS, however as written, they assume that take-offs are conducted from inside the aircraft. Therefore, the phrase “take-off in an aircraft” has been amended to “take-off of an aircraft” e.g. availability of aircraft flight manual, markings and placards, aircraft equipment standards and serviceability, unserviceable and removed equipment.

6.21 There are several recommendations to amended regulations that will allow for documents to be accessible to the pilot-in-command instead of being carried on-board the aircraft e.g. copy of flight authority, copy of the minimum equipment list.

Aircraft Equipment Requirements

6.22 It is recommended that RPAS be excluded from power-driven aircraft equipment requirements. A performance-based list of system capability requirements for RPAS is being introduced. For example, “controlling the flight of the RPA” could include equipment that would measure altitude, automatically hold altitude etc. “Monitoring the RPA and system”, remotely or on-board, could include equipment that would monitor the health of the aircraft, ensure the aircraft is operated within its flight envelope, monitor the telemetry of the aircraft and receive an indication of remaining endurance, etc. The list will have to be reviewed during future phases of work and standards may need to be developed.

6.23 There are cases where the RPA mission may take the aircraft along routes where the aircraft may encounter icing. Therefore, the de-icing or anti-icing equipment regulation is being amended to permit RPA to operate in icing providing they do not endanger persons or property on the ground or other airspace users. This regulation will be reviewed during future phases of work.

6.24 Oxygen equipment and use of oxygen regulations were written with manned aircraft in mind where the pilot and passengers are on-board the aircraft. For operations that require an RPAS operator certificate, the Operations Manual will address oxygen requirements for crew members where control stations are situated above 10,000 ft ASL.

6.25 At present there are no aircraft equipment and maintenance standards for turbo-jet powered RPA, however, when the time comes, it is recommended that the altitude alerting system or device regulation should apply. This regulation may need to be reviewed during future phases of work.

6.26 It is recommended that RPA should not carry ELTs in order to avoid unnecessary searches of downed RPA. However, RPA crashes should be reported in order to limit unnecessary responses especially when there is a possibility of the crash event or wreckage being confused with manned aircraft.

6.27 A new regulation is being introduced that requires a person operating an RPA within VLOS to confirm that no unacceptable radio frequency interference is present prior to flight, nor is likely to be present during flight.

Aircraft Maintenance Requirements

6.28 There are several existing aircraft maintenance requirement regulations that apply to RPAS, however as written, they assume that take-offs are conducted from inside the aircraft. Therefore, the phrase “take-off in an aircraft” has been amended to “take-off of an aircraft” e.g. aircraft maintenance – general, maintenance schedule, inspection after abnormal occurrences.

6.29 Where an RPA is subject to a maintenance release that is conditional, the aircraft may not be operated over a built-up area or open-air assemblies of persons. The language used in the proposed amendment is consistent with helicopter flights with external loads.

Technical Records

6.30 It is recommended that where the pilot-in-command is not on-board the aircraft, required documents be accessible to the pilot-in-command e.g. carrying journey log.

6.31 For RPA that have engines, propellers and other propulsive system components that would never find their way onto another aircraft once they are removed from the aircraft (i.e. are irredeemably scrapped after removal), it is recommended that a separate technical record does not need to be maintained for those components.

Standard 625 - Appendix A - Elementary Work

6.32 Most of the tasks within the Elementary Work list were judged as "elementary" regardless of aircraft type. Additionally the Working Group concluded that small RPAS are somewhat similar to "small privately owned aircraft" for which there are many specific tasks identified. As such, each entry in this section, where "small privately owned aircraft" was cited, was amended to include small RPAS. The complexity of the tasks and risk associated with failure of the associated systems is judged to be similar or lower for a small RPAS compared to a small privately owned aircraft.

6.33 It is recommended that an elementary task for small RPAS be added, as follows:

> "replacement of deliberately frangible structures, "swappable" batteries, propellers/fans, wings, tail surfaces or other such components designed for easy replacement".

The items above are developed as "line replaceable units" by the OEM or kit manufacturer. These tasks are very similar in nature to the "removal and replacement of wings and tail surfaces" for gliders.

Miscellaneous

6.34 RPAS are being exempted from the synthetic flight training equipment regulation. This regulation was written for manned aircraft. There may be a need to review this regulation during future phases of work to establish its applicability to large complex RPAS.

6.35 The Working Group does not believe there is a requirement to create RPAS specific liability insurance regulations at this time.

Collision Avoidance

6.36 Since Phase 1 deliverables apply to RPAS operations within VLOS in VFR flight, there is no need at this time to make recommendations on collision avoidance requirements. For these operations, collision avoidance functions are accomplished by visual reference to the aircraft by the pilot and/or visual observer. This includes seeing and avoiding obstacles/traffic during ground operations, seeing and avoiding obstacles/traffic during flight operations, observing the aircraft and its position during flight operations and observing meteorological phenomena.

6.37 In future phases of work, defining collision avoidance (sense and avoid) equipment for flying beyond VLOS and the technical features and minimum performance requirements for that equipment will have be determined.

Security

6.38 For small RPA operated within VLOS, it is recommended that RPAS security issues for C2 links and control station security be addressed in the RPAS operator's Operations Manual and regulated under the new Part – RPAS. Specifically, the RPAS operator shall outline, in the Operations Manual, procedures to prevent and manage incidents of interference with RPAS command and control links and procedures to prevent and manage incidents of interference with a crew member.

Part VII – Commercial Air Services

7.0 It is the recommendation of the Working Group that RPAS not be regulated under the existing Part VII of the CARs. Instead, a new Part should be created. Consequently, a regulatory amendment has been proposed to exclude RPAS from Part VII.

New Part – Remotely-Piloted Aircraft Systems

8.0 The Working Group is recommending the creation of a new Part in the CARs to address RPAS operational requirements. This new Part will contain Subparts that will differentiate operator certificate requirements to reflect the multiple kinds of operations for RPAS, in the same way that there is a difference between Subparts in Part VII. This New Part will be expanded during future Phases of work. The first three new Subparts were created during Phase 1 work. The air operator certificate required by section 602.41 is being replaced by a requirement for the RPAS operator certificate.

New Part, Subpart 0 - General

8.1 Subpart 0 contains general requirements for RPAS operations. This Subpart will be expanded during future phases of work and will include eligibility to hold an RPAS operator certificate for persons from a foreign state.

8.2 RPAS will require either a special certificate of airworthiness - RPAS - restricted or a special certificate of airworthiness - RPAS. For larger, more complex RPAS (i.e. Phase 4) it is anticipated that the RPAS requirement will be a Certificate of Airworthiness that meets the requirements of Article 31 of the Convention.

8.3 RPAS operators will need to establish maximum flight duty times and minimum rest periods and a system that monitors the flight duty time and time free from duty of each of its flight crew members. The details of that system shall be included in the Operations Manual.

New Part, Subpart 1 - RPAS Notification

8.4 Subpart 1 addresses RPAS operations that may be conducted under a notification requirement. The intent of the notification requirement is to permit persons to operate small RPAS operated within VLOS in VFR flight without an operator certificate providing they meet the applicability criteria and notify the Minister, prior to commencing flight operations, and then on an annual basis**.** The notification requirements are similar to those that presently exist in regulation for ultra-light aeroplane flight training units.

8.5 The operation of these RPAS are not overly complex insofar as they are limited to being operated from a single control station and only a single RPA may be in flight, operated by a single pilot at any one time. The airspeed limitation of 87 kts. is consistent with the FAA recommendation for small RPA (under 55 lb.). The intent of this section is that the responsibility for the operation rests totally with the RPAS operator.

8.6 While Transport Canada has the authority to raise comments regarding the notification, no explicit positive reply is required by Transport Canada after the notification is received. Where the aircraft or mission requirements cannot meet the criteria to operate under this Subpart, the operator will have to make application for a small RPAS operator certificate.

8.7 For those operations conducted under this new Subpart a corresponding operating rule is being introduced in Part VI, Subpart 2 that requires persons to maintain documentation that shows that the

criteria of the Subpart has been met and that imposes a requirement to provide advance written notice to the Minister.

Criteria

8.8 This subpart applies to the operation of a small RPAS operated within VLOS under VFR, day or night, and where a single RPA is operated

(a) from a single control station (i.e. control relays to extend the operational area are not permitted);
(b) in flight by a single pilot at any one time;
(c) at a maximum altitude of 300 ft. above ground level except when inspecting structures and then the aircraft must remain within 100 feet of the structure under inspection;
(d) at not less than 100 feet lateral distance from persons not associated with the operation;
(e) at a lateral distance of not less than 30 feet from persons without a suitable barrier;
(f) outside of advisory, controlled or restricted airspace unless operating wholly within restricted airspace designated for RPAS operations;
(g) more than 5 nm from the centre of an aerodrome unless
  i. the operator has informed the aerodrome operator and the aerodrome operator has no objection,
  ii. the operator has notified the air traffic service unit responsible for the airspace and complies with instructions, and
  iii. the operator consults with the applicable air traffic service authority regarding whether a NOTAM is required.
(h) at a maximum calibrated airspeed at full power in level flight of 87 knots;
(i) with no explosive, corrosive or bio-hazard payloads carried on-board; and
(j) not in a manner that is or is likely to be hazardous to aviation safety.

New Part, Subpart 2 - Small RPAS

8.9 Subpart 2 addresses the operation by a Canadian RPAS operator of a small RPA operated within VLOS in VFR flight and not operated under Subpart I or Subpart 3 of Part VI (SFOC).

8.10 The requirements for a small RPAS operator certificate are based on current regulations and standards found in Part VII, Subpart 2 - Aerial Work, since RPAS are used in a variety of specialized aerial work services such as aerial photography, surveying, monitoring, observation etc. The titles and content of Subpart 2 have been retained, deleted or amended as applicable to RPAS.

New Regulations

8.11 The following is the content outline of the new Subpart 2 regulations.

DIVISION I – GENERAL
- Application
- Aircraft Operation

DIVISION II – CERTIFICATION
- Issuance or Amendment of RPAS Operator Certificate
- Contents of RPAS Operator Certificate

- General Conditions of RPAS Operator Certificate

DIVISION III – FLIGHT OPERATIONS

- Operating Instructions
- Operational Control
- Operational Flight Plan
- Maintenance of Aircraft
- Minimum Visibility - Uncontrolled Airspace
- Built-up Area and Aerial Work Zone

DIVISION IV – PERSONNEL REQUIREMENTS

- Designation of Pilot-in-command
- Crew Member Qualifications

DIVISION V – TRAINING

- Training Program
- Training and Qualification Records

DIVISION VI – MANUALS

- Requirements Relating to Operations Manual
- Contents of Operations Manual
- Distribution of Operations Manual
- Standard Operating Procedures

Associated New Standards

8.12 The following is the content outline of the new Subpart 2 standards.

Foreword

DIVISION I – GENERAL

- Application
- Definitions

DIVISION II – CERTIFICATION

- Reserved

DIVISION III – FLIGHT OPERATIONS

- Operational Flight Plan Standard

DIVISION IV – PERSONNEL REQUIREMENTS

- Reserved

DIVISION V – TRAINING

- Training Program

DIVISION VI – MANUALS

- Contents of Operations Manual
- Standard Operating Procedures

Part VIII – Air Navigation Services

9.0 The Working Group is not recommending any changes to Part VIII regulations at this time. These regulations will be reviewed during future Phases of work.

Immediate Needs

10.0 In accordance with the Terms of Reference, the Working Group was asked to identify immediate needs for staff instructions, guidance material, policy documents, advisory circulars or exemptions and make recommendations to the Director, Standards. Since there will be no immediate development of NPAs, there will be an immediate need to update Staff Instruction (SI) No. 623-001 - The review and processing of an application for a Special Flight Operations Certificate for the Operation of an Unmanned Air Vehicle (UAV) System. In addition, there may also be a need to develop policy documents and regulatory exemptions, in coordination with Regulatory Affairs, in order for the recommendations from this report to be put into practice to the extent practical.

Appendix

WORKING GROUP MEMBERSHIP

Main Working Group

Co-Chairs: Transport Canada – Ron Carter
Unmanned Systems Canada – Wayne Crowe

Members: Alphabetical order by organizational name

• AeroVations Associates	Gerry Marsters
• Air Canada Pilots Association (ACPA)	Brad Kenyon Gary Corbett (Tech Advisor)
• Air Line Pilots Association, Int'l (ALPA)	Réal Levasseur Mark Reed (Tech Advisor)
• Canadian Air Traffic Controllers Association (CATCA)	Greg Myles
• Canadian Centre for Unmanned Vehicle Systems (CCUVS)	Dewar Donnithorne-Tait
• Canadian Federation of AME Associations (CFAMEA)	Ole Nielsen
• Canadian Owners and Pilots Association (COPA)	Kevin Psutka Frank Hofmann (Tech Advisor)
• Department of National Defence (DND)	Major Art Jordan Major Mark Wuennenberg (Tech Advisor)
• Fugro Airborne Surveys Corp.	Richard Partner
• Helicopter Association of Canada (HAC)	Fred Jones
• ING Engineering	Ian Glenn Robb Nesbitt (Tech Advisor)
• InnUVative Systems Inc.	Mike Meakin
• L-3 MAS Canada	Jeremy Cartlidge
• MacDonald Dettwiler and Associates (MDA)	Andrew Carryer
• Model Aeronautics Association of Canada (MAAC)	Richard Lyle Barlow
• National Research Council of Canada (NRC)	Stewart Baillie Kris Ellis (Tech Advisor)
• NAV CANADA	Brian Guimond Kelly Mcllwaine (Tech advisor) Claude Fortier (Tech advisor)
• Ontario Provincial Police (OPP)	Marc Sharpe
• Skylink Aviation Inc.	Alexander (Butch) Waldrum
• Transport Canada	Karen Tarr

	Bob Bancroft
	Terry Chilibeck
• Universal Wing Technologies Inc.	Declan Sweeney
• Xiphos Technologies Inc.	Eric Edwards

Observers:

• CAE	Michel Lacroix Martin Daigle
• CFAMEA	Ben McCarty
• DND	LCol Darrell Marleau
• Northern Air Transportation Association (NATA)	Stephen Nourse Tim Vaillancourt
• Transport Action & APSG	Gerry Einarsson

SUBGROUP MEMBERSHIP

Subgroup 1 – People (CARs Part IV)

Chair: Transport Canada - Terry Chilibeck

Members:

• ALPA	Réal Levasseur
• CCUVS	Sterling Cripps (Tech Adv)
• CFAMEA	Ole Nielsen
• COPA	Frank Hofmann
• DND	Major Art Jordan
• L-3 MAS Canada	Jeremy Cartlidge
• OPP	Marc Sharpe
• Skylink Aviation Inc.	Butch Waldrum
• Transport Canada	Jason Meunier

Subgroup 2 – Product (CARs Part II, V)

Chair: NRC – Stewart Baillie

Members:

• Accuas Inc.	Darryl Jacobs
• AeroVations Associates	Gerry Marsters
• DND	Mike Mansfield
• ING Engineering	Ian Glenn
• InnUVative Systems Inc.	Mike Meakin
• MDA	Andrew Carryer
• NAV CANADA	Brian Guimond

- Transport Canada — Stephen Hallissey, Brian Clarke, Mike Palmer, Ian Moody
- Unmanned Systems Canada — Wayne Crowe

Subgroup 3 – Operations and Access to Airspace (CARs Part I, III, VI, VII, VIII)

Chair: Transport Canada – Karen Tarr

Members:

- DND — Mark Wuennenberg
- Fugro Airborne Surveys Corp. — Richard Partner
- ING Engineering — Robb Nesbitt
- MAAC — Richard Lyle Barlow
- NAV CANADA — Kelly Mcllwaine, Claude Fortier (Tech Adv)
- NRC — Kris Ellis
- Transport Canada — Bob Grant, Pete Firlotte
- Universal Wing Technologies Inc. — Declan Sweeney
- Xiphos Technologies Inc. — Eric Edwards

Observers:

- ACPA — Brad Kenyon
- COPA — Kevin Psutka
- HAC — Fred Jones
- NAV CANADA — Andrew McKenzie

- END -